

**PARTNERS HEALTHCARE SYSTEM, INC.  
DON APPLICATION # PHS-17111513-HE  
ATTACHMENTS**

**SUBSTANTIAL CAPITAL EXPENDITURE  
BRIGHAM AND WOMEN'S HOSPITAL**

**NOVEMBER 15, 2017**

**BY**

**PARTNERS HEALTHCARE SYSTEM, INC.  
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**Attachment/Exhibit**

**A**

**Attachment/Exhibit**

**1**

## 2. Project Description

### Factor 1: Applicant Patient Panel Need, Public Health Values and Operational Objectives

#### F1.a.i

##### Patient Panel:

**Describe your existing Patient Panel, including incidence or prevalence of disease or behavioral risk factors, acuity mix, noted health disparities, geographic breakdown expressed in zip codes or other appropriate measure, demographics including age, gender and sexual identity, race, ethnicity, socioeconomic status and other priority populations relevant to the Applicant's existing patient panel and payer mix.**

Partners HealthCare is a not-for-profit, integrated health care system that was formed in 1994 by an affiliation between The Brigham Medical Center, Inc. (now known as Brigham Health – BWH) and The Massachusetts General Hospital (“MGH”). Partners HealthCare currently operates two tertiary and seven community acute care hospitals in Massachusetts, one community acute care hospital in Southern New Hampshire, one facility providing inpatient and outpatient mental health services and three facilities providing inpatient and outpatient services in rehabilitation medicine and long-term care. Partners HealthCare also operates physician organizations and practices, a home health agency, nursing homes and a graduate level program for health professionals. Partners HealthCare is a non-university-based nonprofit private medical research enterprise and its academic medical centers are principal teaching affiliates of the medical and dental schools of Harvard University. Partners HealthCare provides its services to patients primarily from the Greater Boston area and eastern Massachusetts, as well as New England and beyond. Additionally, Partners HealthCare operates a licensed, not-for-profit managed care organization that provides health insurance products to the MassHealth Program (Medicaid), Commonwealth Care (a series of health insurance plans for adults who meet income and other eligibility requirements) and commercial populations.

Partners HealthCare serves a large and diverse patient panel as demonstrated by the utilization data for the 36-month period covering FY2014-2016 and the first quarter of FY2017.<sup>1</sup> Appendix 1 provides this demographic profile for Partners HealthCare in table form. The number of patients utilizing Partners HealthCare's services has increased over the past three years, with 1,211,361 unique patients in FY2014, 1,255,589 unique patients in FY2015 and 1,299,981 unique patients in FY2016.<sup>2</sup> In the first quarter of FY2017, Partners HealthCare had 635,069 unique patients. Partners HealthCare's patient mix consists of approximately 41% males and 58% females. The Massachusetts Center for Health Information and Analysis (“CHIA”) reports that Partners HealthCare's patient panel represents 19% of all discharges in the Commonwealth.<sup>3</sup> The system's case mix adjusted discharge rate is 22%.<sup>4</sup>

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<sup>1</sup> Fiscal year October 1 – September 30.

<sup>2</sup> Includes hospital billing data (Brigham and Women's Hospital, Brigham and Women's Faulkner Hospital, Massachusetts General Hospital, Newton-Wellesley Hospital, and North Shore Medical Center) and physician billing data (Brigham and Women's Physicians Organization, Massachusetts General Physicians Organization, North Shore Physician Group, Newton-Wellesley Ambulatory Services).

<sup>3</sup> Fiscal Year 2015: Partners HealthCare System, MASSACHUSETTS CENTER FOR HEALTH INFORMATION ANALYSIS, <http://www.chiamass.gov/assets/docs/r/hospital-profiles/2015/Partners-HealthCare-System.pdf> (last visited Jul. 11, 2017).

<sup>4</sup> *Id.*

Partners HealthCare has seen a 4% increase in the number of patients it serves in the 65+ age cohort between FY14 and FY16. Current age demographics show that while the majority of the patients within Partners HealthCare's patient population are between the ages of 18-64 years of age (61-62% of total patient population), patients that are 65 and older make up a significant portion of the total patient population (25-28% of total patient population), and only 10-11% of Partners HealthCare's patients are between 0-17 years of age.

Partners HealthCare's patient panel reflects a mix of races. Data based on patient self-reporting demonstrates that in FY16, 71% of the total patient population identified as White; 6% identified as African American or Black; 4% identified as Asian; 2% identified as Hispanic/Latino; 0.1% identified as American Indian or Alaska Native; and 0.1% identified as Native Hawaiian or Other Pacific Islander. Since patients were grouped into these categories based on how they self-identified,<sup>5</sup> there is a portion of the patient population (17% in FY16) that either chose not to report their race or identified as a race that did not align with the above categories. Therefore, it is important to note that the racial composition of Partners HealthCare patient panel may be understated.

Partners HealthCare provides care to patients from a broad range of geographies including all fifty states. While Partners HealthCare's patient panel resides mainly in Eastern Massachusetts, there is a sizeable portion of the patient panel that resides outside of Massachusetts (12%, 162,301 patients). By applying the Department of Public Health's ("DPH") Health Service Area ("HSA") categories to FY16 data, 45% of Partners HealthCare's patients reside in HSA 4 (584,007 patients); 18% reside in HSA 6 (237,352 patients); 14% reside in HSA 5 (183,635 patients); 5% reside in HSA 3 (61,689 patients); 3% reside in HSA 2 (42,928 patients); 1% reside in HSA 1 (11,716 patients); and the origin of 27,391 patients or 2% of the panel is unknown.

#### A. BWH Patient Panel

BWH has a high-volume emergency department ("ED") as evidenced by the annual number of patients treated, as well as patient visit volume. In FY14, BWH treated 40,497 unique patients for 59,927 unique visits. This number increased to 41,189 unique patients and 60,958 unique visits in FY15 and 42,253 unique patients and 62,252 unique visits in FY16.<sup>6</sup> Accordingly, over the past three fiscal years ED visit volume has increased approximately 4% (see Appendix 1).

Aggregated zip code data by HSA for the last three fiscal years demonstrate that BWH's ED patient population has a similar geographic composition to the larger Partners HealthCare patient panel. These data indicate that 65.1% (65,757 patients) of BWH's ED patients reside in HSA 4; 12.4% reside in HSA 5 (12,500 patients); 5.3% reside in HSA 6 (5,383 patients); 2.9% reside in HSA 3 (2,974 patients); 2.5% reside in HSA 2 (2,539 patients); 0.8% reside in HSA 1 (782 patients); and over 11,022 patients or 10.9% of the panel is from outside of Massachusetts. HSA data is important when considering who utilizes BWH's ED. For example, over 65% of

<sup>5</sup> With the exception of the category "Hispanic/Latino," the race categories shown above are based on the 1997 Office of Management and Budget standards on race and ethnicity. Patients were grouped into these categories based on their responses as follows – White: "White"; African American or Black: "African American", "Black", "Black or African American"; American Indian or Alaska Native: "American Indian", "American Indian or Alaska Native"; Asian: "Asian"; Native Hawaiian or Other Pacific Islander: "Native Hawaiian or Other Pacific Islander", "Native Hawaiian/Other Pacific Islander", "Pacific Islander"; Hispanic/Latino: "Hispanic", "Hispanic or Latino", "Latino"; Other/Unknown: All other responses.

<sup>6</sup> Based on presence of relevant diagnosis code (ICD-9 or ICD-10).

BWH's ED patients live within HSA 4. This HSA comprises Boston and the areas directly adjacent to BWH. Accordingly, many of these patients utilize BWH as their local hospital provider to receive services.

In regard to age, 75.4% of BWH's ED patients are between the ages of 18-64 and 24.2% of patients are over the age of 65. Of the 12,595 patients seen at BWH's ED in the first quarter of FY17, 73.6% of patients were between the ages of 18-64 and 25.6% were 65 years or older. These data reflect similar patterns in patient trends to the Partners HealthCare patient panel.

Moreover, BWH's ED patients also reflect a diversity of races. Data based on patient self-reporting demonstrate that in FY16, 53.3% of BWH's ED patients identified as White; 19.4% identified as African American or Black; 3.4% identified as Asian; 10.7% identified as Hispanic/Latino; 0.2% identified as American Indian or Alaska Native; and 0.1% identified as Native Hawaiian or Other Pacific Islander. Since patients were grouped into these categories based on how they self-identified,<sup>7</sup> there is a portion of the patient population (13.1% in FY16) that either chose to not report their race or identified as a race that did not align with the above categories. Therefore, it is important to note that the racial composition of BWH's ED patients may be understated.

In a review of underlying conditions associated with ED visits at BWH for the last three fiscal years and the first quarter of FY2017, the most prevalent diagnoses were: (1) unspecified chest pain, (2) unspecified abdominal pain, (3) syncope and collapse, (4) headache, and (5) urinary tract infection at an unspecified site. In addition to these noted clinical conditions, 3.3% of BWH's ED population sought services for an underlying behavioral health condition (5,972 patients), 0.1% presented with a myocardial infarction (154 patients were symptomatic for a heart attack), 0.7% presented with stroke (1,311 patients), 8.6% presented with trauma (17,774 patients), and 83.3% presented from "other" causes (152,644 patients).

A review of the payer mix for BWH's ED patients over the last three fiscal years provides that approximately 32% of patients are Medicare and/or MassHealth beneficiaries, 50% have commercial insurance, approximately 3% are self-pay and over 15% have some other form of insurance, such as a government payer supplement or qualify for free care. Over the last three fiscal years, BWH has seen a significant increase in the number of Medicare and MassHealth beneficiaries (from 26.6% in FY14 to 38.8% in FY16) seeking services in the ED. This 12% increase may be attributed to changes in health insurance benefits, an aging population seeking services or increased health crises, such as the statewide opioid epidemic.

Finally, based on other clinical characteristics such as patient severity and admission rate, the increase in ED visits and the shift of increasing patients with government payers does not appear to be driven by low-acuity visits that could easily be cared for in other venues such as primary care or urgent care. For example, ED visits have declined by 16.7% and 7.5%

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<sup>7</sup> With the exception of the category "Hispanic/Latino", the race categories shown above are based on the 1997 Office of Management and Budget standards on race and ethnicity. Patients were grouped into these categories based on their responses as follows – White: "White"; African American or Black: "African American", "Black", "Black or African American"; American Indian or Alaska Native: "American Indian", "American Indian or Alaska Native"; Asian: "Asian"; Native Hawaiian or Other Pacific Islander: "Native Hawaiian or Other Pacific Islander", "Native Hawaiian/Other Pacific Islander", "Pacific Islander"; Hispanic/Latino: "Hispanic", "Hispanic or Latino", "Latino"; Other/Unknown: All other responses.

respectively (combined 8.4% decline) since FY15 for non-urgent and less urgent visits.<sup>8</sup> However, in contrast, urgent and emergent ED visits have increased 1.3% and 5.6% respectively (combined 2.9% increase) since FY15. Overall the proportion of low-acuity patients is decreasing, and patient age, admission rate, and case-mix index are increasing.

#### F1.a.ii

##### **Need by Patient Panel:**

**Provide supporting data to demonstrate the need for the Proposed Project. Such data should demonstrate the disease burden, behavioral risk factors, acuity mix, health disparities, or other objective Patient Panel measures as noted in your response to Question F1.a.i that demonstrates the need that the Proposed Project is attempting to address. If an inequity or disparity is not identified as relating to the Proposed Project, provide information justifying the need. In your description of Need, consider the principles underlying Public Health Value (see instructions) and ensure that Need is addressed in that context as well.**

#### A. High Volumes, Long Wait and Extended Boarding Times Lead to Overcrowding

ED crowding is one of the leading problems facing hospitals, emergency physicians and nurses, and patients across the globe.<sup>9</sup> In 2006, the Institute of Medicine declared crowding – when the number of patients exceeds the ED treatment space capacity – to be a national epidemic.<sup>10</sup> Since then, the volume of patients in EDs, wait times, boarding times, and, consequently, ED crowding rates have all increased dramatically.<sup>11</sup> BWH has been no exception to these trends.

Worldwide, the volume of patients seeking services from EDs has increased over the last 20 years.<sup>12</sup> The most recent available data indicate that the number of ED visits across the United States increased 14.8% from 2006 to 2014, outpacing population growth, which increased only 6.9% over the same period.<sup>13</sup> Similarly, BWH experiences high ED volume, with an average of

<sup>8</sup> This terminology is based on the Emergency Severity Index, which is a five-level ED triage algorithm that provides clinically relevant stratification of patients into five groups on the basis of acuity and resource needs: (1) Resuscitation/Immediate: Immediate, life-saving intervention required without delay, such as cardiac arrest or massive bleeding; (2) Emergent: High risk of deterioration, or signs of a time-critical problem; (3) Urgent: Stable, with multiple types of resources needed to investigate or treat (such as lab tests plus X-ray imaging); (4) Less Urgent: Stable, with only one type of resource anticipated (such as only an X-ray, or only sutures); and (5) Non-Urgent: Stable, with no resources anticipated except oral or topical medications, or prescriptions. NICKI GILBOY ET AL., EMERGENCY SEVERITY INDEX (ESI): A TRIAGE TOOL FOR EMERGENCY DEPARTMENT CARE, IMPLEMENTATION HANDBOOK (Agency for Healthcare Research & Quality, 4th Version 2011), available at <https://www.ahrq.gov/sites/default/files/wysiwyg/professionals/systems/hospital/esi/esihandbk.pdf>.

<sup>9</sup> Adrian Boyle et al., *Emergency Department Crowding: Time for Interventions and Policy Evaluations*, EMERGENCY MED. INT'L (2012), available at <https://www.hindawi.com/journals/emil/2012/838610/>.

<sup>10</sup> INSTITUTE OF MEDICINE, HOSPITAL-BASED EMERGENCY CARE: AT THE BREAKING POINT (The Nat'l Academies Press 2007), available at <http://www.nationalacademies.org/hmd/Reports/2006/Hospital-Based-Emergency-Care-At-the-Breaking-Point.aspx>.

<sup>11</sup> BRIAN J. MOORE ET AL., HEALTHCARE COST AND UTILIZATION PROJECT STATISTICAL BRIEF #227: TRENDS IN EMERGENCY DEPARTMENT VISITS, 2006–2014 (Agency for Healthcare Research & Quality 2017), available at <https://www.hcup-us.ahrq.gov/reports/statbriefs/sb227-Emergency-Department-Visit-Trends.pdf>; *Hospital Compare, Brigham and Women's Hospital*, U.S. CTRS. FOR MEDICARE & MEDICAID SERVS., <https://www.medicare.gov/hospitalcompare/profile.html#profTab=2&ID=220110&loc=BOSTON%2C%20MA&lat=42.3584308&lng=-71.0597732&name=BRIGHAM%20AND%20WOMEN%27S%20HOSPITAL&Distn=3.6> (last visited Nov. 1, 2017).

<sup>12</sup> Boyle et al., *supra* note 9.

<sup>13</sup> MOORE ET AL., *supra* note 11.

41,313 unique patients over the last three fiscal years and an average patient volume of 61,046 for the same timeframe.

The Centers for Medicare & Medicaid Services' ("CMS") Hospital Compare tool provides data on ED care times. According to the tool, national ED wait time averages are as follows: 29 minutes spent in the ED before being seen by a healthcare professional; 5 hours and 33 minutes spent in the ED before being admitted; an additional 2 hours and 16 minutes spent in the ED after the admission decision is made before being taken to an inpatient room (i.e. boarding time); and 2 hours and 52 minutes spent in the ED before being discharged.<sup>14</sup> Massachusetts' averages are higher than national averages across all categories (42 minutes; 6 hours and 4 minutes; 2 hours and 48 minutes; and 3 hours and 10 minutes, respectively).<sup>15</sup> BWH average wait and boarding times are also higher than national averages, and in some instances, BWH's wait times are higher than Massachusetts averages as well (42 minutes, i.e. same as state; 6 hours and 46 minutes, i.e. 42 minutes higher than state; 2 hours and 38 minutes, i.e. 10 minutes lower than state; 4 hours and 21 minutes, i.e. 1 hour and 11 minutes higher than state).<sup>16</sup>

These high volumes, long wait and extended boarding times have led to capacity constraints within BWH's ED, requiring clinical teams to provide care in hallways and waiting areas. During the last two years, 17% of all ED patients at BWH were cared for in hallways, far surpassing the national standard of fewer than 5%. During this same timeframe the "walk-out" rate for ED patients at BWH rose to 2.78%. For FY16, BWH had 13,161 boarders for 41,906 boarding hours. In FY17, BWH saw continued boarding of inpatients in the ED (13,760 boarders for 51,374 boarding hours), but was able to reduce the "walk-out" rate for ED patients to 1.96% by caring for more patients in hallways. While this was a reasonable short-term approach to improve timeliness and safety, it illustrates that ED crowding is one of the main reasons that this Project is needed.<sup>17</sup>

As EDs are high-risk, high-stress environments, when ED capacity is exceeded, there are heightened opportunities for error.<sup>18</sup> A growing list of published studies have presented evidence that ED crowding contributes to a reduction in the quality of patient care.<sup>19</sup> Crowded departments threaten delivery of timely care (e.g., delays in commencement of analgesia, antibiotic therapy, and thrombolysis or percutaneous coronary intervention are all well described), as well as adherence with recognized guidelines and care standards (e.g., regular medications are omitted in elderly frail patients).<sup>20</sup> Additionally, crowding impairs dignity, privacy, and completeness of care, particularly when hospitals are forced to provide care to patients in ED hallways in order to create additional capacity for boarders.<sup>21</sup> Compared with licensed

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<sup>14</sup> *Hospital Compare, Brigham and Women's Hospital, supra* note 11.

<sup>15</sup> *Id.*

<sup>16</sup> *Id.*

<sup>17</sup> Boyle et al., *supra* note 9.

<sup>18</sup> MEGAN MCHUGH ET AL., IMPROVING PATIENT FLOW AND REDUCING EMERGENCY DEPARTMENT CROWDING: A GUIDE FOR HOSPITALS (Agency for Healthcare Research & Quality 2011), available at <https://www.ahrq.gov/research/findings/final-reports/ptflow/section1.html>.

<sup>19</sup> Paul Richard Edwin Jarvis, *Improving emergency department patient flow*, 3 CLINICAL & EXPERIMENTAL EMERGENCY MED. 63, 63-68 (2016), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5051606/pdf/ceem-16-127.pdf>; John R. Richards et al., *Providing Care in Emergency Department Hallways: Demands, Dangers, and Deaths*, ADVANCES IN EMERGENCY MED. (2014), available at <https://www.hindawi.com/archive/2014/495219/>; Boyle et al., *supra* note 9; MCHUGH ET AL., *supra* note 18.

<sup>20</sup> Boyle et al., *supra* note 9.

<sup>21</sup> *Id.*; Richards et al., *supra* note 19.

hospital or standard ED beds, provision of care to patients in ED hallways precludes a full history and physical examination; impedes monitoring; and leads to delays and difficulties in time-sensitive procedures and laboratory testing, providing important medication, supervising intravenous lines, recording vital signs, monitoring cardiac activity, or responding to deteriorations in patient condition.<sup>22</sup> Other negative effects of crowding include prolonged length of stay, patient discomfort and excessive or unrelieved pain, unrecognized sudden respiratory arrest or unstable cardiac arrhythmias, increased disability, exposure to traumatic psychological events, and increased patient morbidity and mortality.<sup>23</sup> Finally, ED crowding results in patient dissatisfaction and contributes to walk-out rates, which are 2% in the US, 2% in MA, and 2.78% at BWH.<sup>24</sup> robs

In addition to quality concerns within the ED, a crowded ED creates problems beyond the department. Specifically, patients impacted by crowding in an ED continue to feel its effects after they have been admitted.<sup>25</sup> Moreover, crowding impacts hospital staff as it is well-documented that this issue leads to absenteeism, staff sickness, and burnout and results in experienced staff leaving and more junior staff delivering an increasingly busy and inefficient service.<sup>26</sup> In addition, treating physicians are placed at increased risk for malpractice liability, medical board censure, or poor patient satisfaction survey results, which may adversely impact a physician's career.<sup>27</sup> Lastly, crowded EDs result in increased refusals of transfer requests arriving via ambulance, which reduces resilience and the capacity of pre-hospital services to respond to calls, and deprives patients of certain hospital-specific benefits, such as subspecialty care or continuity of care with existing caregivers.<sup>28</sup> Through the proposed Project, BWH will be able to address these concerns around overcrowding by renovating existing ED clinical space and expanding the footprint of the ED; thereby, leading to better health outcomes for patients, higher rates of patient and provider satisfaction and more efficient patient flow and administrative processes.

## B. An Aging Patient Population Needs Access to ED Services

The proposed Project also will allow the Applicant, and specifically BWH, to address the needs of an aging patient panel and the need for improved access to ED services. According to the University of Massachusetts' Donahue Institute's ("UMDI") *Long-Term Population Projections for Massachusetts Regions and Municipalities*, statewide population growth is projected to grow a total of 11.8% from 2010 through 2035.<sup>29</sup> An analysis of UMDI's projections shows that the growth of the Commonwealth's population is segmented by age sector, and that within the next 20 years, the bulk of the state's population growth will cluster around residents that are age fifty

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<sup>22</sup> Richards et al., *supra* note 19.

<sup>23</sup> *Id.*

<sup>24</sup> *Id.*; *Hospital Compare, Brigham and Women's Hospital*, *supra* note 11.

<sup>25</sup> Boyle et al., *supra* note 9.

<sup>26</sup> *Id.*

<sup>27</sup> Richards et al., *supra* note 19.

<sup>28</sup> Boyle et al., *supra* note 9.

<sup>29</sup> UNIVERSITY OF MASSACHUSETTS DONAHUE INSTITUTE, LONG-TERM POPULATION PROJECTIONS FOR MASSACHUSETTS REGIONS AND MUNICIPALITIES 11 (Mar. 2015), available at [http://pep.donahue-institute.org/downloads/2015/new/UMDI\\_LongTermPopulationProjectionsReport\\_2015%2004%20\\_29.pdf](http://pep.donahue-institute.org/downloads/2015/new/UMDI_LongTermPopulationProjectionsReport_2015%2004%20_29.pdf). The Massachusetts Secretary of the Commonwealth contracted with the University of Massachusetts Donahue Institute (UMDI) to produce population projections by age and sex for all 351 municipalities. *Id.* at 7. Within the past five years, Massachusetts has been experiencing an increase in the population growth rate per year due to high immigration and low domestic outflow, which is expected to slow down in 2030. *Id.* at 12.

(50) and older.<sup>30</sup> Moreover, between 2015 and 2035, the Commonwealth's 65+ population is expected to increase at a higher rate compared to all other age cohorts.<sup>31</sup> By 2035, the 65+ age cohort will represent approximately a quarter of the Massachusetts population.<sup>32</sup> The general trend of growth appears consistent across the counties where Partners HealthCare's affiliates are located, as well as within BWH's service area. As the number of patients that fall into the 65+ age cohort for BWH and Partners HealthCare continues to grow, the demand for ED services is expected to increase as well.

Elderly patients are one of the top three cohorts that tend to overuse the ED for primary care services.<sup>33</sup> Studies show that older adults use emergency services at a higher rate than young adults.<sup>34</sup> Moreover, when an older adult presents at an ED, their visits are typically more emergent and require longer stays and increased services.<sup>35</sup> These elderly patients are more likely to require repeat ED visits due to complex care needs.<sup>36</sup> As previously discussed, individuals in the 65+ age cohort account for one quarter of all ED visits at BWH. The projected increase in the older adult population necessitates the need for redesigned patient flow and care processes at BWH to allow this at-risk-population to receive quality care. However, these changes are only possible through renovations to and the expansion of the existing clinical space. Through the proposed Project, BWH will increase the overall ED footprint by 26,000 GSF, allowing for the addition of private rooms and the expansion of designated trauma bays.

### C. Behavioral Health and the Need for Improved ED Services

Delays for behavioral health patients awaiting care in EDs has become a national health crisis. To combat this issue, the Massachusetts Executive Office of Health and Human Services ("EOHHS") via the Department of Public Health ("Department") convened a task force in 2013 to examine the issue of ED boarding. This task force was charged with evaluating data, trends, and possible policy solutions to address this issue. In 2015, the Department updated its Code Help policies and regulations to address the need to move behavioral health patients from the ED to appropriate care settings.

In 2017, the *Annals of Emergency Medicine* published a study that investigated ED Boarding at 10 Massachusetts hospitals (not including BWH).<sup>37</sup> This study documented data for over 800

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<sup>30</sup> *Massachusetts Population Projections – EXCEL Age/Sex Details*, UNIVERSITY OF MASSACHUSETTS DONAHUE INSTITUTE (2015), [http://pep.donahue-institute.org/downloads/2015/Age\\_Sex\\_Details\\_UMDI\\_V2015.xls](http://pep.donahue-institute.org/downloads/2015/Age_Sex_Details_UMDI_V2015.xls). This data has been extracted for counties where current Partners HealthCare's hospitals and affiliates are located. *Id.*

<sup>31</sup> UNIVERSITY OF MASSACHUSETTS DONAHUE INSTITUTE, *supra* note 29, at 14. The report uses the cohorts as defined by the U.S. Census Bureau 2010 Census Summary, which are 0-19, 20-39, 40-64, and 65+. *Id.* Figure 2.5 in the report demonstrates that where the 65+ cohort increases from 2015 to 2035, all other cohorts are predicted to decrease. *Id.*

<sup>32</sup> *Id.*

<sup>33</sup> Doris F. Glick & Karen MacDonald Thompson, *Analysis of emergency room use for primary care needs*, 15 NURSING ECONOMICS 42 (1997).

<sup>34</sup> Faranak Aminzadeh & William Burd Dalziel, *Older adults in the emergency department: A systematic review of patterns of use, adverse outcomes, and effectiveness of interventions*, 39 ANNALS OF EMERGENCY MED. 238, 238-47 (2002).

<sup>35</sup> *Id.*

<sup>36</sup> SR Lowenstein et al., *Care of the elderly in the emergency department*, 15 ANNALS OF EMERGENCY MED. 528, 528-35 (1986).

<sup>37</sup> Mark D. Pearlmuter et al., *Analysis of Emergency Department Length of Stay for Mental Health Patients at Ten Massachusetts Emergency Departments*, 70 ANNALS OF EMERGENCY MED. 193, 193-202 (2017), available at [http://www.annemergmed.com/article/S0196-0644\(16\)31217-3/pdf](http://www.annemergmed.com/article/S0196-0644(16)31217-3/pdf).

patients receiving care at ten unnamed EDs over a two-week period in 2012.<sup>38</sup> Researchers found that patients with mental health issues waited an average of 16.5 to 21.5 hours for an admission or a transfer.<sup>39</sup> Meanwhile, patients with physical health problems spent an average of about four hours inside the ED.<sup>40</sup> Moreover, the researchers observed that the median length of stay for mental health patients was nearly 11 hours, and a patient's type of insurance also correlated with greater delays.<sup>41</sup> For example, patients with Medicaid were twice as likely as privately insured patients to see delays of a day or more.<sup>42</sup> Patients without insurance were 2.8 times more likely than privately insured patients to stay in the ED that long, too, the study reported.<sup>43</sup> The uninsured also waited in the ED for approximately four hours longer than privately insured patients.<sup>44</sup> The patterns described in this study are consistent with the experience at BWH's ED.

During the past three fiscal years, behavioral health patients have represented approximately 3% of all ED visits at BWH. However, these patients account for 20-25% of care hours. In FY17, on average, patients requiring transfer to a psychiatric facility remain in the ED for 23.2 hours. National trends indicate that the number of psychiatric units and freestanding psychiatric hospitals are slowly declining, exacerbating the overcrowding issue as clinical staff are unable to readily move these patients to appropriate care settings.<sup>45</sup> Through the proposed Project, BWH will designate specific clinical space within the ED for BWH's behavioral health patients. These designated treatment spaces will create care efficiencies that allow for expedited care.<sup>46</sup> Specifically, a treatment for behavioral health patients will have lower stimulation reducing agitation and violent behavior, and will have spaces designed for agitated and violent patients thus improving patient and staff safety.

Finally, the opioid epidemic in Massachusetts has led to increased ED utilization. BWH offers substance use disorder evaluation ("SUDE") for patients in need. However, overcrowding often leads to substance use disorder patients frequently waiting for SUDE for prolonged periods in general treatment spaces and/or hallways, creating a barrier to care and challenges in providing treatment. The redesigned ED will provide appropriate space for this activity to occur in a more timely and private manner.

#### D. Cancer and the Need for ED Services

From 2009 through 2013, there were 183,009 newly diagnosed cases of cancer in Massachusetts, for an average annual age-adjusted incidence rate of 480.4 cases per 100,000 persons.<sup>47</sup> Overall, cancer incidence in Massachusetts slightly decreased from 2009 to 2013.<sup>48</sup>

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<sup>38</sup> *Id.*; Lisa Creamer, *Study: Patients With Mental Illnesses Wait Significantly Longer Inside Mass. Emergency Rooms*, WBUR (Jan. 5, 2017), <http://www.wbur.org/commonhealth/2017/01/05/study-mental-illness-er-waits>.

<sup>39</sup> Pearlmutter et al., *supra* note 37; Creamer, *supra* note 38.

<sup>40</sup> Pearlmutter et al., *supra* note 37; Creamer, *supra* note 38.

<sup>41</sup> Pearlmutter et al., *supra* note 37; Creamer, *supra* note 38.

<sup>42</sup> Pearlmutter et al., *supra* note 37; Creamer, *supra* note 38.

<sup>43</sup> Pearlmutter et al., *supra* note 37; Creamer, *supra* note 38.

<sup>44</sup> Pearlmutter et al., *supra* note 37; Creamer, *supra* note 38.

<sup>45</sup> STEVEN BUTTLAIRE & PETER BROWN, EMERGING STRATEGIES TO IMPROVE CARE FOR BEHAVIORAL HEALTH CLIENTS IN THE EMERGENCY DEPARTMENT (Institute for Behavioral Healthcare Improvement 2012), *available at* [http://www.ibhi.net/ref-lib-papers/Webinar\\_October\\_10\\_2012\\_rev2\[1\].pdf](http://www.ibhi.net/ref-lib-papers/Webinar_October_10_2012_rev2[1].pdf).

<sup>46</sup> *Id.*

<sup>47</sup> *Massachusetts Cancer Statistics*, COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF HEALTH & HUMAN SERVS., <http://www.mass.gov/eohhs/gov/departments/dph/programs/community-health/cancer-age/massachusetts-cancer-statistics.html> (last visited Nov. 1, 2017).

However, since 2006, cancer has been the leading cause of death in the Commonwealth and this number is expected to rise given the aging population within the state, as well as in the Applicant's patient panel.<sup>49</sup> A recent study evaluating cancer trends from 2006-2012 found that 29.5 million ED visits were related to an underlying cancer diagnosis.<sup>50</sup> These visits are evidence of a new challenge in providing high quality ED care to cancer patients, as a significant number of these individuals are seeking routine care in the ED, as well as palliative care services in the ED.<sup>51</sup> This issue is of particular importance to BWH's clinical staff, as the BWH ED provides support and services to Dana-Farber Cancer Institute's cancer patients. Accordingly, through this proposed Project, BWH will create a designated area for cancer treatment in the expanded ED. Regionalization of these patients will create care efficiencies, including expedited services for cancer care patients through highly trained ED-oncology staff.

#### E. Patients with Complex Medical and Psychosocial Needs and the Need for Redesigned Emergency Services

BWH's ED is a critical component of the social safety net for patients with complex medical and psychosocial needs. Consequently, many of the patients that present at BWH's ED need to be connected with ongoing primary and behavioral healthcare, as well as social work and case management services that may help these patients address challenges with the social determinants of health ("SDoH"), such as food and housing insecurity. Numerous studies have shown that patients that struggle with SDoH issues have a higher frequency of ED visits, as well as inpatient visits.

To identify patients that may face SDoH issues, BWH has developed a dataset that follows patients with high ED utilization to ensure they are connected to appropriate resources, including a community health worker that may assist in addressing SDoH challenges. Internal evaluation of this program has shown a significant reduction in hospitalizations, ED visits, and total costs (inclusive of program costs, the return of investment for this program is >5).

Due to the success of this program, BWH plans to expand screening for SDoH and ED-linkage activities as part of the Partners HealthCare Medicaid ACO. However, physical space constraints present a barrier to these important activities as screenings for SDoH and engaging patients with care linkage resources (including a community health worker or social worker) takes additional time during an ED visit. Since ED space is at a premium, it is difficult to perform these evaluations in critically needed ED bays when patients with urgent and emergent healthcare issues are in need of a bed. Accordingly, through the proposed Project, designated ED space will be implemented for SDoH screenings and linkage activities. Ultimately, the creation of appropriate space for these activities may lead to a reduction in future ED visits, unnecessary hospital admissions and overall total medical expenses, particularly for MassHealth patients, who are overrepresented in the population impacted by SDoH.

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<sup>48</sup> *Id.*

<sup>49</sup> *Stats of the State of Massachusetts*, NAT'L CTR. FOR HEALTH STATISTICS, CENTERS FOR DISEASE CONTROL & PREVENTION, <https://www.cdc.gov/nchs/pressroom/states/massachusetts.htm> (last updated Jul. 7, 2016); BUREAU OF HEALTH INFORMATION, STATISTICS, RESEARCH, & EVALUATION, MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH, *A Decade of Mortality Massachusetts: 2000-2009 (2012)*, available at <http://www.mass.gov/eohhs/docs/dph/research-epi/death-data/death-report-09.pdf>.

<sup>50</sup> Donna R. Rivera et al., *Trends in Adult Cancer-Related Emergency Department Utilization*, JAMA ONCOLOGY (2017).

<sup>51</sup> *Id.*

## F. Team-Based Care and the Need for Redesigned Emergency Services

With the advent of team-based care in EDs, the need for expanded physical space and the size, as well as the configuration of an ED has changed over time. “EDs that do not use a team structure typically face several common challenges. To illustrate those challenges, consider an ED that has two physicians and a number of nurses who cover about 20 patient rooms. As patients come into the ED, the physicians see each patient in the next available room. In this scenario, at any given time, one physician may have patients in rooms 1, 5, 10, 17 and 20. To treat those patients, the physician must cover a large span of the department. A spaghetti diagram of his or her steps would show the physician walking all over the ED.”<sup>52</sup> All of this travel consumes valuable time that the physician otherwise could spend at the bedside or performing other important tasks. In turn, it increases patients' lengths of stay – much of which may be spent waiting for the physician to return. Additionally, because nursing teams are typically assigned to a cluster of adjacent rooms, this ED physician also ends up working with most or all of the nurses in the department at the same time. This reduces the likelihood that the physician and nurses can develop the collaboration and teamwork necessary for optimal efficiency.

Accordingly, team-based care is only efficient and successful if the ED is configured with co-located team member administrative space, appropriate size exam rooms and areas for teams to conduct meetings. Currently, the BWH ED footprint does not have the ability to efficiently facilitate team based care given space constraints and overcrowding issues. Evidence suggests that dividing patients into work streams results in reduced waiting times and shorter ED journey times when compared with a non-streamed model.<sup>53</sup> Accordingly, through the proposed Project, BWH will expand the space within the ED allowing for co-located services and more team based care. Patients will be placed in specific team work streams, decreasing the amount of time and steps that clinical staff take to see patients. Additionally, operational efficiencies will be created by designating specific clinical teams to certain areas of the ED.

### F1.a.iii

#### **Competition:**

**Provide evidence that the Proposed Project will compete on the basis of price, total medical expenses, provider costs, and other recognized measures of health care spending. When responding to this question, please consider Factor 4, Financial Feasibility and Reasonableness of Costs.**

The renovation and expansion of the BWH ED will not have an adverse effect on competition in the Massachusetts healthcare market based on price, total medical expenses (“TME”), provider costs or other recognized measures of health care spending. The provision of ED care is a current service-line at BWH with a stable annual rate of growth of 1%. This slight annual increase does not have an impact on provider costs or the overall market. Moreover, through the proposed Project, the Applicant is not seeking to increase ED patient volume. Rather, the goal of the proposed Project is to right-size the ED to accommodate projected demand and redesign the care experience for ED patients to ensure higher quality care that leads to a meaningful impact on quality outcomes. The first step in restructuring care processes is to

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<sup>52</sup> Joseph Spinell, *Emergency department “teams” deliver results*, BECKER'S HOSPITAL REVIEW (Nov. 25, 2014), <https://www.beckershospitalreview.com/hospital-physician-relationships/emergency-department-teams-deliver-results.html>.

<sup>53</sup> Jarvis, *supra* note 19.

expand and redesign the footprint of the ED, so patients are able to be treated in an appropriate clinical setting, as well as in a more timely and efficient manner.

As discussed in the Patient Panel Discussion in Section F.1.a.i, the demand for urgent and emergent services in the ED has increased since FY15, creating a shift in BWH's overall ED population. This shift is due in part to increases in specific patient populations seeking care within the ED. For example, BWH's collaboration with Dana-Farber Cancer Institute has resulted in a large increase in oncology patients seeking care in the BWH ED. Through the creation of dedicated oncology space within the ED, BWH will be able to meet the demand for services and provide oncology patients with the urgent and emergent care that they need while creating operating efficiencies and cost savings.

These operating efficiencies and overhead savings will be achieved in numerous ways. First, operating efficiencies will be created through the implementation of a more efficient fast-track process for patients with non- and less-urgent rather than urgent and emergent care needs (e.g. minor extremity injuries, sinus infections, etc.). By staffing this service with nurse practitioners and physician assistants, BWH will create cost savings. Second, by creating regionalized areas, such as designated behavioral health and oncology sections of the ED, BWH's leadership may create more efficient staffing patterns centered around high-volume times, creating operating efficiencies for "ramp up and ramp down" times, ultimately leading to overhead savings. Finally, the renovated ED will include designated space for patient screenings and evaluation to address SDoH issues. The creation of formal linkages to necessary healthcare and psychosocial supports for patients will lead to a reduction in unnecessary ED and inpatient visits by underserved populations who utilize the ED as a primary care source. Accordingly, overall TME for these ED patients will decrease, as patients will have the tools they need to receive services through lower-cost outpatient services.

**F1.b.i            Public Health Value /Evidence-Based:  
Provide information on the evidence-base for the Proposed Project. That is, how does the Proposed Project address the Need that Applicant has identified.**

**A. Applicant's Proposed ED Expansion and Redesign**

The Applicant's proposed physical plant upgrade and redesigned care processes are supported by extensive literature related to evidence-based strategies to reduce ED crowding and improve patient throughput. Consequently, BWH proposes to expand and redesign its ED as follows: (1) increase the square footage of the ED from 25,000 GSF to 51,000 GSF; (2) increase the number of private exam rooms from 49 to 69 with ten additional care initiation chairs for patient intake and rapid assessment of patients with low-acuity conditions; (3) expand the observational unit within the ED with ten additional beds; and (4) add two larger trauma resuscitation bays to accommodate necessary equipment and team-based care and meet current national standards. The Applicant also proposes to add radiology capacity, including an additional Computed Tomography ("CT") scanner, ultrasound, and portable X-ray, to reduce delays in service during peak demand.

Through these physical changes to the ED, BWH will redesign the following: (1) patient care/flow; (2) regionalization; and (3) operations. In terms of patient care, BWH will improve the patient experience by changing flow to forward patient progression and integrating waiting area, triage, rapid assessment, and team-based care initiation services. With respect to regionalization, BWH will implement designated spaces for certain groups of patients, such as

behavioral health and oncology patients. Finally, BWH will redesign operations. Specifically, BWH will improve access to care overnight and patient safety by creating flexible zones to allow for overnight ramp down and ramp up. Additional space for care and operational support are also part of the proposed construction and redesign (e.g., designated space to support a social worker providing resources around SDoH issues, staff providing medication reconciliation and care transitions, and interpreters having private conversations with patients).

#### B. Research Supporting the ED Expansion and Redesign

Several professional societies including the Society of Academic Emergency Medicine, American College of Emergency Physicians, American Academy of Emergency Physicians, Emergency Nurses Association, College of Emergency Medicine, and the Institute of Medicine have published proposals to reduce or end ED crowding.<sup>54</sup> However, before any intervention is instituted, it is critical that a hospital identify what the main causes of crowding are in its individual ED. The Applicant has thoughtfully engaged in this process and has determined that physical expansion and renovation of BWH's ED, as well as redesign of patient flow, regionalization, and operations activities, is necessary in order to combat the ED crowding problem that it faces and provide improved quality of care and experience to its ED patients.

##### Expansion of Space

The reality of trying to provide care for more patients than the ED's physical space can accommodate is a major contributor to crowding.<sup>55</sup> One component of alleviating ED crowding and hallway care is to expand the ED space and number of beds.<sup>56</sup> In accordance with this established intervention, and as noted above, the Applicant proposes to expand the physical space of BWH's ED in the following ways: (1) increase the square footage by 26,000 GSF; (2) increase the number of private exam rooms by 20, in order to minimize hallway care during routine operations; and (3) increase the size of trauma bays to enable all trauma team activations to occur in an optimal setting for patient resuscitation.

Significantly, physical expansion alone will not completely solve crowding problems.<sup>57</sup> While having adequate physical space helps, merely increasing square footage and the number of beds does not reduce crowding if processes within the ED are not improved.<sup>58</sup> In fact, it is well-documented that poor ED design contributes to ED crowding and long wait times.<sup>59</sup> Recognizing these facts, the Applicant proposes to complement the physical expansion of BWH's ED with a simultaneous redesign of the ED patient throughputs, both in terms of space and activity.

##### Redesign of ED Space and Activities – Enhanced Waiting and Care Initiation Areas and Related Activities to Improve Patient Flow

The first proposed redesign relates to patient intake and assessment. The traditional ED care model is as follows: (1) registration by non-clinical personnel; (2) hold in waiting area until triage, unless determined to need immediate care (3) triage; (4) hold in waiting area until an ED bed is

<sup>54</sup> Richards et al., *supra* note 19.

<sup>55</sup> Patricia Kunz Howard, *President's Message: Overcrowding: Not Just an Emergency Department Issue*, 31 J. EMERGENCY NURSING 227, 227-28 (2005), available at [http://www.jenonline.org/article/S0099-1767\(05\)00154-6/pdf](http://www.jenonline.org/article/S0099-1767(05)00154-6/pdf).

<sup>56</sup> Richards et al., *supra* note 19.

<sup>57</sup> Richards et al., *supra* note 19.

<sup>58</sup> Boyle et al., *supra* note 9.

<sup>59</sup> *Id.*

available, unless determined to need immediate placement; and (5) transfer to an ED bed, where waiting continues (e.g., for assessment, labs, radiology, etc.).<sup>60</sup> This model is fraught with periods of waiting time that occur between each of the steps, which interrupts patient flow and causes bottlenecks and backlogs early on and throughout the process.<sup>61</sup> To improve flow and patient care, the Applicant will implement a new model of care in BWH's ED that integrates triage, rapid assessment, care initiation services, and team-based care in such a way that allows patients get into the ED faster and go direct-to-provider rather than being held in the waiting area. Specifically, the new process works as follows: (1) patient checks-in with registration staff and undergoes a quick registration; (2) patient is assessed by a registered nurse with a set of vital signs and provides a focused history (including travel screen) as a means of initial triage; (3)(a) if determined to be lower-acuity, the patient is assigned to a provider team, brought to the care initiation area instead of back to the waiting area, and is taken out of the patient load of those requiring more acute care, thereby freeing up beds and lessening wait times for the general ED patient population; (3)(b) if determined to be higher-acuity, the patient is moved to an open room and receives immediate care; (4) lower-acuity patient is seen by the provider team in the patient care area, diagnostic testing is completed, pain is treated, and the patient is monitored; and (5) if the lower-acuity patient is not sent home, s/he proceeds to an ED room/bed and awaits test results and intervention. An internal waiting area will be provided for low-acuity patients awaiting discharge instructions to keep rooms open for new arrivals.

The new model that will be developed incorporates effective methods of triage, rapid assessment, and team-based care. One of the benefits of this model is that it decreases the potential risk to patients because one of the first people who greets the patient is a registered nurse who can immediately recognize seriously ill patients and ensure prompt treatment.<sup>62</sup> Such immediate nurse-led triage facilitates allocation of limited resources, such as staff and physical space; the nurse can risk stratify patient presentation and prioritize accordingly based on clinical need.<sup>63</sup> Moreover, by having a greeter nurse in the waiting room, patients are more satisfied and fewer leave without being seen.<sup>64</sup> Overall, the method of triage under this model has been shown to be associated with earlier diagnosis, shorter waiting times, and faster throughput in the ED.<sup>65</sup>

Finally, this model is one of team-based care initiation, under which the patient is seen in the patient care area by a team composed of a nurse, physician, and physician assistant or resident. This approach ensures that all providers are thoroughly familiar with the patient's condition and removes the redundancy of a patient giving the same information several times before they are treated.<sup>66</sup> In addition to the proven shorter wait times and lengths of stay,

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<sup>60</sup> Video: Future of the ED: Here Today (Brigham & Women's Hospital 2015), available at [http://www.brighamandwomens.org/Departments\\_and\\_Services/emergencymedicine/video.aspx](http://www.brighamandwomens.org/Departments_and_Services/emergencymedicine/video.aspx); Penne A. Marino et al., *Bypass Rapid Assessment Triage: How Culture Change Improved One Emergency Department's Safety, Throughput and Patient Satisfaction*, 41 J. EMERGENCY NURSING 213, 213-20 (2015), available at [http://www.jenonline.org/article/S0099-1767\(14\)00319-5/pdf](http://www.jenonline.org/article/S0099-1767(14)00319-5/pdf).

<sup>61</sup> Jarvis, *supra* note 19; Marino et al., *supra* note 60.

<sup>62</sup> Marino et al., *supra* note 60.

<sup>63</sup> Jarvis, *supra* note 19.

<sup>64</sup> Marino et al., *supra* note 60.

<sup>65</sup> Jarvis, *supra* note 19.

<sup>66</sup> R.S. Mackenzie et al., *Implementation of a Rapid Assessment Unit (Intake Team): Impact on Emergency Department Length of Stay*, 62 ANNALS OF EMERGENCY MED. S12, S12-13 (2013), available at [http://www.annemergmed.com/article/S0196-0644\(13\)00994-3/pdf](http://www.annemergmed.com/article/S0196-0644(13)00994-3/pdf); Spinell, *supra* note 52.

patients also tend to feel they are getting faster and more personalized care in a team environment.<sup>67</sup> To achieve this new model, physical redesign of the space is necessary.

*Redesign of ED Space and Activities – Additional Radiology Capacity*

The second redesign element proposed by the Applicant is to add additional CT, ultrasound and X-ray capacity to the expanded BWH ED. This will improve wait times and patient throughput, as having the required diagnostic imaging capacity within the ED is essential to making timely patient diagnoses.

*Redesign of ED Space and Activities – Regionalization and Streaming*

The Applicant also proposes to redesign the BWH ED space to accommodate designated spaces for patients presenting with specific conditions such as cancer and behavioral health needs. This process, known as regionalization or streaming, involves triaging similar patients (with regard to disease severity, nature of complaint, or condition) to a particular work stream.<sup>68</sup> Typically, patients in each work stream are assessed by dedicated staff in a specific area in the ED and are managed through separate processes.<sup>69</sup> Evidence suggests that dividing patients into work streams results in reduced waiting times and shorter ED journey times when compared with a non-streamed model.<sup>70</sup> The effectiveness of this strategy is dependent on having enough appropriately plotted physical space to meet the patient demand of each individual work stream.<sup>71</sup> Thus, physical expansion and redesign of BWH's ED is necessary to allow for this model of care.

**F.1.b.ii      Public Health Value /Outcome-Oriented:  
Describe the impact of the Proposed Project and how the Applicant will assess such impact. Provide projections demonstrating how the Proposed Project will improve health outcomes, quality of life, or health equity. Only measures that can be tracked and reported over time should be utilized.**

**A. ED Expansion and Redesign: Improving Health Outcomes and Quality of Life**

The Applicant anticipates that the proposed Project will provide BWH's ED patients with improved health outcomes, improved quality of life and additional access to high quality ED services by redesigning the patient care experience. As more fully discussed in Factor F.1.b.i., with the expansion of the ED footprint, operational efficiencies will be created that will improve the patient experience and reduce overcrowding through strategic patient flow changes. Moreover, these modifications will allow more patients to receive care in an exam room, rather than a hallway or waiting area, leading to improved privacy and an overall better care experience. When patients feel comfortable in their care setting, they are most honest with clinical staff and provide detailed information about their clinical histories, leading to improved care discussions and the initiation of sound treatment, which ultimately leads to improved health outcomes and a better quality of life. In addition, BWH will regionalize care in the ED with space designed to meet the specific and unique needs of oncology and behavioral health patients.

<sup>67</sup> Mackenzie et al., *supra* note 66; Spinell, *supra* note 52.

<sup>68</sup> Jarvis, *supra* note 19.

<sup>69</sup> *Id.*

<sup>70</sup> *Id.*

<sup>71</sup> *Id.*

Through the implementation of designated areas, clinical expertise may be centralized, care may be expedited and provided in an appropriate environment. Each of these changes will result in improved patient and provider satisfaction.

Furthermore, the improved space will also allow for the implementation of team-based administrative areas for clinical staff. Although minor improvements have been made to the BWH ED over the last ten years, space constraints hinder the implementation of evolving team-based care practices. Numerous studies have documented the benefits of multi-disciplinary care teams in the ED, including improved patient health outcomes, improved patient experience and increased provider satisfaction. However, current space constraints in BWH's ED make the provision of team-based care challenging given the lack of administrative space for team huddles, rounding and discussions. The expanded footprint of the ED will allow for the implementation of co-located, team-based administrative areas, so clinical team members may conduct team-based meetings after rounding on patients; case managers may meet with patients and families regarding appropriate care plans, options and alternatives; social workers can discuss specific psycho-social supports or SDoH needs for patients with other team members, teams can provide medication reconciliation and interpreters may have private conversations about care concerns with patients, etc. Providing adequate space to conduct these activities will result in improved health outcomes and more cohesive care that addresses patient's health needs as well as social service needs.

## B. Assessing the Impact of the Proposed Project

To assess the impact of the proposed Project, BWH has developed the following quality metrics and reporting schematic, as well as metric projections for quality indicators that will measure patient satisfaction, access and quality of care. The measures are discussed below:

1. **Satisfaction – Patient Satisfaction:** Patients that are satisfied with care are more likely to seek additional treatment when necessary. BWH will review patient satisfaction levels with ED services via Press Ganey Scores.

**Measure:** To ensure a service-excellence approach, patient satisfaction surveys will be distributed to all ED patients who provided a valid e-mail address and received services at BWH's ED with specific questions around (a) satisfaction levels with wait times; (b) satisfaction with services; and (c) satisfaction with clinical staff, including the physician.

**Projections:** Baseline: 85.30%; Year 1: 90.0%; Year 2: 91.8%; and Year 3: 92.72%

**Monitoring:** Any category receiving a less than exceptional rating (satisfactory level) will be evaluated and policy changes instituted as deemed appropriate.

2. **Access Measure – Walk-Out Rate:** As previously discussed, given overcrowding issues, BWH experienced a walk-out rate of 2.78% in FY16, with an increased rate over the last two years. Through a redesigned physical space and new patient throughput processes, BWH will be able to move patients to exam rooms more quickly, reducing wait time, overcrowding and the walk-out rate.

**Measure:** The number of patients leaving the ED without treatment, without being seen or without an appropriate discharge.

**Projections:** Baseline: 2.78%; Year 1: 1.20%; Year 2: 1.18%; and Year 3: 1.16%

**Monitoring:** This data will be evaluated on a quarterly basis by the ED operations leadership team.

3. **Access Measure – The Amount of Time between Registration to Being Seen by a Physician:** Patients will be evaluated to determine the amount of time it takes for the individual to move from registering as a patient in the ED to being seen by a physician (or equivalent, such as a nurse practitioner).

**Measure:** The amount of time it takes between a patient registering in the ED to being seen by a treating clinician

**Projections:** Baseline: 24 minutes; Year 1: 15 minutes; Year 2: 15 minutes; and Year 3: 15 minutes

**Monitoring:** This data will be evaluated on a quarterly basis by the ED operations leadership team.

4. **Process Measure – The Amount of Care Provided Outside of an ED bay:** Currently, approximately 17% of care within BWH's ED is provided in areas outside of formal exam bays. This measure will be evaluated to determine the impact of the redesigned space and patient flow on overcrowding.

**Measure:** The number of times care is provided outside of an ED bay.

**Projections:** Baseline: 16.52%; Year 1: 8.00%; Year 2: 5.00%; and Year 3: 5.00%

**Monitoring:** This data will be evaluated on a quarterly basis by the ED operations leadership team.

5. **Quality Measure – Early Management Bundle, Severe Sepsis/Septic Shock:** This measure focuses on adults 18 years and older with a diagnosis of severe sepsis or septic shock. Consistent with Surviving Sepsis Campaign guidelines, it assesses measurement of lactate, obtaining blood cultures, administering broad spectrum antibiotics, fluid resuscitation, vasopressor administration, reassessment of volume status and tissue perfusion, and repeat lactate measurement. The first three interventions should occur within 3 hours of presentation of severe sepsis, while the remaining interventions are expected to occur within 6 hours of presentation of septic shock.

**Measure:** Percentage of patients receiving care within the timeframe of the Measure Guidelines

**Projections:** Baseline: 27.32% Year 1; 60.72% Year 2: 66.79%; and Year 3: 73.47%

**Monitoring:** This data will be evaluated on a quarterly basis by the ED's Continuous Quality Improvement ("CQI") Committee.

**F1.b.iii**

**Public Health Value /Health Equity-Focused:**

**For Proposed Projects addressing health inequities identified within the Applicant's description of the Proposed Project's need-base, please justify**

**how the Proposed Project will reduce the health inequity, including the operational components (e.g. culturally competent staffing). For Proposed Projects not specifically addressing a health disparity or inequity, please provide information about specific actions the Applicant is and will take to ensure equal access to the health benefits created by the Proposed Project and how these actions will promote health equity.**

To ensure health equity to all populations, including those deemed underserved, the proposed Project will not affect accessibility of BWH's services for poor, medically indigent, and/or Medicaid eligible individuals. BWH does not discriminate based on ability to pay or payer source and this practice will continue following implementation of the proposed Project. As further detailed throughout this narrative, the proposed Project will increase access to high quality ED services for all BWH patients in a number of ways.

The renovation and expansion of the ED will specifically address underserved populations and promote health equity through the development and implementation of a "care initiation" area within the ED. While this area can shift functionality to initiate care for more complex patients during surge times, during routine operations the care initiation area will function like a fast-track and be designated for lower-acuity patients who tend to be underserved and need urgent care services rather than ED care. Currently, due to their lower acuity, many of these patients receive treatment in hallways in order to prioritize higher acuity patients for formal treatment bays. This is not ideal as patient privacy is impacted and may have a negative impact on the care that is provided, quality outcomes and patient experience. Through the development of a designated care initiation area, patients will receive expedited care in private exam rooms. Additionally, social work staff will be able to meet with patients in private to discuss any linkages that are needed to social supports.

In addition, Partners HealthCare, and specifically BWH, has also adopted the Culturally and Linguistically Appropriate Service ("CLAS") standards set forth by the U.S. Department of Health and Human Services Office of Minority Health for all practice sites. BWH provides effective, understandable, and respectful care with an understanding of patients' cultural health beliefs and practices and preferred languages. Additionally, BWH has arrangements to offer ongoing education and training in culturally and linguistically appropriate areas for staff at all levels and across all disciplines. Language assistance services are provided by certified translators at no cost to BWH's patients with limited English proficiency by BWH at all points of clinical contact in a timely manner; additional translation services in less frequently encountered languages are available at all times through Language Assistance lines. Additionally, all patient-related materials and signage are posted in multiple languages. Given these processes, by renovating and expanding the current ED, BWH will allow for equal access to ED services by all patients.

Finally, all Partners HealthCare hospitals, including BWH, participate in the American Hospital Association's #123Equity Pledge Campaign. This Campaign seeks to eliminate health and health care disparities that exist for racially, ethnically and culturally diverse individuals. The campaign requires hospital leaders to accelerate progress in the following areas: (1) Increasing the collection and use of race, ethnicity, language preference and other socio-demographic data; (2) Increasing cultural competency training; and (3) Increasing diversity in leadership and governance. Currently, all Partners HealthCare hospitals participate in the Campaign. This Campaign will allow BWH staff to ensure equal access to the benefits created by the proposed Project.

**F1.b.iv Provide additional information to demonstrate that the Proposed Project will result in improved health outcomes and quality of life of the Applicant's existing Patient Panel, while providing reasonable assurances of health equity.**

By redesigning the patient care experience in the ED, BWH will initiate operational activities aimed at creating efficiencies. For example, modifying patient throughput will allow for improved access to care in the overnight hours and patient safety by creating flexible zones to allow for overnight ramp down and ramp up. This will allow for better utilization of staff resources and ensure timely care for patients. Currently, care is provided in three separate areas, or pods. It is not feasible to assign staff to multiple pods due to geographic divisions, and as a result, inefficiencies are created due to the challenge of balancing staff resources to patient needs. Moreover, a smaller treatment area is needed during overnight hours due to a decrease in patient demand. BWH contracts the ED treatment areas overnight. However, due to the current pod design of the ED, an entire pod must be taken offline. Preparing to close a pod renders the pod ineffective in the 1-2 hours leading into closure. Consequently, larger zones of care will enable flexible areas where ED staff may efficiently expand and contract capacity according to patient needs.

As mentioned in section F.1.a.ii.E, the ED is a key part of the social safety net for patients with complex medical and psychosocial needs. The proposed Project will create additional space that allows for increased screening for SDoH and linkages to programs to address these challenges, thus improving health equity by improving care access and outcomes for vulnerable patients.

**F1.c Provide evidence that the Proposed Project will operate efficiently and effectively by furthering and improving continuity and coordination of care for the Applicant's Patient Panel, including, how the Proposed Project will create or ensure appropriate linkages to patients' primary care services.**

To ensure continuity of care, improved health outcomes and enhanced quality of life, through the proposed Project, BWH staff will continue existing formal processes for linking ED patients with primary care physicians and specialists for follow-up care, as well as case management/social work support to ensure patients have access to resources around SDoH issues. Providing patients with linkages to these necessary services prevents unnecessary readmissions, ensures appropriate care management and provides the patient with the resources for leading a better life. Additionally, the redesign of patient throughput processes will allow for enhanced care transitions through patient rounds conducted by a multi-disciplinary care team that may provide medication reconciliation, establish linkages to a patient's primary medical home or establish a relationship with a primary care physician.

**F1.e.i Process for Determining Need/Evidence of Community Engagement: For assistance in responding to this portion of the Application, Applicant is encouraged to review *Community Engagement Standards for Community Health Planning Guideline*. With respect to the existing Patient Panel, please describe the process through which Applicant determined the need for the Proposed Project.**

Given ongoing space constraints within the ED, BWH's leadership and clinical staff are acutely aware from its patients and staff of the need for renovations and expansion of this clinical space. Consequently, following strategic internal discussions around the most effective way to

address issues with ED overcrowding and providing ED patients with the highest quality care, BWH's leadership developed a plan to renovate and expand the ED. In contemplation of this renovation and expansion, BWH's leadership sought to define its community broadly and engage patients, family members, local residents and resident groups that may be impacted by the proposed Project to obtain feedback and answer questions. These groups were engaged through various initiatives.

As a first step in the engagement process, the proposed Project was presented to a BWH service-line Patient and Family Advisory Council ("PFAC") known as the ED Patient & Family Centered Care Committee ("ED PFCCC"). The ED PFCCC reports to the BWH Patient Family Advisory Steering Committee ("Steering Committee"), which is co-chaired by BWH's Chief Medical Officer, Chief Nursing Officer, and the Senior Patient Advisor along with fourteen patient advisors. This Steering Committee is the overarching Council for each of the service-line PFACs. BWH currently has fourteen service line councils that are either in existence, launching or preparing to start a council phase along with eight research studies that have patient advisors collaborating with research investigators. One to two advisors from each of the service-line PFACs sit on the Steering Committee. During Steering Committee meetings, specific topics are discussed by the Chief Medical Officer and Chief Nursing Officer in an effort to provide information on hospital initiatives and to obtain feedback from the advisors on ongoing projects. Advisors from each service-line PFAC report to the Steering Committee and report back to their service line on what they have learned; thereby, making a direct flow of information between the two groups. The goal of the Steering Committee is to create an environment of patient and family-centered care across the entire institution, and provide feedback regarding patient and family centered care activities at BWH.

Specifically, the ED PFCCC is now in its sixth year and is comprised of seven patient/family advisors that meet monthly. Advisors have been working closely with clinical staff to understand ED expansion efforts. Additionally, advisors are focused on working with the ED Nursing Director on creating a PFAC orientation for new nurses, as well as gender orientation identification and the opioid epidemic in Massachusetts. To educate members of the ED PFCCC on the ED renovation and expansion initiative, Janet Gorman, Nursing Director presented to the committee on December 3, 2015 and October 27, 2016. Additionally, Jonathan McCabe, RN provided the ED PFCCC with an update on the expansion and construction of the new ED on July 13, 2017 and September 28, 2017. At these meetings, clinical staff sought feedback on BWH's ED expansion efforts.

In addition to engaging patients and family members around the ED expansion initiative, BWH sought to engage local residents, as well as those resident groups impacted by all of the proposed projects, including the ED expansion, the acquisition of a MRI simulator and a MRI linear accelerator, as well as the transition of a 7T MRI from research to clinical use. Accordingly, BWH hosted two community forums, the first forum was held on September 15, 2017 and the second forum was held on September 20, 2017. These forums were publicized in clinical and administrative areas of the hospital, as well as through staff outreach to local resident and community groups. The goal of these forums was to educate community members on ongoing ED renovation and expansion efforts, as well as on the radiology projects. The meetings were attended by several individuals representing various constituencies, including staff, patients, neighbors and other community members. Sign-in sheets for these forums may be found in Appendix 2. During these sessions, BWH staff presented on the proposed Project and obtained feedback from staff, neighbors, patients and other individuals. Feedback forms may be found in Appendix 2. Feedback from these sessions was positive with many attendees noting that the ED expansion was needed and necessary for providing better patient care citing

long wait times for personal care or for family members seeking care at the BWH ED. Given the community's interest in the proposed Project, BWH will continue to update patients, family members, as well as residents and resident groups through postings on the hospital's web site about each of the proposed projects.

**F1.e.ii Please provide evidence of sound Community Engagement and consultation throughout the development of the Proposed Project. A successful Applicant will, at a minimum, describe the process whereby the "Public Health Value" of the Proposed Project was considered, and will describe the Community Engagement process as it occurred and is occurring currently in, at least, the following contexts: Identification of Patient Panel Need; Design/selection of DoN Project in response to "Patient Panel" need; and Linking the Proposed Project to "Public Health Value".**

To ensure sound community engagement throughout the development of the proposed Project, the Applicant in conjunction with BWH took the following actions:

- Presentations to BWH's ED PFCCC by Janet Gorman, Nursing Director on December 3, 2015 and October 27, 2016 and by Jonathan McCabe, RN on July 13, 2017 and September 28, 2017;
- Community forums on September 15, 2017 and September 20, 2017 where staff presented on the ED renovation and expansion initiative, as well as the proposed radiology projects. Information on these forums was publicized and posted in BWH's clinical and administrative areas;
- BWH staff sent correspondence to local resident groups on September 7, 2017 notifying them of the community forums on the proposed Project;
- BWH staff created a feedback/comment form to obtain feedback from patients, family members, residents and local resident groups at all forums.

For detailed information on these activities, see Appendix 2.

For transparency and to educate the community regarding the public health value of the proposed Project, BWH developed a presentation to provide at the aforementioned community forums. This presentation documents the components of the proposed Project and the patient panel need that the Project will meet, as well as the impact of the proposed Project including its public health value.

## **Factor 2: Health Priorities**

**Addresses the impact of the Proposed Project on health more broadly (that is, beyond the Patient Panel) requiring that the Applicant demonstrate that the Proposed Project will meaningfully contribute to the Commonwealth's goals for cost containment, improved public health outcomes, and delivery system transformation.**

**F2.a. Cost Containment:  
Using objective data, please describe, for each new or expanded service, how the Proposed Project will meaningfully contribute to the Commonwealth's goals for cost containment.**

The goals for cost containment in Massachusetts center around providing low-cost care alternatives without sacrificing high quality. As stated, BWH is a high value provider for ED services. However, to ensure patients are receiving the highest quality care, BWH needs to address issues around ED capacity and space constraints. As previously stated, the provision of ED care is a current service-line at BWH with a stable annual rate of growth of 1%. The Applicant is not seeking to increase BWH ED patient volume, rather the goal of the proposed Project is to redesign the care experience for ED patients to ensure higher quality care that leads to a meaningful impact on quality outcomes.

To address current space challenges, BWH will expand the footprint of the ED and create designated space for specific patient populations and activities. For example, a care initiation area will be created to expedite care for non- and less-urgent patient care needs. By providing patients with expedited care, BWH staff may address a patient's care needs and educate patients about lower-cost urgent care alternatives for non- and less-urgent/emergent needs in the future. Additionally, the renovated ED will create more capacity for observational care, which is a lower-cost alternative to short-stay hospitalizations. Moreover, through the creation of regionalized areas, such as designated behavioral health and oncology sections of the ED, BWH will institute more efficient staffing patterns centered around high-volume times, creating operating efficiencies for "ramp up and ramp down" times, ultimately resulting in overhead savings. Finally, the renovated ED will include designated space for patient screenings and evaluation to address SDoH issues. The creation of formal linkages to necessary healthcare and psychosocial supports for patients will lead to a reduction in unnecessary ED and inpatient visits, allowing BWH to address SDoH challenges prior to their impact on a patient's health and over time reducing overall TME.

**F2.b. Public Health Outcomes:  
Describe, as relevant, for each new or expanded service, how the Proposed Project will improve public health outcomes.**

As previously discussed, to address the issue of ED boarding and overcrowding, the Department of Public Health ("Department") has established the ED Boarding and Patient Flow Task Force, which is charged with examining the issue of ED boarding. The task force is looking at data, trends, and possible policy solutions to this issue. In 2015, the Department initiated Code Help policies and regulations to address the need to move behavioral health patients, as well as other patient populations from the ED to appropriate care settings. Through this expansion effort, BWH staff are utilizing lessons learned and best practices to institute realistic solutions to address ED capacity constraints. Through the implementation of additional aspects of team based care, clinical staff will ensure patients are receiving holistic, timely, quality care.

By providing patients with high quality care services in appropriate settings, patients are more likely to stay to obtain care services (a reduction in the walk-out rate) and seek additional services when necessary. Accordingly, the improved ED will reduce ED revisits, readmissions and will allow clinical staff to refer or link patients to additional community services that will facilitate the improvement of health outcomes.

**F2.c. Delivery System Transformation:  
Because the integration of social services and community-based expertise is central to goal of delivery system transformation, discuss how the needs of their patient panel have been assessed and linkages to social services organizations have been created and how the social determinants of health have been incorporated into care planning.**

To address issues associated with the SDoH and to ensure all patients have equal access to care, BWH has developed a robust social work program in the ED that facilitates linkages to social service organizations through a community health worker, as well as to clinical services, such as collaborative relationships with primary care clinicians. For underserved patients, these linkages may mean obtaining the care they need in a timely fashion or obtaining necessary psycho-social supports to get well.

As previously discussed in section F.1.A.ii.E, the ED is a key part of the social safety net for patients with complex medical and psychosocial needs. Through the proposed Project, designated ED space will be created for SDoH screenings and linkage activities. Ultimately, these activities may lead to a reduction in future ED visits, unnecessary hospital admissions and overall TME, particularly for MassHealth patients, who are overrepresented in the population struggling with SDoH.

Programs that address SDoH are a key element of care transformation, making the ED a necessary part of the preventative care system and addressing the population health challenges for vulnerable patients, rather than providing acute, episodic treatment.

#### **Factor 5: Relative Merit**

**F5.a.i** Describe the process of analysis and the conclusion that the Proposed Project, on balance, is superior to alternative and substitute methods for meeting the existing Patient Panel needs as those have been identified by the Applicant pursuant to 105 CMR 100.210(A)(1). When conducting this evaluation and articulating the relative merit determination, Applicant shall take into account, at a minimum, the quality, efficiency, and capital and operating costs of the Proposed Project relative to potential alternatives or substitutes, including alternative evidence-based strategies and public health interventions.

**Proposal:** The proposed Project is to renovate and expand BWH's ED to address overcrowding issues and redesign the delivery of care to provide better patient experience and improve health outcomes.

**Quality:** The Proposed Project is a superior alternative for providing high quality ED services and improving health outcomes as patients will be treated in the appropriate clinical space. This Project seeks to increase the overall square footage of the ED from 25,000 GSF to 51,000 GSF, implement improved waiting areas for patients, and increase private exam rooms from 49 to 69 in an effort minimize the provision of services in hallways and waiting areas. As previously discussed, studies have shown that appropriate patient flow and the use of care teams in the ED has a significant impact on ED overcrowding and patient health outcomes. Additionally, the proposed Project seeks to increase the overall square footage of the trauma bays, enabling all trauma team activations to occur in an optimal setting for patient resuscitation.

Furthermore, the proposed Project seeks to add increased radiology capacity in the ED, including a CT, ultrasound and portable X-ray machine to reduce delays during peak demand and ensure timely service for patients in need. Expedited care improves patient satisfaction, as well as encourages patients to wait for treatment, rather than leaving prior to receiving services; thereby increasing the number of patients seen by providers and ultimately improving health outcomes.

**Efficiency:** Through an expanded ED footprint, clinical staff will be able to redesign patient flow, improving a patient's overall care experience and expediting a patient's progression through waiting areas, rapid assessment and care initiation. Moreover, the proposed Project will allow for regionalization of care services by implementing designated clinical space behavioral health and oncology patients that present at the ED for services. Redesigning patient flow and the implementation of regionalization will create care and operational efficiencies that will improve patient outcomes and experience, as well as provider satisfaction.

**Capital Expense:** The proposed renovation and expansion of the ED represents the superior alternative for capital expense, as BWH leadership worked tirelessly with the architects and the design team to implement the most cost-effective expansion possible.

**Operating Costs:** The current ED footprint is not large enough to manage the current volume of patients treated at BWH's ED, creating overcrowding issues, as well as a large percentage of patients who "walk-out" prior to receiving services. These overcrowding and boarding issues cost BWH approximately \$480,000 in lost patient revenue annually. Accordingly, an expanded ED footprint will allow for a redesign of clinical operations that will facilitate expedited care with patients receiving services in a timely fashion; thereby reducing the walk-out rate and increasing overall patient service revenue by 1%.

#### List alternative options for the Proposed Project:

##### Option 1

**Alternative Proposal:** The alternative option for the Proposed Project would be to sustain the current ED footprint and infrastructure without expanding or redesigning the clinical space or patient flow.

**Alternative Quality:** From a quality of care perspective, BWH's ED cannot continue with its current footprint, as a significant amount of care is currently being provided in sub-optimal settings leaving clinicians to conduct visits in a public setting with little to no privacy for patients. This current process is less than ideal for both patient experience and health outcomes, as it leads to a high walk-out rate of patients who leave prior to being seen by a clinician, leaving patients to determine if they'll seek care from an alternative site or delay treatment.

**Alternative Efficiency:** No care efficiencies may be created through the current ED footprint. Rather, the current space and patient flow lead to care inefficiencies with clinical teams providing care in common areas.

**Alternative Capital Expenses:** Although this alternative will allow the hospital to forgo construction costs, allowing the ED to remain in its current state will have an overall impact of quality of care, as well as patient and provider satisfaction.

**Alternative Operating Costs:** Allowing the ED to remain in its current state will not afford BWH will any operational efficiencies; thereby there will continue to be administrative costs associated with inefficient and ineffective patient flow.

## 2. Project Description

### Factor 1: Applicant Patient Panel Need, Public Health Values and Operational Objectives

#### F1.a.i Patient Panel:

**Describe your existing Patient Panel, including incidence or prevalence of disease or behavioral risk factors, acuity mix, noted health disparities, geographic breakdown expressed in zip codes or other appropriate measure, demographics including age, gender and sexual identity, race, ethnicity, socioeconomic status and other priority populations relevant to the Applicant's existing patient panel and payer mix.**

In FY16, BWH provided 31,200 unique patients with 44,016 magnetic resonance imaging ("MRI") scans. This number is expected to increase with current year-to-date data for FY17 indicating 25,249 unique patients have already had 42,001 MRI scans. Although this data gives context to the volume of MRI services being provided at BWH, the need for 7T Magnetom Terra MRI ("7T MRI") services is not based on the need for additional capacity, but rather the technology's ability to provide novel clinical applications meeting the special needs for specific subsets of patients.

On October 12, 2017, the United States Food and Drug Administration ("FDA") approved the 7T MRI for clinical use, announcing it as the first 7T MRI system cleared for clinical use in the United States. Until this time, the highest field strength MRI cleared for clinical use in the U.S. was 3T. Currently, only four 7T MRIs have been installed in the United States (several more are planned), and the BWH 7T MRI, which is currently used for research only, is the only such device installed in Massachusetts. As an ultra-high field MRI (with a magnetic field more than 140,000 times the strength of the earth's magnetic field), the BWH 7T MRI produces higher spatial resolution images (higher quality pictures), as well as useful functional images reporting on the metabolic or molecular activity of healthy and pathologic tissue.

Research studies on the 7T MRI have demonstrated that these MR images provide exceptional value in assessing and treating diseases of the brain and the musculoskeletal system, such as multiple sclerosis ("MS"), Parkinson's disease, Alzheimer's disease, brain tumors, epilepsy, cerebrovascular diseases, traumatic brain injury, and tendon and soft-tissue conditions. Accordingly, BWH is seeking to convert its existing 7T MRI from full-time research use to part-time clinical use. BWH staff project that approximately 1,500 patients annually will be scanned with the 7T MRI, resulting in approximately 1,750 scans as BWH clinicians will seek to use the 7T MRI for patients with challenging diagnostic problems (primarily as a substitute for scans that otherwise would be made using existing BWH's 3T MRI or 1.5T MRI). Additionally, 500 patients per year will have translational research examinations on this technology. Initially BWH clinicians will utilize the 7T MRI for patients in the current patient panel, including selected patients from the Anne Romney Multiple Sclerosis Center (which had approximately 450 new patients last year), as well as selected patients suffering from Alzheimer's Disease, dementia, Parkinson's Disease and related syndromes, and severe knee osteoarthritis and similar conditions. The total number of patients in BWH's patient panel with these conditions is currently estimated at 9,052 patients.

#### F1.a.ii Need by Patient Panel:

**Provide supporting data to demonstrate the need for the Proposed Project. Such data should demonstrate the disease burden, behavioral risk factors,**

**acuity mix, health disparities, or other objective Patient Panel measures as noted in your response to Question F1.a.i that demonstrates the need that the Proposed Project is attempting to address. If an inequity or disparity is not identified as relating to the Proposed Project, provide information justifying the need. In your description of Need, consider the principles underlying Public Health Value (see instructions) and ensure that Need is addressed in that context as well.**

MRI is a powerful, noninvasive imaging technique that has increased in technical capability and clinical application over the last three decades. One important aspect of improved MRI capability has been the development of devices that employ a higher magnetic field strength. The use of higher powered magnets is advantageous as it leads to improved images, as well as facilitates the use of functional imaging methods that can demonstrate tissue function, biochemical content and vascularity.

Based on this innovation, a research and clinical imperative exists to utilize magnets with even higher field strength, and one manufacturer, Siemens Healthineers, has produced a recently FDA-cleared MRI that operates at 7T. The need for the 7T Magnetom Terra System is based on the technology's innovative applications when evaluating neurological and musculoskeletal disorders. At present, only four of these scanners have been installed in the United States, including the 7T MRI located at BWH's Building For Transformative Medicine. Currently, this powerful device is only equipped to image two parts of the body – the brain and the knee. Over time, additional hardware and software will be developed to expand imaging to other regions. Consequently, clinicians will only be able to utilize this device for evaluation of certain patients.

Novel clinical applications of the 7T MRI include:

- Detection of cortical lesions that have particular clinical importance for patients with MS.
- Evaluation of grey-matter injury in patients with MS.
- Discovery of central veins in white matter lesions that are essentially pathognomonic for patients with MS.
- Useful in imaging deep brain stimulation targets, such as the subthalamic nucleus, internal globus pallidus and substantia nigra for patients with Parkinson's disease.
- Provides more anatomical detail in evaluation of the hippocampus and sub-structures for patients with Alzheimer's disease.
- Precise delineation of arterial microvasculature, as well as tumor metabolism via T2\* weighted venography in patients with brain tumors.
- Detection of small areas of cortical dysplasia or sclerosis via better spatial resolution for epilepsy patients.
- Detection of microbleeds is stronger at higher field strengths for patients with cerebrovascular diseases and traumatic brain injury patients.
- Improved spatial resolution to visualize ever-smaller, arteries as well as anatomic details of aneurysms for patients with cerebrovascular diseases.
- Ability to perform ultra-high resolution morphological imaging, 3D T2 and T2\* mapping, as well as ultra-short TE applications for patients with musculoskeletal disorders.

Through the conversion of the 7T MRI from full-time research use to part-time clinical use, approximately 1,500 clinical patients per year will benefit from this modality.

**F1.a.iii****Competition:**

**Provide evidence that the Proposed Project will compete on the basis of price, total medical expenses, provider costs, and other recognized measures of health care spending. When responding to this question, please consider Factor 4, Financial Feasibility and Reasonableness of Costs.**

The conversion of the 7T MRI from full-time research use to part-time clinical use will not have an adverse effect on competition in the Massachusetts healthcare market based on price, total medical expenses ("TME"), provider costs or other recognized measures of health care spending as evidenced by the information below.

On October 12, 2017, Siemens received approval from the FDA via the 510K approval process for the 7T MRI. The approval of this modality was granted as the 7T MRI is equivalent or "non-inferior" to other, lower field strength MRI systems that have already received FDA approval. Accordingly, reimbursement for these 7T scans by government and commercial payers will be the same as other MRI scans. There is no difference in the rate of reimbursement for an MRI scan due to field strength. Additionally, since a limited number of patients qualify for these scanning services (approximately 1,500 patients per year will receive these services) and since BWH clinicians will seek to use the 7T MRI for patients with challenging diagnostic problems (as a substitute for scans on existing BWH's 3T MRI or 1.5T MRI), additional capacity will not be added to the market. For these reasons, it is anticipated that the overall impact on the Massachusetts healthcare market will be negligible.

In regard to acquisition and site preparation costs, the Applicant and BWH were able to minimize these expenses as the purchase of the 7T MRI was bundled with other technology that was purchased for BWH's Building For Transformative Medicine. By bundling the technology into one contract, BWH was able to negotiate a lower purchase price for the unit. Moreover, BWH's 7T MRI is one of the first of a new generation of ultra-high field MRIs and includes design features such as magnetic stray field self-shielding (its high magnetic field's 'reach' is markedly constrained by the device itself). Therefore, it does not require a substantial amount of magnetic shielding, leading to lower site preparation costs. Finally, the 7T MRI was installed in the Building For Transformative Medicine at BWH, a new area that was designed to include capabilities for the efficient entrance and exit of new imaging hardware. Accordingly, the acquisition and siting costs were substantially lower than the costs for previously-installed MRI systems.

**F1.b.i****Public Health Value /Evidence-Based:**

**Provide information on the evidence-base for the Proposed Project. That is, how does the Proposed Project address the Need that Applicant has identified.**

As an overview, MRI is a technology that uses a magnetic field and pulses of radio waves to generate detailed images of organs, tissues, and structures inside the body.<sup>1</sup> During an MRI, a patient is placed at the center of an extremely strong magnetic field and bodily tissue information is obtained by measuring how atoms respond to pulses of radiofrequency energy

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<sup>1</sup> *Magnetic Resonance Imaging (MRI)*, NAT'L INST. OF BIOMEDICAL IMAGING & BIOENGINEERING, <https://www.nibib.nih.gov/science-education/science-topics/magnetic-resonance-imaging-mri> (last visited Sep. 25, 2017).

sent from a scanner.<sup>2</sup> MRI images provide anatomical, and in some cases functional, information that can be used to help diagnose, evaluate, plan for, monitor, and guide treatment for a variety of conditions.<sup>3</sup>

Over time, technical and engineering advances have produced MRI systems with higher field strengths, and today most clinical MRIs operate at field strengths of 1.5T or 3T.<sup>4</sup> As stated, technical and clinical imperatives exist to move to even higher field strengths, such as 7T. Previously available only for research purposes, the Siemens Healthineers 7T MRI scanner recently received FDA approval for clinical use.<sup>5</sup> Clinical application of ultra-high magnetic field strengths, such as 7T, has several advantages. Most notably, increased magnetic field strength is associated with increased signal-to-noise and increased contrast-to-noise ratios.<sup>6</sup> These improved physical characteristics can be used to generate improved image quality for certain applications, all of which result in better anatomic image quality (i.e. higher resolution images, better contrast between different tissues, and increased ability to image smaller structures with improved resolution).<sup>7</sup> It is also possible to acquire images more quickly at higher field strengths without sacrificing image quality.<sup>8</sup> In addition, 7T magnets yield increased spectral resolution for localized MR spectroscopy and produce exceptionally useful functional images that demonstrate anatomical detail, tissue function, biochemical content, and vascularity.<sup>9</sup> Finally, the 7T MRI has the ability to provide convenience for both physicians and patients; image acquisition times are shorter at higher field strengths.<sup>10</sup>

#### A. Applicant's Proposed Use of 7T MRI

Presently, the Applicant has a Siemens Healthineers 7T MRI scanner installed and available for investigational research-only applications at its Building For Transformational Medicine on the BWH campus. The Applicant proposes to use the 7T MRI unit part-time for clinical purposes and continue to research the utility of 7T MRI in diagnosis and treatment during the remaining available time. While the addition of the 7T MRI unit represents an expansion of the Applicant's overall, active clinical MRI equipment inventory (15 clinical MRI devices prior to the 7T), BWH clinicians will seek to use the 7T MRI for patients with challenging diagnostic problems (often as a substitute for scans on existing BWH 3T MRI or 1.5T MRI). In addition, the use of the 7T MRI will be restricted to those patients who meet the clinical and safety requirements for this device.

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<sup>2</sup> *Id.*

<sup>3</sup> *Id.*; *Magnetic Resonance Imaging (MRI) – Body*, RADIOLOGYINFO.ORG, <https://www.radiologyinfo.org/en/info.cfm?pg=bodymr> (last updated May 24, 2016).

<sup>4</sup> Beth W. Orenstein, *4T, 7T, 8T, and Beyond — High-Field MR Research Seeks a Closer Look Inside the Human Body*, 10 RADIOLOGY TODAY 16 (2009), available at <http://www.radiologytoday.net/archive/050409p16.shtml>.

<sup>5</sup> *FDA clears first 7T magnetic resonance imaging device*, U.S. FOOD & DRUG ADMIN., <https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm580154.htm> (last updated Oct. 12, 2017).

<sup>6</sup> Siegfried Trattnig et al., *Key clinical benefits of neuroimaging at 7 T*, NEUROIMAGE (2016), available at [https://ac.els-cdn.com/S1053811916306516/1-s2.0-S1053811916306516-main.pdf?\\_tid=bade4f66-bd91-11e7-9d36-00000aab0f6b&acdnat=1509382106\\_b7712d3a62f4ef34164342cf1a6d5740](https://ac.els-cdn.com/S1053811916306516/1-s2.0-S1053811916306516-main.pdf?_tid=bade4f66-bd91-11e7-9d36-00000aab0f6b&acdnat=1509382106_b7712d3a62f4ef34164342cf1a6d5740); Hyeong Cheol Moon et al., *Comparison of 3 and 7 Tesla Magnetic Resonance Imaging of Obstructive Hydrocephalus Caused by Tectal Glioma*, 4 BRAIN TUMOR RES & TREAT 150, 150-54 (2016), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5114189/pdf/btr-4-150.pdf>.

<sup>7</sup> Orenstein, *supra* note 4; Trattnig et al., *supra* note 6; Moon et al., *supra* note 6.

<sup>8</sup> Moon et al., *supra* note 6.

<sup>9</sup> Orenstein, *supra* note 4; Trattnig et al., *supra* note 6.

<sup>10</sup> Moon et al., *supra* note 6.

Research into the various uses and benefits of 7T MRI is ongoing, with studies focusing on specific diseases, as well as parts of the body that may benefit from this imaging modality. Neurological diseases and musculoskeletal conditions that involve the cartilage, muscle, and fascia of the knee joint are initial targets for clinical use of the 7T MRI. The recent FDA clearance of this 7T MRI for clinical use, as well as the optimal placement of the BWH 7T device in close proximity to patients with neurologic and musculoskeletal diseases (the BWH outpatient facilities for neurological and musculoskeletal diseases sit two/three floors above the MRI) create an enormous opportunity to use the scanner for advanced patient care. Clinical application of the 7T MRI scanner in the diagnosis and treatment planning for the identified clinical conditions is further supported by BWH's patient panel need; historical volume trends for MRI services at BWH suggest that the number of MRI scans performed each year will continue to increase into the future, and BWH's patient panel data indicate high neurologic and musculoskeletal disease/trauma burden (with 9,052 patients potentially eligible for treatment).

#### B. Research Supporting the Clinical Utility of 7T MRI Technology

Enumerated below are the current clinical opportunities for the 7T MRI modality. This review focuses on diseases in the brain and the knee where existing, lower field strength magnets have not fully answered clinical questions and where research has demonstrated the tremendous value of 7T images. Over time and as research continues, additional hardware and software will be developed to expand 7T imaging to other regions and more clinical protocols will be developed.

##### Neurological Diseases

High and ultra-high magnetic field imaging, such as 7T MRI, permits noninvasive visualization of the brain in unprecedented detail with enhanced contrast mechanisms.<sup>11</sup> The increased signal-to-noise and enhanced contrast available at 7T enables higher resolution anatomic and vascular imaging; the greater spectral separation improves detection and characterization of metabolites; and enhanced blood oxygen level-dependent contrast affords higher resolution functional imaging.<sup>12</sup> These improved imaging methods available at 7T may be applied to detect subtle anatomic, functional, and metabolic abnormalities associated with a wide range of neurologic disorders and diseases.<sup>13</sup> Specific clinical applications for 7T MRI in the brain include MS, cerebrovascular diseases, degenerative diseases, brain tumors and epilepsy.<sup>14</sup>

The most evident advantage at 7T in neuroimaging is to gain higher spatial resolution and contrast for imaging gray and white matter diseases, such as MS.<sup>15</sup> Cortical lesions in the gray matter, which are important in gaining more insight into the pathogenesis of MS, remain an imaging challenge at 1.5T and 3T because of the lower resolution that can be attained at lower field strengths and the reduced contrast between the lesion and its surrounding tissue.<sup>16</sup> Studies

<sup>11</sup> P. Baichandani & T.P. Naidich, *Ultra-High-Field MR Neuroimaging*, 36 AM. J. NEURORADIOLOGY 1204, 1204-15 (2015), available at <http://www.ajnr.org/content/ajnr/36/7/1204.full.pdf>.

<sup>12</sup> *Id.*

<sup>13</sup> *Id.*

<sup>14</sup> *Id.*; Anja G. van der Kolk et al., *Clinical applications of 7 T MRI in the brain*, 82 EUR. J. RADIOLOGY 708, 708-18 (2013), available at [https://ac.els-cdn.com/S0720048X11006450/1-s2.0-S0720048X11006450-main.pdf?\\_tid=bf2673f0-bd91-11e7-a529-00000aabb0f6b&acdnat=1509382113\\_641faa6cdfc2d6d60856781f1d1039a9](https://ac.els-cdn.com/S0720048X11006450/1-s2.0-S0720048X11006450-main.pdf?_tid=bf2673f0-bd91-11e7-a529-00000aabb0f6b&acdnat=1509382113_641faa6cdfc2d6d60856781f1d1039a9).

<sup>15</sup> Trattig et al., *supra* note 9

<sup>16</sup> Van der Kolk et al., *supra* note 14.

show that the 7T MRI has particular clinical utility in this regard.<sup>17</sup> 7T imaging permits increased detection of changes in cortical structure, like the visualization of cortical plaques in MS, and the number of detected cortical lesions has been shown to be higher at 7T than at 3T, with about 30-50% of histopathologically confirmed cortical MS lesions being detected at 7T.<sup>18</sup> In addition, 7T MRI also is useful in classifying lesions at the cortical boundary; in patients with MS, cortical lesions can be more precisely classified as cortical, cortical-subcortical, or solely subcortical occurring due to the higher spatial resolution at 7T in comparison to 3T.<sup>19</sup> Other features that are potentially pathognomonic of MS that are more reliably detected and visualized via the 7T include central veins in white matter lesions and iron deposits in brain parenchyma.<sup>20</sup> This capability to improve early diagnosis is important as it provides neurologists with more accurate, quantitative, longitudinal data about disease burden and affects directly how and what medical therapies are used in patients with MS.

The 7T MRI has also shown promise in the diagnosis and characterization of cerebrovascular diseases. First, it has been found that microbleed detection is superior at 7T compared to lower field strengths.<sup>21</sup> With the lower resolution that accompanies lower field strengths, small microbleeds may not appear on an MRI scan at a lower field strength; however, the increased susceptibility and spatial resolution attained at the 7T field strength permits smaller microbleeds to be imaged.<sup>22</sup> The appearance of aneurysms can also be assessed with the 7T MRI; the improved spatial resolution allows for visualization of ever-smaller arteries, as well as anatomic details of aneurysms, including the presence of small perforating branches which can result in infarction if unnoticed.<sup>23</sup> Finally, 7T MRI enhances detection and characterization of intracranial atherosclerosis, which is the narrowing and blockage of the blood vessels that supply the brain.<sup>24</sup> Visualization of the arterial lumen (i.e., inside space of vessel) only gives information regarding possible stenosis, but does not give information regarding the nature of this narrowing; for this, visualization of the intracranial vessel wall itself is necessary.<sup>25</sup> Significantly, the high signal-to-noise ratio at 7T may be exploited for an increased resolution that makes it possible to directly depict the intracranial vessel wall, determine the nature of the stenosis, and plan intervention accordingly.<sup>26</sup>

Another neurological clinical application of the 7T MRI is detection and treatment of degenerative diseases. An early pathologic change in Alzheimer's disease is neuronal loss in specific substructures of the hippocampus.<sup>27</sup> High-resolution hippocampal imaging at 7T has been proposed as an effective tool for revealing these changes; several comparative studies have shown that the 7T provides more anatomical detail in the evaluation of the hippocampus and substructures compared to the 1.5T and 3T MRI, by means of higher contrast between white and gray matter.<sup>28</sup> Additionally, studies with 7T MRI have been performed in patients with Parkinson's disease.<sup>29</sup> Generally, the studies have been directed at visualizing the substantia

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<sup>17</sup> Trattng et al., *supra* note 9; Balchandani & Naidich, *supra* note 11.

<sup>18</sup> Trattng et al., *supra* note 9.

<sup>19</sup> *Id.*; Balchandani & Naidich, *supra* note 11.

<sup>20</sup> Van der Kolk et al., *supra* note 14.

<sup>21</sup> *Id.*

<sup>22</sup> *Id.*

<sup>23</sup> *Id.*

<sup>24</sup> *Id.*

<sup>25</sup> *Id.*

<sup>26</sup> *Id.*

<sup>27</sup> Balchandani & Naidich, *supra* note 11.

<sup>28</sup> *Id.*; Van der Kolk et al., *supra* note 14.

<sup>29</sup> Van der Kolk et al., *supra* note 14.

nigra, which is thought to play a primary role in the pathogenesis of Parkinson's disease, and at imaging deep brain stimulation targets for treatment, such as the subthalamic nucleus and internal globus pallidus.<sup>30</sup> These studies show that 7T MRI can distinguish sub-regions of the substantia nigra and provide visualization of differences in anatomical patterns of the substantia nigra between healthy controls and Parkinson's disease patients, thereby possibly enabling earlier diagnosis of the disease; and that the 7T MRI is superior in delineating deep brain stimulation target areas for treatment compared to 1.5T and 3T.<sup>31</sup>

Finally, the 7T MRI shows promise in the diagnosis, classification, and treatment of brain tumors and epilepsy. With respect to brain tumors, ultra-high field MRI imaging can be applied to better visualize pathology.<sup>32</sup> For instance, 7T MRI images may show more precise delineation of the arterial cerebral microvasculature and provide additional information regarding delineation of more rare tumors.<sup>33</sup> Improved detail of tumor metabolism is also possible with the ultra-high magnetic field strength.<sup>34</sup> With regard to epilepsy, the improved spatial resolution, signal-to-noise ratio, and novel contrast mechanisms available at 7T show structural and biochemical abnormalities in greater detail, which is useful in delineating seizure foci, aiding in surgical planning, and improving patient outcomes.<sup>35</sup> Specifically, 7T studies have shown value for improved detection and characterization of small areas of cortical dysplasia, hippocampal sclerosis, and vascular malformations associated with epilepsy (i.e. epileptic lesions not currently seen, or seen well, at lower field strengths).<sup>36</sup> Such detection of abnormalities not visible at 1.5T or 3T is not only diagnostically valuable, but is also significant in that it may obviate the need for invasive evaluation or may provide the information needed to establish concordance with invasive evaluations.<sup>37</sup>

#### Musculoskeletal System – Knee

In addition to neurological diseases, various studies suggest high clinical effectiveness of the 7T MRI in musculoskeletal imaging, specifically with respect to the knee.<sup>38</sup> One promising application relates to assessment of trabecular bone microarchitecture, which is an important determinant of bone fragility.<sup>39</sup> The 7T MRI system's ability to facilitate ultra-high morphological imaging with improved signal-to-noise ratios and resolution is significant in obtaining more precise quantitative assessments of trabecular bone structure.<sup>40</sup> Specifically, studies have shown the 7T MRI's ability to more precisely and accurately image and detect important changes in trabecular bone microstructure (e.g., adaptation, deterioration, etc.) in response to intense mechanical loading/trauma and osteoarthritis.<sup>41</sup> Other applications of the 7T MRI on the

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<sup>30</sup> *Id.*

<sup>31</sup> *Id.*

<sup>32</sup> *Id.*; Balchandani & Naidich, *supra* note 11.

<sup>33</sup> Van der Kolk et al., *supra* note 14; Balchandani & Naidich, *supra* note 11.

<sup>34</sup> Van der Kolk et al., *supra* note 14; Balchandani & Naidich, *supra* note 11.

<sup>35</sup> Van der Kolk et al., *supra* note 14; Balchandani & Naidich, *supra* note 11.

<sup>36</sup> Van der Kolk et al., *supra* note 14; Balchandani & Naidich, *supra* note 11.

<sup>37</sup> Balchandani & Naidich, *supra* note 11.

<sup>38</sup> Neal K. Bangarter et al., *Quantitative techniques for musculoskeletal MRI at 7 Tesla*, 6 *QUANT IMAGING MED & SURG* 715, 715-30 (2016), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5219959/pdf/qims-06-06-715.pdf>.

<sup>39</sup> *Id.*; Ravinder R. Regatte & Mark E. Schweitzer, *Ultra-high-field MRI of the musculoskeletal system at 7.0T*, 25 *J. MAGNETIC RESONANCE IMAGING* 262, 262-69 (2007), available at <http://onlinelibrary.wiley.com/doi/10.1002/jmri.20814/epdf>.

<sup>40</sup> Regatte & Schweitzer, *supra* note 39.

<sup>41</sup> Gregory Chang et al., *Adaptations in Trabecular Bone Microarchitecture in Olympic Athletes Determined by 7T MRI*, 27 *J. MAGNETIC RESONANCE IMAGING* 1089, 1089-95 (2008), available at

knee include superior imaging of the collagen ultrastructure and makeup in osteoarthritis and collagen grafts (e.g., assessment of proteoglycan content in cartilage), detection of small morphological changes in cartilage over time, and tendon and soft-tissue imaging.<sup>42</sup>

**F.1.b.ii Public Health Value /Outcome-Oriented:**  
**Describe the impact of the Proposed Project and how the Applicant will assess such impact. Provide projections demonstrating how the Proposed Project will improve health outcomes, quality of life, or health equity. Only measures that can be tracked and reported over time should be utilized.**

**A. Conversion of 7T MRI from Research to Part-Time Clinical Use**

Massachusetts residents benefit from access to premier healthcare institutions. One key aspect to healthcare in the Commonwealth is the industry's commitment to innovation and leadership in patient care, as well as the investment in basic and translational research by academic medical centers. This dedication to implementing new technology that may lead to new treatments means the quality of clinical care in the state is unsurpassed by other areas in the nation.

In particular, the field of medical imaging, as well as scientific and clinical innovation, have been "signposts" of advances in medicine, in general, and in the Commonwealth. The Radiology Department at BWH consistently ranks in the top ten awardees in the nation for National Institutes of Health ("NIH") grant support. According to publicly available data summarized annually by the Academy of Radiology and Biomedical Imaging Research, in FY16, approximately 19.3% of all NIH grants to imaging scientists in the country were provided to physician-scientists in Massachusetts.<sup>43</sup> BWH's radiologists have led the nation in the application of emerging technologies, such as CT scan, MRI, PET scan and image-guided, minimally invasive therapies.

The addition of the first FDA-approved ultra-high field MRI to the Commonwealth's inventory of advanced medical technologies is fitting and appropriate. As outlined above, the early clinical applications of this technology will be in the fields of neuroscience and musculoskeletal diseases. The Commonwealth hosts many of the best programs in the nation in these two disease areas. Accordingly, BWH's physicians and patients will benefit from having the 7T MRI available at BWH's Building For Transformative Medicine, the facility that houses all of the BWH ambulatory clinics for neuroscience and musculoskeletal disease patients at BWH's main campus.

Based on a review of literature, experience and staff discussions with other facilities that already own a 7T MRI, BWH staff project that in the initial phase of the 7T MRI program, approximately 1,500 patients will be scanned annually. An additional 500 patients will have translational research examinations each year. These scans will evaluate disease progression and determine the best path for care. Through the utilization of the 7T MRI, clinical staff will have

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<http://onlinelibrary.wiley.com/doi/10.1002/jmri.21326/epdf>; Gregory Chang et al., *Reproducibility of subregional trabecular bone micro-architectural measures derived from 7-Tesla magnetic resonance images*, 24 MAGMA 121, 121-25 (2011), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3710719/pdf/nihms-488218.pdf>.

<sup>42</sup> Bangerter et al., *supra* note 38.

<sup>43</sup> THE ACADEMY FOR RADIOLOGY & BIOMEDICAL IMAGING RESEARCH, <http://www.acadrad.org/> (last visited Oct. 30, 2017).

increased capacity to review a patient's MRI scans for neurological and musculoskeletal disorders, leading to improved care and ultimately to overall better health outcomes for patients.

#### B. Assessing the Impact of the Proposed Project

To assess the impact of the conversion of the 7T MRI to part-time clinical use, BWH has developed the following quality metrics and reporting schematic, as well as metric projections for quality indicators that will measure patient satisfaction, access and quality of care. The measures are discussed below:

1. **Quality of Care – Quality of the 7T Image:** The quality of a MRI scan is imperative to its interpretation. Accordingly, BWH will evaluate the number of scans that need to be repeated because of insufficient image quality over the course of 30 days to ensure radiology technicians are performing scans optimally and that the device is functioning within norms.

**Measure:** The percentage of examinations that need to be repeated within 30 days due to technical inadequacy.

**Projections:** Baseline: 0.5% Year 1: 0.5-1.0% Year 2: 0.5-1.0% Year 3: 0.5-1.0%

**Monitoring:** This data will be provided on an annual basis.

2. **Access – Waiting Times for Patients:** The proposed Project seeks to ensure access to 7T MRI services. Accordingly, BWH will track the time to appointment, as well as the time it takes a patient to be seen upon arrival and to be scanned.

- a. **Measure – Time to Next Available Outpatient Appointment:** The time (in days) to the next available outpatient appointment

**Projections:** Baseline: 3 days Year 1: 3 days Year 2: 3 days Year 3: 3 days

**Monitoring:** This data will be provided on an annual basis.

- b. **Measure – Waiting Time after Patient Arrival:** The amount of time (in minutes) between a patient arriving at the clinic for MRI services and beginning scan services.

**Projections:** Baseline: 36 minutes Year 1: 36 minutes Year 2: 36 minutes Year 3: 36 minutes

**Monitoring:** This data will be provided on an annual basis.

- F1.b.iv Provide additional information to demonstrate that the Proposed Project will result in improved health outcomes and quality of life of the Applicant's existing Patient Panel, while providing reasonable assurances of health equity.**

BWH's 7T MRI has the potential to improve early diagnosis and monitor responses to therapy for neurological and musculoskeletal conditions. For these patients, this technology may lead to new treatments and the ability to respond to a condition in an expedited manner. Moreover, during a period of "clinical transition," BWH's staff expect the use of BWH's 7T MRI to begin

replacing the use of existing, lower field strength MRI units for use in specialized neurologic and musculoskeletal conditions. This will lead to expedited quality care as better imaging information allows clinicians to determine the best treatments; thereby, leading to improved health outcomes for patients.

**F1.c Provide evidence that the Proposed Project will operate efficiently and effectively by furthering and improving continuity and coordination of care for the Applicant's Patient Panel, including, how the Proposed Project will create or ensure appropriate linkages to patients' primary care services.**

To ensure continuity of care, improved health outcomes and enhanced quality of life, through the proposed Project, BWH's radiology staff will utilize BWH's electronic health record ("EHR") to share images and provide follow-up information to a patient's primary care and specialty physicians. Additionally, patients utilizing the 7T MRI will be linked with the necessary services to address social determinant of health ("SDoH") issues. Providing patients with linkages to these necessary services prevents unnecessary readmissions, ensures appropriate care management and provides the patient with the necessary resources for leading a better life.

**Factor 2: Health Priorities**

**Addresses the impact of the Proposed Project on health more broadly (that is, beyond the Patient Panel) requiring that the Applicant demonstrate that the Proposed Project will meaningfully contribute to the Commonwealth's goals for cost containment, improved public health outcomes, and delivery system transformation.**

**F2.a. Cost Containment:  
Using objective data, please describe, for each new or expanded service, how the Proposed Project will meaningfully contribute to the Commonwealth's goals for cost containment.**

As previously discussed in this application, the 7T MRI purchase cost was bundled into a larger package of clinical and research devices negotiated in connection with the construction of BWH's Building For Transformative Medicine. In addition, due to the FDA clearance pathway utilized by Siemens for the 7T MRI, clinical scans on this device will be reimbursed at the same rates as existing MRI units with field strengths of 1.5T or 3T. For these reasons, and despite the substantial clinical benefits delivered to citizens of the Commonwealth by the introduction of this novel ultra-high field MRI, the addition of a 7T MRI will not impact the cost benchmark set for the Commonwealth as the technology will improve the diagnosis accuracy of hard to diagnose conditions and thereby eliminate the utilization of less effective and inconclusive scans and tests.

**F2.b. Public Health Outcomes:  
Describe, as relevant, for each new or expanded service, how the Proposed Project will improve public health outcomes.**

Since BWH's 7T MRI is currently the only installed modality of its kind in New England, all patients in and around New England will be provided access to the BWH 7T MRI. This technology will be used for specific patient conditions to improve care outcomes as existing imaging tools do not have the capability to provide the level of detail available in a 7T MRI study. With this enhanced diagnostic capability, clinicians can develop more tailored treatment plans and diagnose conditions and severity sooner, ultimately leading to improved public health

outcomes for this subset of the population. Through the use of high resolution images, clinicians can determine the best course of treatment for a patient. Accordingly, this technology will have a significant impact on patients with neurologic conditions, as well as patients with musculoskeletal conditions/diseases.

**F2.c. Delivery System Transformation:**

**Because the integration of social services and community-based expertise is central to goal of delivery system transformation, discuss how the needs of their patient panel have been assessed and linkages to social services organizations have been created and how the social determinants of health have been incorporated into care planning.**

To address issues associated with the SDoH and to ensure all patients have equal access to care, BWH has developed a robust social work program that facilitates linkages to social service organizations, as well as to clinical services, such as collaborative relationships with primary care clinicians. For underserved patients, these linkages may mean obtaining the care that they need in a timely fashion or obtaining necessary psycho-social supports to get well. The BWH 7T MRI will add a unique clinical asset to the BWH armamentarium that will be available to all patients. In addition to the initial clinical focus for the 7T MRI (e.g., MS, epilepsy, etc.), through its ongoing research program using the 7T MRI, BWH clinicians will investigate conditions where the increased resolution of this device will assist primary care physicians with more precise, definitive diagnoses for patients, enabling better and more effective care for some of the most difficult conditions affecting our patients.

**Factor 5: Relative Merit**

**F5.a.i Describe the process of analysis and the conclusion that the Proposed Project, on balance, is superior to alternative and substitute methods for meeting the existing Patient Panel needs as those have been identified by the Applicant pursuant to 105 CMR 100.210(A)(1). When conducting this evaluation and articulating the relative merit determination, Applicant shall take into account, at a minimum, the quality, efficiency, and capital and operating costs of the Proposed Project relative to potential alternatives or substitutes, including alternative evidence-based strategies and public health interventions.**

**Proposal:** The proposed Project is to convert the 7T MRI from full-time research use to part-time clinical use, so that patients with neurologic or musculoskeletal conditions/disease may have access to advanced imaging that can improve diagnosis and treatment and expedite care.

**Quality:** The proposed Project is a superior alternative for providing high quality MRI services and improving health outcomes as clinicians will have higher resolution and better quality images that will impact prescribed clinical treatments.

**Efficiency:** The use of 7T MRI images to determine appropriate treatment for specific patients creates efficiencies by ensuring the efficacy of treatment. Through use of the 7T MRI, a physician will be able to determine if specific treatments will be more effective on a patient. Accordingly, this eliminates the need to try multiple treatment courses, which wastes time and money.

**Capital Expense:** As noted, the capital expenses for this project are limited, as BWH already owns the unit for research purposes and accordingly there is no new capital expenditure involved with the conversion of the unit to part time use. Further, the unit was purchased through a bulk purchase from the manufacturer. Additionally, reimbursement for 7T MRI services will be the same as lower strength MRI units.

**Operating Costs:** These costs include staff, medical supplies and ongoing maintenance of the machine, but are minimal as patients receiving these services would be receiving scans via a 3T MRI if not performed on the 7T MRI.

**List alternative options for the Proposed Project:**

**Option 1**

**Alternative Proposal:** The alternative option for the proposed Project would be to continue to use the 7T MRI for research use only.

**Alternative Quality:** If the 7T MRI is left solely as a research-only based unit, approximately 1,500 patients per year would not have access to these needed imaging services that will help determine a more appropriate course of treatment in an expedited manner.

**Alternative Efficiency:** Without the conversion of the 7T MRI to part-time clinical use, patients will be forced to try various treatments for neurologic and musculoskeletal conditions, rather than having an image that will help a physician decipher the best course of treatment.

**Alternative Capital Expenses:** Although leaving the 7T MRI for research use does not have financial implications associated with it, the expense of not converting the unit may impact many local residents because the cost of care may be increased through the need for trial and error of treatment plans developed without the benefit of the detailed imaging the 7T MRI can offer.

**Alternative Operating Costs:** There would be no operating costs associated with leaving the machine as research-based.

## 2. Project Description

### Factor 1: Applicant Patient Panel Need, Public Health Values and Operational Objectives

#### F1.a.i

##### Patient Panel:

**Describe your existing Patient Panel, including incidence or prevalence of disease or behavioral risk factors, acuity mix, noted health disparities, geographic breakdown expressed in zip codes or other appropriate measure, demographics including age, gender and sexual identity, race, ethnicity, socioeconomic status and other priority populations relevant to the Applicant's existing patient panel and payer mix.**

#### A. Relevant Patient Projections for the Radiation Therapy-Dedicated MRI Simulator

BWH has four computerized axial tomography ("CT") simulators installed and available for clinical use in radiation oncology; three at the BWH campus and one at its Milford satellite location. The BWH campus also has one fluoroscopic simulator, which is very antiquated and needs replacement. Rather than replace the nearly obsolete fluoroscopic simulator with an additional CT simulator, the Applicant proposes to introduce a Radiation Therapy-dedicated MRI simulator ("RT-MRI simulator"), which is superior to CT simulation for many applications, to the BWH campus. The proposed RT-MRI simulator will replace the fluoroscopic simulator and thus is not providing additional RT simulator capacity for the hospital; rather RT simulation for certain cancers will be performed on the RT-MRI simulator. Currently, there are no RT-MRI simulators performing RT simulation and MR-guided brachytherapy in the Commonwealth. The acquisition by BWH of a RT-MRI simulator will result in the first time this modality and its benefits will be available to patients in the region.

The BWH/Dana-Farber Cancer Institute ("DFCI") patient panel data demonstrates<sup>1</sup> the prevalence in the panel of cancers that may be treated with RT and thus would benefit from improved RT planning. In FY17, BWH/DFCI provided RT to patients with the following cancers, for which planning via a RT-MRI simulator is indicated: 562 Brain and central nervous system ("CNS"); 174 Head and Neck; 368 genitourinary ("GU"); and 233 Gynecological cancer patients. In addition, RT planning for BWH/DFCI patients on BWH's existing CT simulators represented 3,216 scans in CY15 and 3,421 scans in CY16. Based on historical utilization of RT for certain cancers, BWH projects the RT-MRI simulator will be used in treatment planning for a total of 276 patients in 2019; 1,103 in 2020; 1,125 in 2021; 1,148 in 2022; and 1,171 in 2023. Moreover, as further discussed below, MRI simulator guided brachytherapy for gynecologic cancers results in more optimal treatment planning. In FY15, 120 gynecologic brachytherapy procedures performed at BWH would have been optimally guided with a RT-MRI simulator. The historical demand within the BWH/DFCI patient panel and projected population trends support the replacement of the hospital's existing fluoroscopic simulator with a RT-MRI simulator

#### B. Relevant Patient Projections for the MRI-Guided Linear Accelerator

BWH operates four linear accelerators ("LINACs") at its main campus plus one Cobalt Gamma

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<sup>1</sup> For statistical purposes, the data will include patients treated at the Dana-Farber Cancer Institute ("DFCI") and BWH. The DFCI does not provide simulation and treatment planning for their patients and contracts with the BWH to provide these services.

Beam device. BWH also has one LINAC at its satellite location in Milford. The MRI-LINAC is a cutting-edge technology that has only recently been developed (FDA approved in 2017) and deployed in clinical operation.<sup>2</sup> Currently, there are no MRI-LINACs available to patients in the Commonwealth. The acquisition by BWH of a MRI-LINAC will result in the first time this modality and its benefits will be available to patients in the region.

The BWH/DFCI patient panel data<sup>3</sup> indicate the prevalence in the panel of specific cancers that may be treated with RT, but that require more precise radiation accuracy than can be provided with a conventional LINAC. These patients would benefit from enhanced image-guided RT via an MRI-LINAC device. Specifically, in FY17, BWH/DFCI provided RT to patients with the following cancers, for which RT with a MRI-LINAC is indicated: 146 gastrointestinal ("GI"); 33 pancreatic; 368 GU; 233 gynecological, 18 liver, and 409 breast cancer patients. Moreover, historical RT volume trends, as well as population projections that indicate an aging population, suggest that the need for image-guided RT will continue to increase into the future. BWH provided 32,569 RT treatments in FY14; 33,877 in FY15; and 33,942 in FY16. Over the next three years, it is estimated that the number of patients and treatments on the MRI-LINAC will be as follows: 66 new starts and 2,278 treatments in Year 1; 154 new starts and 4,364 treatments in Year 2; and 175 new starts and 5,389 treatments in Year 3. Accordingly, to meet the need for more targeted RT for certain cancers within the aging BWH patient panel, the Applicant proposes to implement an MRI-LINAC device at the BWH main campus.

#### F1.a.ii

##### **Need by Patient Panel:**

**Provide supporting data to demonstrate the need for the Proposed Project. Such data should demonstrate the disease burden, behavioral risk factors, acuity mix, health disparities, or other objective Patient Panel measures as noted in your response to Question F1.a.i that demonstrates the need that the Proposed Project is attempting to address. If an inequity or disparity is not identified as relating to the Proposed Project, provide information justifying the need. In your description of Need, consider the principles underlying Public Health Value (see instructions) and ensure that Need is addressed in that context as well.**

As discussed above, statewide population projections provided by the University of Massachusetts' Donahue Institute suggest that population growth in Massachusetts is expected to increase through 2035.<sup>4</sup> As the number of BWH patients in the 55+ age cohort continues to increase, the need for innovative technologies, such as a RT-MRI simulator and a MRI- LINAC are needed to meet increased demand for detecting, managing, and treating specific cancers.

Research-based findings demonstrate that the prevalence of cancer increases with age.<sup>5</sup> Persons over 65 comprise 60% of newly diagnosed malignancies and 70% of all cancer

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<sup>2</sup> *First Patients Treated with ViewRay's MRIdian Linac System at Henry Ford Health System*, PR NEWSWIRE (Jul. 20, 2017), <https://www.pnewswire.com/news-releases/first-patients-treated-with-viewrays-mridian-linac-system-at-henry-ford-health-system-300491295.html>.

<sup>3</sup> For statistical purposes, the data will include patients treated at the DFCI and BWH. DFCI patients will benefit from the capabilities of this new MRI-LINAC device.

<sup>4</sup> UNIVERSITY OF MASSACHUSETTS DONAHUE INSTITUTE, LONG-TERM POPULATION PROJECTIONS FOR MASSACHUSETTS REGIONS AND MUNICIPALITIES 11 (Mar. 2015), available at [http://pep.donahue-institute.org/downloads/2015/new/UMDI\\_LongTermPopulationProjectionsReport\\_2015%2004%20\\_29.pdf](http://pep.donahue-institute.org/downloads/2015/new/UMDI_LongTermPopulationProjectionsReport_2015%2004%20_29.pdf).

<sup>5</sup> Nathan A. Berger et al., *Cancer in the Elderly*, 117 TRANSACTIONS OF THE AM. CLINICAL & CLIMATOLOGICAL ASSOC. 147, 147-56 (2006), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1500929/pdf/tacca117000147.pdf>.

deaths.<sup>6</sup> The incidence of cancer in individuals over 65 is 10 times greater than in those younger than 65.<sup>7</sup> The cancer death rate is 16 times greater in patients over 65 compared to younger patients.<sup>8</sup>

In Massachusetts, from 2009 through 2013, there were 183,009 newly diagnosed cases of cancer, for an average annual age-adjusted incidence rate of 480.4 cases per 100,000 persons. Overall, cancer incidence in Massachusetts slightly decreased from 2009 to 2013.<sup>9</sup> The most commonly diagnosed type of cancer in Massachusetts for men during this time period was prostate cancer, followed by cancers of the bronchus and lung, colon/rectum, and urinary bladder.<sup>10</sup> Among women in Massachusetts, the most commonly diagnosed cancer types were cancers of the breast, bronchus and lung, colon/rectum, and corpus uteri (uterus). From 2009 to 2013, there were 64,543 deaths from cancer among Massachusetts residents, for an average annual age-adjusted mortality rate of 162.9 deaths per 100,000 persons.<sup>11</sup> Similar to newly diagnosed cases, cancer mortality in Massachusetts decreased from 2009 to 2013.<sup>12</sup> However, cancer is still the leading cause of death in the Commonwealth. Accordingly, to address demand for radiation-based cancer treatment, BWH plans to acquire a RT-MRI simulator that may be used for RT treatment techniques (e.g., external beam radiation therapy and brachytherapy). In addition, BWH plans to acquire a MRI-LINAC that will provide real-time MRI imaging of a tumor during treatment. These innovative technologies will allow specific types of cancer patients to receive better treatment resulting in higher quality care and improved health outcomes, as well as improved quality of life.

#### F1.a.iii

##### **Competition:**

**Provide evidence that the Proposed Project will compete on the basis of price, total medical expenses, provider costs, and other recognized measures of health care spending. When responding to this question, please consider Factor 4, Financial Feasibility and Reasonableness of Costs.**

#### A. Acquisition of the RT-MRI Simulator

The proposed Project has no material impact on provider price, total medical expenses ("TME") or provider costs. Costs for MRI scans obtained on the RT-MRI simulator are currently bundled into RT reimbursement codes for external beam RT planning, and therefore there is no increase to costs on a per patient basis for these therapies. Moreover, the rate of reimbursement for treatment planning on a RT-MRI simulator is the same as planning performed on a CT simulator. As a result, there is no difference in reimbursement by shifting appropriate cases to a RT-MRI simulator for RT treatment planning.

Additionally, cost savings will be generated based on care efficiencies and costs avoided by minimizing complications from cancer treatments. First, current RT planning includes MRI

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<sup>6</sup> *Id.*

<sup>7</sup> *Id.*

<sup>8</sup> *Id.*

<sup>9</sup> *Massachusetts Cancer Statistics*, COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF HEALTH AND HUMAN SERVICES, <http://www.mass.gov/eohhs/gov/departments/dph/programs/community-health/cancer-age/massachusetts-cancer-statistics.html> (last visited Oct. 31, 2017).

<sup>10</sup> *Id.*

<sup>11</sup> *Id.*

<sup>12</sup> *Id.*

scans. However, these scans are conducted on diagnostic radiology scanners that are not optimal for radiation planning (there may be issues with patient placement or imaging parameters). Accordingly, MRIs are often repeated on cancer patients prior to treating with RT. This duplicative testing, although necessary given the capability of current technology, is inefficient and costly to the overall healthcare market. Therefore, the acquisition and implementation of the RT-MRI simulator will assist in decreasing overall healthcare spending.

Finally, the RT-MRI simulator has proven benefits for cancer patients as it reduces toxicity levels from radiation to other organs and improves tumor control via brachytherapy and external beam RT. These benefits translate into cost savings as a reduction in toxicity levels leads to less frequent hospital visits and inpatient stays. Moreover, improving tumor control improves the morbidity and mortality associated with specific cancers, again, reducing inpatient and hospital visits. For these reasons, the proposed Project will have a positive impact on the healthcare market as it will reduce the amount of unnecessary hospital admissions and readmissions for specific cancer patients by providing targeted, appropriate and high-quality treatment.

## B. Acquisition of the MRI-LINAC

Implementation of a MRI-LINAC at BWH will also achieve cost savings. A LINAC is often used to treat soft tissue tumors, including prostate, breast, GI, head and neck, and gynecological cancers. The unique capabilities of the MRI-LINAC to deliver precise RT and adapt treatment parameters in real-time allows for radiation dose escalation levels, which cannot be achieved in current technologies. The escalation of dose to a patient shortens the course of treatment; thereby, reducing the costs of cancer care, while improving health outcomes for patients. Additionally, given the MRI-LINAC's ability to visualize soft tissue structures, there is the potential to reduce toxicity through more refined parameters and allow for more widespread adoption of cost-effective cancer treatments.

**F1.b.i**      **Public Health Value /Evidence-Based:**  
**Provide information on the evidence-base for the Proposed Project. That is, how does the Proposed Project address the Need that Applicant has identified.**

### A. RT-MRI Simulator

#### 1. Overview

Although many forms of diagnostic imaging are routinely used in RT treatment planning, a dedicated imaging simulation treatment planning approach is essential in providing accurate RT and minimizing adverse secondary outcomes.<sup>13</sup> At a high-level, such planning ensures that patients get the full benefit of radiation with minimal impact on other parts of the body.<sup>14</sup> More specifically, cancer treatment with RT treatment techniques (e.g., external beam radiation therapy and brachytherapy) requires pre-treatment information regarding the patient's anatomy – such as the precise location and positioning of the tumor, the definition of the tumor and

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<sup>13</sup> M. KÖHLER ET AL., MR-ONLY SIMULATION FOR RADIOTHERAPY PLANNING (2015), available at [http://incenter.medical.philips.com/doclib/enc/11228039/4522\\_991\\_11581\\_MR\\_RT\\_Ingenia\\_White\\_Paper.pdf%3ffunc%3ddoc.Fetch%26nodeid%3d11228039](http://incenter.medical.philips.com/doclib/enc/11228039/4522_991_11581_MR_RT_Ingenia_White_Paper.pdf%3ffunc%3ddoc.Fetch%26nodeid%3d11228039).

<sup>14</sup> *The Radiation Planning Session (Simulation)*, BREASTCANCER.ORG, <http://www.breastcancer.org/treatment/radiation/types/ext/expect/simulation> (last updated May 30, 2013).

normal tissues, the tissue attenuation properties necessary for dose calculations, and identification of organs at risk – in order to maximize the effects of RT on tumor cells and minimize toxicity elsewhere.<sup>15</sup> For these reasons, it is imperative to simulate treatment and image the patient in the position that the patient will be treated in in order to obtain accurate visualization of the tumor and organs at risk, determine and target the precise area to be treated, calculate the correct dosages, and ensure accuracy of the treatment plan.<sup>16</sup>

A RT-MRI simulator is an MRI scanner that has been adapted to allow patients to be immobilized and imaged in the treatment position, which greatly increases the precision and accuracy of RT planning and subsequent delivery.<sup>17</sup> Although CT has long been the primary imaging modality for treatment planning, the RT-MRI simulator allows for more accurate target definition.<sup>18</sup> In comparison to CT, MRI provides superior soft-tissue contrast, which allows for more precise and reliable determinations of tumor location and volume, particularly in regions such as the brain, head and neck, prostate, and female reproductive system.<sup>19</sup> The RT-MRI simulator's ability to improve the delineation of tumors allows clinicians to target radiation delivery more accurately to the cancer and reduce the size of the region that is irradiated and the radiation exposure to surrounding organs, which in turn leads to improved cancer control outcomes and reduced toxicity, respectively.<sup>20</sup> Other acknowledged benefits of RT-MRI simulation include dynamic imaging techniques for motion assessment; functional imaging, which provides the ability to plan RT based on the underlying biology of the cancer to further improve outcomes; and lack of ionizing radiation exposure, which provides the opportunity of multiple patient examinations for validation and adaptation of treatment plans.<sup>21</sup>

## 2. Research Supporting the Clinical Utility of RT-MRI Simulator

While RT-MRI simulators are not currently in clinical operation in New England, MRI simulators have been adopted around the world for planning two types of RT: external beam radiation therapy ("EBRT") and brachytherapy. As described in detail below, multiple studies have demonstrated the clinical benefits of these applications of MRI technology to RT planning, particularly with regard to brain, head and neck, prostate, and gynecological cancers.

### RT-MRI Simulator for EBRT

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<sup>15</sup> Robba Rai et al., *The integration of MRI in radiation therapy: collaboration of radiographers and radiation therapists*, 64 J. MED. RADIATION SCIENCES 61, 61-68 (2017), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5355372/pdf/JMRS-64-61.pdf>; F. Guerreiro et al., *Evaluation of a multi-atlas CT synthesis approach for MRI-only radiotherapy treatment planning*, 35 EUR. J. MED. PHYSICS 7, 7-17 (2017), available at [http://www.physicamedica.com/article/S1120-1797\(17\)30045-5/pdf](http://www.physicamedica.com/article/S1120-1797(17)30045-5/pdf).

<sup>16</sup> Rai et al., *supra* note **Error! Bookmark not defined.**; *The Radiation Planning Session (Simulation)*, *supra* note **Error! Bookmark not defined.**

<sup>17</sup> M. KÖHLER ET AL., *supra* note 13.

<sup>18</sup> *Id.*

<sup>19</sup> Guerreiro et al., *supra* note 15; Rai et al., *supra* note 15.

<sup>20</sup> Maria A. Schmidt & Geoffrey S. Payne, *Radiotherapy Planning using MRI*, 60 PHYSICS IN MED. & BIOLOGY R323, R323-61 (2015), available at <http://iopscience.iop.org/article/10.1088/0031-9155/60/22/R323/pdf>.

<sup>21</sup> M. KÖHLER ET AL., *supra* note 13; Schmidt & Payne, *supra* note 20; Christopher M. Rank et al., *MRI-based treatment plan simulation and adaptation for ion radiotherapy using a classification-based approach*, 8 RADIATION ONCOLOGY 1, 1-13 (2013), available at <https://ro-journal.biomedcentral.com/track/pdf/10.1186/1748-717X-8-51?site=ro-journal.biomedcentral.com>.

EBRT is the most common type of RT used for cancer treatment.<sup>22</sup> During EBRT, a LINAC is used to aim high-energy rays (or beams) from outside the body into the tumor in a way that allows the precise delivery of RT to the target site.<sup>23</sup> The process of EBRT involves three parts: simulation, treatment planning, and treatment delivery.<sup>24</sup> Simulation is critical, as it allows the radiation oncologist to develop a treatment plan that accounts for the patient's anatomy, adjust the position of the patient and re-focus the radiation as needed to hit the tumor and limit other damage to surrounding tissues and organs.<sup>25</sup>

Stereotactic radiation (also called stereotactic radiosurgery or stereotactic radiotherapy) is a type of EBRT increasingly used for treatment of brain metastases.<sup>26</sup> This increased utilization is largely due to the declining use of whole brain radiation because of the toxicities associated with this treatment and the need for RT that is more precisely targeted.<sup>27</sup> Stereotactic radiation for brain metastases necessitates the use of an MRI for treatment planning, as MRI is vastly superior in target delineation relative to any other form of brain-directed imaging including CT and PET-CT.<sup>28</sup> Without RT-MRI simulation, MRI images are acquired on diagnostic MRI scanners in radiology departments without the immobilization equipment used in RT planning and delivery, and must be fused to a radiation planning CT using deformable registration software, which introduces some error into the ability to contour the normal tissue and tumor.<sup>29</sup> With the RT-MRI simulator, however, the radiation oncologist can identify critical normal tissues such as the optic nerves and chiasm as well the tumor on the planning imaging with the patient in the treatment position, eliminating the error inherent in fusing MRI images of the patient in a different position than they will be in for treatment.<sup>30</sup> Given that stereotactic radiation in the management of brain metastases at BWH/DFCI has increased significantly, with roughly 400 courses of treatment in FY15 and FY16, the need for a RT-MRI simulator to help facilitate this treatment has correspondingly increased.

EBRT is also commonly used in head and neck cancers.<sup>31</sup> As head and neck RTs have become

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<sup>22</sup> *External Beam Radiation Therapy*, AM. CANCER SOCIETY, <https://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/radiation/external-beam-radiation-therapy.html> (last updated Feb. 10, 2017).

<sup>23</sup> *Id.*

<sup>24</sup> *External Beam Therapy (EBT)*, RADIOLOGYINFO.ORG, <https://www.radiologyinfo.org/en/info.cfm?pg=ebt> (last updated May 8, 2017).

<sup>25</sup> *Id.*

<sup>26</sup> *External Beam Radiation Therapy (EBRT)*, RADIATION ONCOLOGY TARGETING CANCER, <https://www.targetingcancer.com.au/radiation-therapy/ebrt/> (last visited Oct. 31, 2017).

<sup>27</sup> P.D. Brown et al., *Effect of Radiosurgery Alone vs Radiosurgery With Whole Brain Radiation Therapy on Cognitive Function in Patients With 1 to 3 Brain Metastases: A Randomized Clinical Trial*, 316 J. AM. MED. ASS'N. 401, 401-09 (2016), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5313044/pdf/nihms843400.pdf>; E.L. Chang et al., *Neurocognition in patients with brain metastases treated with radiosurgery or radiosurgery plus whole-brain irradiation: a randomised controlled trial*, 10 LANCET 1037, 1037-44 (2009); M. Kocher et al., *Adjuvant whole-brain radiotherapy versus observation after radiosurgery or surgical resection of one to three cerebral metastases: results of the EORTC 22952-26001 study*, 29 J. CLINICAL ONCOLOGY 134, 134-41 (2011), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3058272/pdf/zlj134.pdf>; R. Soffiatti et al., *A European Organisation for Research and Treatment of Cancer phase III trial of adjuvant whole-brain radiotherapy versus observation in patients with one to three brain metastases from solid tumors after surgical resection or radiosurgery: quality-of-life results*, 31 J. CLINICAL ONCOLOGY 65, 65-72 (2013), available at <http://ascopubs.org/doi/pdfdirect/10.1200/JCO.2011.41.0639>.

<sup>28</sup> T. Nishikawa et al., *Early detection of metachronous brain metastases by biannual brain MRI follow-up may provide patients with non-small cell lung cancer with more opportunities to have radiosurgery*, 112 CLINICAL NEUROLOGY & NEUROSURGERY 770, 770-74 (2010).

<sup>29</sup> V. Fortunati et al., *Feasibility of multimodal deformable registration for head and neck tumor treatment planning*, 90 INT'L J. RADIATION ONCOLOGY BIOLOGY PHYSICS 85, 85-93 (2014).

<sup>30</sup> *Id.*

<sup>31</sup> *External Beam Radiation Therapy (EBRT)*, *supra* note 26.

more targeted, the need for millimeter-level target delineation has become more critical in order to avoid missing tumors, identify areas at highest risk for microscopic tumor spread, and ensure accurate definition of normal structures such as the spinal cord and brainstem to prevent steep dose gradients and high doses delivered in close proximity from harming these critical organs.<sup>32</sup> Thus, it is crucial to incorporate all anatomical information available during the RT planning process. In head and neck RT planning, evidence shows that MRI is complimentary to CT for target volume delineation.<sup>33</sup> MRI is particularly useful for identifying pathologic retropharyngeal lymph nodes or defining the extent of primary disease in critical areas such as the nasopharynx, sinuses, or parotid; providing better resolution for targeting tumor invading cranial nerves or critical structures such as the brainstem, optic nerves and optic chiasm; and aiding in radiation target delineation in cases where CT scans are limited by dental artifact.<sup>34</sup>

Finally, EBRT is the treatment of choice for many men with prostate cancer.<sup>35</sup> EBRT simulation is performed with volumetric imaging to visualize the target volumes and relevant pelvic anatomy and perform dose calculations in treatment planning.<sup>36</sup> Traditional planning of EBRT for prostate cancer entails utilization of CT simulators for target definition.<sup>37</sup> However, inter- and intra-operator variation in target delineation can be significant, particularly at the prostate apex and seminal vesicles because the poor soft tissue definition available with conventional CT simulators make identification of the boundaries of the prostate challenging.<sup>38</sup> Prior studies have demonstrated that CT delineation of the prostate gland was on average 30% larger than the true gland but only included 84% of its volume, indicating that CT-based RT planning for prostate cancer is both prone to over-treatment of adjacent organs and missing the tumor itself.<sup>39</sup> Incorporating MRI simulation in the planning process for prostate target volume delineation offers an advantage because it has been shown to decrease contouring variability when compared with the use of CT imaging.<sup>40</sup> MRI's ability to provide higher resolution imaging of soft tissue structures results in reduction in volume of the prostate target for RT by ~30-35%, and this improved accuracy allows higher likelihood of delivering targeted curative doses to the tumor, while minimizing unnecessary high dose radiation delivery to the surrounding organs,

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<sup>32</sup> Laura A. Dawson et al., *Patterns of local-regional recurrence following parotid-sparing conformal and segmental intensity-modulated radiotherapy for head and neck cancer*, 46 INT'L J. RADIATION ONCOLOGY BIOLOGY PHYSICS 1117, 1117-26 (2000); Avraham Eisbruch et al., *Recurrences near base of skull after IMRT for head-and-neck cancer: implications for target delineation in high neck and for parotid gland sparing*, 59 INT'L J. RADIATION ONCOLOGY BIOLOGY PHYSICS 28, 28-42 (2004).

<sup>33</sup> Anuradha Thiagarajan et al., *Target Volume Delineation in Oropharyngeal Cancer: Impact of PET, MRI, and Physical Examination*, 83 INT'L J. RADIATION ONCOLOGY BIOLOGY PHYSICS 220, 220-27 (2012); P. Metcalfe et al., *The Potential for an Enhanced Role for MRI in Radiation-therapy Treatment Planning*, 12 TECHNOLOGY IN CANCER RESEARCH & TREATMENT 429, 429-46 (2013), available at [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4527434/pdf/10.7785\\_tcr.2012.500342.pdf](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4527434/pdf/10.7785_tcr.2012.500342.pdf); Schmidt & Payne, *supra* note 20.

<sup>34</sup> Metcalfe et al., *supra* note 33; Schmidt & Payne, *supra* note 20.

<sup>35</sup> Nicholas G. Zaorsky et al., *ACR Appropriateness Criteria® external beam radiation therapy treatment planning for clinically localized prostate cancer, part 1 of 2*, 2 ADVANCES IN RADIATION ONCOLOGY 62, 62-84 (2017), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5514238/pdf/main.pdf>.

<sup>36</sup> *Id.*

<sup>37</sup> *Id.*

<sup>38</sup> Claudio Fiorino et al., *Intra- and inter-observer variability in contouring prostate and seminal vesicles: implications for conformal treatment planning*, 47 RADIOLOGY & ONCOLOGY 285, 285-92 (1998); L.F. Cazzaniga et al., *Interphysician variability in defining the planning target volume in the irradiation of prostate and seminal vesicles*, 47 RADIOLOGY & ONCOLOGY 293, 293-96 (1998).

Zaorsky et al., *supra* note 35.

<sup>39</sup> Zhanrong Gao et al., *A Study of prostate delineation referenced against a gold standard created from the visible human data*, 85 RADIOLOGY & ONCOLOGY 239, 239-46 (2007); Zaorsky et al., *supra* note 35.

<sup>40</sup> Zaorsky et al., *supra* note 35.

and reducing toxicity.<sup>41</sup>

### RT-MRI Simulator for Brachytherapy

Brachytherapy is a type of RT given at a short distance that involves placing radioactive seeds or sources in or near the tumor itself.<sup>42</sup> Like EBRT, the nature of this treatment makes proper estimation of tumor location, volume, and delineation imperative. In order optimally place the applicators to deliver a high dose of radiation to the tumor but minimize normal tissue toxicity, accurate information about the tumor and surrounding healthy tissues is necessary.<sup>43</sup> For these reasons, the application of image-guided, specifically, MRI-guided brachytherapy has grown during the last two decades.<sup>44</sup>

Another area in which MRI-guided brachytherapy and MRI simulation for brachytherapy are emerging as important modalities is in the treatment of gynecological malignancies, such as cervical and vaginal cancers. Compared to CT-based simulation, the physician can create a highly customized RT treatment plan with MRI-based simulation that can maximize dose to the tumor while minimizing dose to the surrounding organs.<sup>45</sup> In a systematic review of 13 studies, CT-based planning was found to significantly overestimate the residual cervical tumor when compared to MRI-based brachytherapy planning and the corresponding radiation doses to the tumor were lower.<sup>46</sup> A recent study of 32 patients who underwent MRI simulation for vaginal cylinder brachytherapy found that approximately 50% of the cohort received substantial under-dosing (less than 50% of the prescription dose) with CT-based planning.<sup>47</sup> Accordingly, it is expected that MRI simulation based planning will be more accurate for gynecological cancer brachytherapy than CT simulation based planning.<sup>48</sup>

## B. MRI-LINAC

### 1. Overview

Conventional RT typically involves the creation of a single radiation plan for the patient that is then delivered identically over multiple treatments during the treatment course.<sup>49</sup> This approach does not allow adaptation to tumor response or movement that may occur during the treatment

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<sup>41</sup> C. Rasch et al., *Definition of the prostate in CT and MRI: a multi-observer study*, 43 INT'L J. RADIATION ONCOLOGY BIOLOGY PHYSICS 57, 57-66 (1999); H. Tanaka et al., *Usefulness of CT-MRI fusion in radiotherapy planning for localized prostate cancer*, 52 J. RADIATION RESEARCH 782, 782-88 (2011); Zaorsky et al., *supra* note 35.

<sup>42</sup> *What is Brachytherapy?*, CANCER TREATMENTS CTRS. OF AM., <http://www.brachytherapy.com/> (last visited Nov. 2, 2017).

<sup>43</sup> *Id.*; Anurita Srivastava & Niloy Ranjan Datta, *Brachytherapy in cancer cervix: Time to move ahead from point A?*, 5 WORLD J. CLINICAL ONCOLOGY 764, 764-74 (2014), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4129539/pdf/WJCO-5-764.pdf>.

<sup>44</sup> Kari Tanderup et al., *MRI-guided brachytherapy*, 24 SEMINARS IN RADIATION ONCOLOGY 181, 181-91 (2014) available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4147854/pdf/nihms613074.pdf>.

<sup>45</sup> *Id.*

<sup>46</sup> Fang Wang et al., *Comparison of computed tomography and magnetic resonance imaging in cervical cancer brachytherapy: A systematic review*, 16 BRACHYTHERAPY 353, 353-65 (2017).

<sup>47</sup> C.H. Chapman et al., *MRI-Based Evaluation of the Vaginal Cuff in Brachytherapy Planning: Are We Missing the Target?*, 95 INT'L J. RADIATION ONCOLOGY BIOLOGY PHYSICS 743, 743-50 (2016).

<sup>48</sup> *Id.*

<sup>49</sup> *Radiation Therapy Basics*, AM. CANCER SOCIETY, <https://www.cancer.org/treatment/treatments-and-side-effects/treatment-types/radiation/basics.html> (last updated Jun. 6, 2017).

course.<sup>50</sup> Image-guided RT platforms use frequent imaging during a course of RT for the purpose of improving the precision and accuracy of treatment delivery.<sup>51</sup> In image-guided RT, machines that deliver radiation, such as a LINAC, are equipped with imaging technology to allow real-time imaging of a tumor during treatment while the patient is positioned on the treatment table.<sup>52</sup> By comparing these images to the reference images taken during pre-treatment simulation, the patient's position and/or the radiation beams may be adjusted in real-time to more precisely target the radiation dose to the tumor, thereby minimizing the possibility of damaging healthy organs located near the tumor and allowing the radiation oncologist to see how the tumor is responding over the course of cancer treatment.<sup>53</sup>

While image-guided RT has traditionally used CT or X-ray, these modalities introduce extra radiation exposure with relatively poor contrast in soft tissue (making it difficult to image tumors in areas like the brain, liver and pelvic region) and poor visualization in regions with continuous motion such as breathing, swallowing, or digesting.<sup>54</sup> MRI-guided RT solves these problems; the MRI modality provides much greater viewing contrast in soft tissue and does not use radiation for imaging.<sup>55</sup> Because there is no additional radiation dose to the patient, radiation oncologists can image more frequently, allowing constant real-time viewing of the tumor and surrounding organs, which makes it easier track soft tissues to avoid missing a moving tumor or irradiating sensitive internal structures; track moving tumors in areas such as the lungs and stomach; adapt or reshape the treatment volume to accommodate changes in the shape and location of the tumor and healthy tissues; and accurately align the tumor to the treatment beams.<sup>56</sup> Taken together, these benefits will allow radiation oncologists to utilize the MRI-LINAC to practice truly adaptive radiation therapy in Massachusetts.<sup>57</sup>

## 2. Research Supporting the Clinical Utility of MRI-LINAC

As noted above, the evidence for the increased clinical efficacy of the MRI-LINAC device is based on its ability to enable real-time imaging and adjustment of targeting during treatment and improve image guidance during RT, including superior soft tissue contrast, all of which help to decrease the amount of healthy tissue exposed to radiation. Data to support the efficacy of these techniques in specific regions of the body comes primarily from predecessor MRI-guided Cobalt-60 therapy units (ViewRay MRIdian), which have been used at multiple centers in the United States since January 2014.<sup>58</sup>

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<sup>50</sup> Beth W. Orenstein, *Real-Time Radiotherapy*, 18 RADIOLOGY TODAY 16 (2017), available at <http://www.radiologytoday.net/archive/rt0117p16.shtml>.

<sup>51</sup> *Image-guided Radiation Therapy (IGRT)*, RADIOLOGYINFO.ORG, <https://www.radiologyinfo.org/en/info.cfm?pg=igrt> (last updated Mar. 21, 2016)

<sup>52</sup> *Id.*

<sup>53</sup> *Id.*; Jeff Zagoudis, *MRI Brings New Vision to Radiation Therapy*, IMAGING TECHNOLOGY NEWS (Jul. 6, 2015), <https://www.itnonline.com/article/mri-brings-new-vision-radiation-therapy>; Kathy Hardy, *MRI-Guided Radiation Therapy*, 15 RADIOLOGY TODAY 20 (2014), available at <http://www.radiologytoday.net/archive/rt0914p20.shtml>.

<sup>54</sup> Hardy, *supra* note 53; Zagoudis, *supra* note 53; Jeff Zagoudis, *MRI-guided Radiation Therapy*, IMAGING TECHNOLOGY NEWS (Jul. 5, 2017), <https://www.itnonline.com/article/mri-guided-radiation-therapy-0>.

<sup>55</sup> Hardy, *supra* note 53; Orenstein, *supra* note 50; Zagoudis, *supra* note 53.

<sup>56</sup> Hardy, *supra* note 53; Orenstein, *supra* note 50; Zagoudis, *supra* note 53; VIEWRAY, MRIDIAN LINAC ADVANTAGE (2017), available at [http://www.radiustech.it/upld/catalogo/doc/ViewRay\\_MRIdianLinacBrochure%20L-0083\\_EU%20Rev%20A.pdf](http://www.radiustech.it/upld/catalogo/doc/ViewRay_MRIdianLinacBrochure%20L-0083_EU%20Rev%20A.pdf).

<sup>57</sup> Hardy, *supra* note 53; Orenstein, *supra* note 50; Zagoudis, *supra* note 53; VIEWRAY, *supra* note 56.

<sup>58</sup> Benjamin W. Fischer-Valuck et al., *Two-and-a-half-year clinical experience with the world's first magnetic resonance image guided radiation therapy system*, 2 ADVANCES IN RADIATION ONCOLOGY 485, 485-93 (2017), available at [http://advancesradonc.org/article/S2452-1094\(17\)30096-9/pdf](http://advancesradonc.org/article/S2452-1094(17)30096-9/pdf).

*Tracking Mobile Tumors and Surrounding Organs to Allow More Accurate and Precise RT Delivery: GI, Pancreatic, Prostate, and Gynecological Cancer Examples*

RT plays a critical role in the treatment of multiple cancers; it is significant in the treatment of gastrointestinal and pelvic tumors, is particularly important as the only local therapy option for locally advanced pancreatic cancer, and is also used to treat prostate and gynecologic cancers.<sup>59</sup> Nonetheless, imaging constraints continue to hinder accurate and adequate dosing of radiation to tumors in these regions.<sup>60</sup> Most of these soft tissue tumors are difficult to visualize with traditional CT and X-ray imaging, and in all of these cancer sites, the motion of adjacent organs due to respiration and digestive processes leads to uncertainty in targeting the tumor and sparing the stomach, bowels, pancreas, and reproductive organs.<sup>61</sup> Studies suggest that MRI-guided RT will be useful in overcoming these issues.<sup>62</sup>

At a high-level, MRI imaging during RT allows for the RT to be adapted to changes in the patient's anatomy and tumor location on a given treatment.<sup>63</sup> With regard to specific applications, proof of principle studies from Washington University demonstrated that using MRI-guided RT with the ViewRay MRidian system allowed physicians to perform online adaptive planning in a series of 20 patients with abdominal tumors.<sup>64</sup> In this cohort, 54% of treatments required an adjustment or re-optimization of the treatment plan due to tumor progression or regression and/or a change in normal anatomy location such as movement of the small bowel.<sup>65</sup>

Similarly, studies have shown the value of MRI-guided RT for pancreatic cancer.<sup>66</sup> Proximity to the duodenum, the primary dose-limiting organ in the treatment of pancreatic cancer with RT, remains a challenge.<sup>67</sup> One study demonstrated the high effectiveness of real-time MRI in detecting significant interfractional motion of the duodenum relative to the pancreas, which allows for plan adaptation and/or improves control via dose escalation to the tumor and reduced toxicity to surrounding organs.<sup>68</sup> Another study presented clinical results from patients that were treated for pancreatic cancer with the MRidian system and received an escalation of radiation dose from conventional RT techniques.<sup>69</sup> All patients tolerated treatment well, further confirming

<sup>59</sup> *Radiation Therapy*, NAT'L CANCER INSTITUTE, <https://www.cancer.gov/about-cancer/treatment/types/radiation-therapy#ui-id-2> (last updated Jul. 19, 2017); *Radiation Therapy for Pancreatic Cancer*, AM. CANCER SOCIETY, <https://www.cancer.org/cancer/pancreatic-cancer/treating/radiation-therapy.html> (last updated May 31, 2016); *Radiation Therapy for Prostate Cancer*, AM. CANCER SOCIETY, <https://www.cancer.org/cancer/prostate-cancer/treating/radiation-therapy.html> (last updated Mar. 11, 2016).

<sup>60</sup> *Radiation Therapy*, *supra* note 59; *Radiation Therapy for Pancreatic Cancer*, *supra* note 59; *Radiation Therapy for Prostate Cancer*, *supra* note 59.

<sup>61</sup> *Radiation Therapy*, *supra* note 59; Hardy, *supra* note 53; Orenstein, *supra* note 50; K.E. Mittauer et al., *Multi-Institutional Investigation of Relative Pancreatic Tumor to Duodenal Motion in Magnetic Resonance Imaging Guided Radiation Therapy for Potential Online Adaptive Radiation Therapy*, 96 INT'L J. RADIATION ONCOLOGY S212, S212-13 (2016), available at [http://www.redjournal.org/article/S0360-3016\(16\)30854-9/pdf](http://www.redjournal.org/article/S0360-3016(16)30854-9/pdf).

<sup>62</sup> Hardy, *supra* note 53; Orenstein, *supra* note 50.

<sup>63</sup> Hardy, *supra* note 53; Orenstein, *supra* note 50.

<sup>64</sup> Sahaja Acharya et al., *Online Magnetic Resonance Image Guided Adaptive Radiation Therapy: First Clinical Applications*, 94 INT'L J. RADIATION ONCOLOGY 394, 394-403 (2016).

<sup>65</sup> *Id.*

<sup>66</sup> Orenstein, *supra* note 50; Mittauer et al., *supra* note 61; A. Bruynzeel et al., *Clinical experience with stereotactic MR-guided adaptive radiation therapy for pancreatic tumors*, 123 RADIOTHERAPY & ONCOLOGY S224, S224-25 (2017), available at [https://ac.els-cdn.com/S0167814017308678/1-s2.0-S0167814017308678-main.pdf?\\_tid=e9eea26c-bfff-11e7-bbd7-00000aab0f26&acdnat=1509647614\\_e48c26f83123dd7475ba88b591766276](https://ac.els-cdn.com/S0167814017308678/1-s2.0-S0167814017308678-main.pdf?_tid=e9eea26c-bfff-11e7-bbd7-00000aab0f26&acdnat=1509647614_e48c26f83123dd7475ba88b591766276).

<sup>67</sup> Orenstein, *supra* note 50; Mittauer et al., *supra* note 61.

<sup>68</sup> Mittauer et al., *supra* note 61.

<sup>69</sup> Bruynzeel et al., *supra* note 66.

that MRI-guided RT enables optimal and real-time normal tissue sparing while delivering targeted high biological doses.<sup>70</sup>

The utilization of a MRI-LINAC to deliver real-time adapted RT will also likely have a substantial impact on prostate cancer.<sup>71</sup> While MRI simulators allow for improved targeting of prostate cancers at the time of planning, the random movement of the prostate gland and surrounding bladder and rectum during and in-between treatments can result in significant uncertainty and has traditionally required large margins.<sup>72</sup> MRI-LINACs that can monitor and adapt to both inter- and intra-fraction motion will allow reduction in target margins.<sup>73</sup> Because these margins often overlap with rectum and bladder, such a significant reduction in margin should reduce toxicities and allow RT doses to be safely escalated, thus improving treatment outcomes.<sup>74</sup>

Finally, MRI-LINAC use has been studied in the treatment of gynecologic cancer, the treatment of which is also affected by movement.<sup>75</sup> One particular study presented the use of intra-fraction MRI imaging of six post-operative gynecologic cancer patients over 5 fractions.<sup>76</sup> Using the MRIdian device, the researchers measured the motion of the radiation target (i.e. the vaginal apex) and found that the required margins to capture 99% of the observed motion were 5mm in the superior-inferior direction and 9 mm in the anterior-posterior direction, but that for an individual patient the necessary margin could vary day-to-day by up to 8mm.<sup>77</sup> The results further highlight the potential for more accurately treating the target and sparing normal tissue enabled by real-time MRI-guided RT.<sup>78</sup>

*Real-Time Imaging of Soft Tissue Tumors that Cannot Be Visualized with Conventional Linear Accelerators: A Liver Tumor Example*

MRI imaging during RT also allows better visualization of soft tissue tumors, such as in the liver. Stereotactic body radiation therapy ("SBRT") is a type of RT increasingly utilized as a non-invasive treatment for both primary liver tumors and liver metastases.<sup>79</sup> However, because liver tumors are poorly visualized with conventional X-ray imaging due to the similar density of liver tumors and the surrounding soft tissue of the liver, current SBRT approaches require placement of fiducials (metal markers implanted into the liver tumor) in an invasive procedure to allow accurate targeting of the tumor.<sup>80</sup> Significantly, an MRI-guided LINAC would eliminate the need

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<sup>70</sup> *Id.*

<sup>71</sup> Orenstein, *supra* note 50; A.J. McPartlin et al., *MRI-guided prostate adaptive radiotherapy – A systematic review*, 119 *RADIOTHERAPY & ONCOLOGY* 371, 371-80 (2016), available at [http://www.thegreenjournal.com/article/S0167-8140\(16\)31048-9/pdf](http://www.thegreenjournal.com/article/S0167-8140(16)31048-9/pdf).

<sup>72</sup> McPartlin et al., *supra* note 71.

<sup>73</sup> *Id.*

<sup>74</sup> *Id.*

<sup>75</sup> M. Kamrava et al., *Assessment of Intrafraction Motion of the Vaginal Apex During Postoperative MRI-Guided Radiation Therapy*, 96 *INT'L J. RADIATION ONCOLOGY E302* (2016), available at [http://www.redjournal.org/article/S0360-3016\(16\)31708-4/pdf](http://www.redjournal.org/article/S0360-3016(16)31708-4/pdf).

<sup>76</sup> *Id.*

<sup>77</sup> *Id.*

<sup>78</sup> *Id.*

<sup>79</sup> K.K. Herfarth, *Stereotactic Single-Dose Radiation Therapy of Liver Tumors: Results of a Phase I/II Trial*, 19 *J. CLINICAL ONCOLOGY* 164, 164-70 (2001), available at <http://ascopubs.org/doi/pdfdirect/10.1200/JCO.2001.19.1.164>; *Radiation Therapy for Liver Cancer*, AM. CANCER SOCIETY, <https://www.cancer.org/cancer/liver-cancer/treating/radiation-therapy.html> (last updated Apr. 28, 2016).

<sup>80</sup> A.P. Wojcieszynski et al., *Gadoxetate for direct tumor therapy and tracking with real-time MRI-guided stereotactic body radiation therapy of the liver*, 118 *RADIOTHERAPY & ONCOLOGY* 416, 416-18 (2016); Marta Scorsetti et al.,

for fiducial placement by allowing higher resolution soft tissue visualization and real-time motion tracking.<sup>81</sup> Proof of principle studies from the University of Wisconsin demonstrate that the Viewray MRIdian system allows real-time tracking of liver tumors during SBRT delivery and provide a promising new treatment option for patients with liver tumors that does not require invasive placement of fiducial markers.<sup>82</sup> This ability to image and target soft tissue tumors with MRI is crucial, as it will eliminate the necessity for fiducial placement to target tumors, which can reduce the costs of RT delivery and reduce the therapeutic burden on the patient.<sup>83</sup>

*Reducing RT Margins to Reduce Dose to Normal Tissues and Allow Adoption of Short Course RT: A Breast Cancer Example*

Finally, the MRI-LINAC has promising application in the field of breast cancer RT. Traditionally, RT has been utilized as part of breast conserving therapy to improve local control after lumpectomy for breast cancer patients, with typical treatment courses involving 4-6 weeks of daily RT delivered to the entire breast.<sup>84</sup> More recently, accelerated partial breast irradiation ("APBI"), which involves RT treatment of just the surgical cavity, has emerged as a shorter (1-2 weeks) and more cost-effective treatment approach with comparable local control.<sup>85</sup> However, widespread adoption of APBI has not occurred due to concerns regarding accurate targeting of the lumpectomy cavity using conventional LINACs (traditional X-ray imaging results in poor visualization of the cavity) and toxicity (short course breast RT involves higher doses per day).<sup>86</sup>

The application of MRI technology to this clinical situation with a MRI-guided LINAC is opportune given the superior visualization of lumpectomy cavities with MRI.<sup>87</sup> In addition, MRI at the time of treatment will allow for more precise definition of the lumpectomy site on a day-to-day basis, which will likely permit a smaller margin on the lumpectomy site.<sup>88</sup> In one study, a series of 30 patients were treated with APBI using the Viewray MRIdian device with daily MRI visualization and adaptive targeting/planning to the cavity.<sup>89</sup> The results of the study demonstrated that the RT target volume could be reduced by 52% with MRI-guidance.<sup>90</sup> By monitoring the location of the cavity throughout the treatment with the on-board MRI scanner, the researchers demonstrated that APBI could be delivered using MRI-guidance with 1-3 mm

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*Stereotactic body radiation therapy for liver metastases*, 5 J. GASTROINTESTINAL ONCOLOGY 190, 190-97 (2014), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4074953/pdf/jgo-05-03-190.pdf>.

<sup>81</sup> Wojcieszynski et al., *supra* note 80.

<sup>82</sup> *Id.*

<sup>83</sup> Fischer-Valuck et al., *supra* note 58.

<sup>84</sup> Early Breast Cancer Trialists' Collaborative Group, *Effect of radiotherapy after breast-conserving surgery on 10-year recurrence and 15-year breast cancer death: meta-analysis of individual patient data for 10,801 women in 17 randomised trials*, 378 LANCET 1707, 1707-16 (2011), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3254252/>.

<sup>85</sup> David J. Sher et al., *Partial Breast Irradiation Versus Whole-Breast Irradiation For Early-Stage Breast Cancer: A Cost-Effectiveness Analysis*, 74 INT'L J. RADIATION ONCOLOGY BIOLOGY PHYSICS 440, 440-46 (2009), available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2695677/>.

<sup>86</sup> Ivo A. Olivetto et al., *Interim Cosmetic and Toxicity Results From RAPID: A Randomized Trial of Accelerated Partial Breast Irradiation Using Three-Dimensional Conformal External Beam Radiation Therapy*, 31 J. CLINICAL ONCOLOGY 4038, 4038-48 (2013), available at <http://ascopubs.org/doi/pdfdirect/10.1200/JCO.2013.50.5511>.

<sup>87</sup> W. Huang et al., *A Comparison of Lumpectomy Cavity Delineations Between Use of Magnetic Resonance Imaging and Computed Tomography Acquired With Patient in Prone Position for Radiation Therapy Planning of Breast Cancer*, 94 INT'L J. RADIATION ONCOLOGY BIOLOGY PHYSICS 832, 832-40 (2016).

<sup>88</sup> *Id.*; S. Acharya et al., *Magnetic Resonance Image Guided Radiation Therapy for External Beam Accelerated Partial-Breast Irradiation: Evaluation of Delivered Dose and Intrafractional Cavity Motion*, 96 INT'L J. RADIATION ONCOLOGY BIOLOGY PHYSICS 785, 785-92 (2016).

<sup>89</sup> Acharya et al., *supra* note 88.

<sup>90</sup> *Id.*

margins compared to 1 cm margins typically used with conventional RT.<sup>91</sup> This significant reduction in radiation exposure to surrounding, healthy, normal tissues with MRI-guidance is extremely promising.

**F.1.b.ii Public Health Value /Outcome-Oriented:**

**Describe the impact of the Proposed Project and how the Applicant will assess such impact. Provide projections demonstrating how the Proposed Project will improve health outcomes, quality of life, or health equity. Only measures that can be tracked and reported over time should be utilized.**

**A. Public Health Value of the RT-MRI Simulator and MRI-LINAC**

The proposed technologies will have an impact on cancer treatment that will lead to improved health outcomes and a better quality of life for cancer patients treated at BWH. The RT-MRI simulator provides improved visualization of certain cancers, including cancers of the brain, head and neck, prostate, as well as gynecological cancers. This enhanced capability leads to less radiation exposure of tissue and organs around the tumor. Moreover, use of MRI instead of CT simulation in treatment planning results in decreased overall exposure to radiation for the patient as MRI does not use radiation to produce images. Currently, the time from MRI scan to stereotactic treatment is approximately fourteen days; however, the availability of a RT-MRI simulator can reduce this timeframe and ensure patients receive care in an expedited manner. Finally, this technology can provide high-quality imaging of difficult to reach areas and differentiate between various types of soft tissue that is not possible with CT simulation. Accordingly, access to a RT-MRI simulator will provide patients with more refined treatment plans with a technology that does not expose patients to additional radiation, ultimately leading to improved health outcomes and quality of life for a subset of cancer patients.

The MRI-LINAC also enhances quality care and leads to improved patient outcomes by precisely delivering radiation that can improve disease control while reducing toxicity. Better quality outcomes are achieved through the integrated MR imager that provides pre-treatment and real-time soft tissue visualization that is not possible with current state-of-the-art conventional LINACs. Accordingly, the MRI-LINAC will improve cancer patients' health outcomes and quality of life by providing targeted radiation to better treat certain cancers.

**B. Assessing the Impact of the Proposed Project**

To assess the impact of the acquisition of the RT-MRI simulator and the MRI-LINAC, BWH developed the following quality metrics and reporting schematic, as well as metric projections for quality indicators that will measure patient access and quality of care. The measures are discussed below:

**RT-MRI Simulator**

- 1. Access – Increased Access to MR-guided Gynecological Brachytherapy Procedures:** This measure seeks to ensure that clinically eligible patients for MRI-guided brachytherapy receive treatment on the RT-MRI simulator.

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<sup>91</sup> *Id.*

**Measure:** The proportion of gynecological cancer patients who are MR-eligible treated with the RT-MRI Simulator.

**Projections:** Baseline: 0% Year 1: 10% Year 2: 25% Year 3: 50%

**Monitoring:** This data will be provided on an annual basis.

2. **Access – Impact on Care Efficiency and Patient-Centered Care Integration:** This measure seeks to determine how integrated care may be provided to all patients.

**Measure:** The proportion of clinically eligible patients whose treatment was planned on the RT-MRI simulator as part of same-day radiation planning compared to number of patients who had treatment planning on a traditional MRI scanner.

**Projections:** Baseline: 0% Year 1: 10% Year 2: 25% Year 3: 50%

**Monitoring:** This data will be provided on an annual basis.

### MRI-LINAC

1. **Quality Care – Patients who have their RT Plan Adjusted due to Movement or Shrinkage:** This measure seeks to determine how effective the technology is at adjusting RT plans due to organ/tumor movement or shrinkage.

**Measure:** Number of patients who received treatment on the MRI-LINAC and had their RT plans adjusted during treatment to account for tumor movement and/or shrinkage, and/or organ movement.

**Projections:** Baseline: 0% Year 1: 10% Year 2: 25% Year 3: 50%

**Monitoring:** This data will be provided on an annual basis.

2. **Quality Care – Reducing Radiation Toxicity:** This measure evaluates the impact on reducing toxicity and morbidity on cancer patients.

**Measure:** The impact of reducing toxicity and morbidity by collecting patient-reported outcomes using the PRO CTCAE scales by disease site in aggregate and compared against departmental baseline data.

**Projections:** Baseline: 0% Year 1: 10% Year 2: 25% Year 3: 50%

**Monitoring:** This data will be provided on an annual basis.

- F1.b.iv Provide additional information to demonstrate that the Proposed Project will result in improved health outcomes and quality of life of the Applicant's existing Patient Panel, while providing reasonable assurances of health equity.**

Currently, the majority of RT planning is performed with a CT simulator. Additionally, image-guided RT is delivered on X-ray guided LINACs with alignment to bone implanted makers as surrogates for tumor location. These technologies cannot directly visualize soft tissue tumors,

including common tumors of the prostate, breast, head and neck, GI and gynecological cancers. However, MRI provides several benefits that are currently not available with CT-based simulation for RT, including higher soft tissue contrast resolution, functional imaging and the ability to perform continuous imaging without exposing patients to additional ionizing radiation. This integration of MRI technology into RT planning (through the RT-MRI simulator) and radiation delivery (through the MRI-LINAC) has created a paradigm shift in how these services are provided, enabling radiation oncology departments to deliver RT that is more accurate and precise. Consequently, these improvements have led to a reduction to radiation toxicity and improved health outcomes based on this lack of radiation exposure to other organs.

**F1.c Provide evidence that the Proposed Project will operate efficiently and effectively by furthering and improving continuity and coordination of care for the Applicant's Patient Panel, including, how the Proposed Project will create or ensure appropriate linkages to patients' primary care services.**

To ensure continuity of care, improved health outcomes and enhanced quality of life, through the proposed Project, BWH's radiology oncology staff will utilize BWH's electronic health record ("EHR") to share images and provide follow-up information to a patient's medical oncologist and primary care physician. Additionally, patients utilizing these modalities will be linked with the necessary services to address social determinant of health issues. Providing patients with linkages to these necessary services prevents unnecessary readmissions, ensures appropriate care management and provides the patient with the necessary resources for leading a better life. Additionally, it is the Radiation Oncology Department's practice to transmit a copy of consultation notes and a full radiation treatment summary (this includes the dose, technique and other details) at the completion of treatment to each patient's primary care physician and all oncology and referring providers. This practice will continue with the implementation of this new technology.

Furthermore, continuity will be improved as patients will no longer be referred to other departments for MRI scans, which often cause delays in treatment due to wait times. Patients will receive imaging and therapies in BWH's Radiation Oncology Department on the same day and time as other appointments. This will also lead to a more focused integrated cancer team and greater patient satisfaction.

**Factor 2: Health Priorities**

**Addresses the impact of the Proposed Project on health more broadly (that is, beyond the Patient Panel) requiring that the Applicant demonstrate that the Proposed Project will meaningfully contribute to the Commonwealth's goals for cost containment, improved public health outcomes, and delivery system transformation.**

**F2.a. Cost Containment:  
Using objective data, please describe, for each new or expanded service, how the Proposed Project will meaningfully contribute to the Commonwealth's goals for cost containment.**

The goals for cost containment in Massachusetts center around providing low-cost care alternatives without sacrificing high quality. The proposed Project seeks to align with these goals through the creation of care efficiencies and avoided costs. As discussed, the RT-MRI simulator and MRI-LINAC both seek to reduce radiation toxicity and assure that only the area needing radiation is affected through precise RT, avoiding impact to than adjacent organs

and/or regions. Current technology and RT practices cannot control for these issues. However, through the acquisition of these two modalities, BWH can reduce overall costs by preventing toxicity and may avoid future costs that are associated with the co-morbid conditions that accompany toxicity, including additional hospital ED visits, inpatient admissions and readmissions. Additionally, these therapies allow for better tumor control, reduced wait times for treatments and expedited care, all of which, impact healthcare costs. Accordingly, the acquisition and installation of the technology will contribute to the Commonwealth's goals for better quality care at lower costs.

**F2.b. Public Health Outcomes:  
Describe, as relevant, for each new or expanded service, how the Proposed Project will improve public health outcomes.**

As discussed, cancer is the leading cause of death in the Commonwealth with 183,009 newly diagnosed cases between 2009-2013. However, cancer incidence in Massachusetts slightly decreased from 2009 to 2013. To continue this trend, it is imperative that Massachusetts residents, especially elderly residents, have access to cutting-edge technology that allows for better tumor control, expedited care and a reduced impact from radiation, including radiation toxicity. Additionally, the RT offered by these new modalities is not available at any provider in New England. For these reasons, the acquisition and installation of the RT-MRI simulator and the MRI-LINAC will improve access to more precise treatment; thereby, improving health outcomes for specific cancer patients in New England.

**F2.c. Delivery System Transformation:  
Because the integration of social services and community-based expertise is central to goal of delivery system transformation, discuss how the needs of their patient panel have been assessed and linkages to social services organizations have been created and how the social determinants of health have been incorporated into care planning.**

To address issues associated with the social determinants of health and to ensure all patients have equal access to care, BWH has developed a robust social work program that facilitates linkages to social service organizations, as well as to clinical services, such as collaborative relationships with primary care clinicians. For underserved patients, these linkages may mean obtaining the care that they need in a timely fashion or obtaining necessary psycho-social supports to get well – ultimately, they can mean life or death.

Prior to being seen for any form of RT, radiotherapy patients receive a physical exam. Additionally, every patient is assessed by a nurse to discuss his/her nutritional status and coping abilities, including possible depression and anxiety issues. After this initial assessment, patients are referred to social work and psychiatry as needed at the beginning or during a course of treatment. These linkages are imperative for cancer patients, as the social work team helps patients find local housing at reduced costs and identifies transportation to BWH. Moreover, patients are connected with the DFCI's Survivorship Programs, which are designed to help patients assist fellow patients in finding expertise, education, and support to help manage issues related to surviving cancer. This includes managing the risk of secondary cancers, understanding the long-term effects of treatment, and addressing social, physical, or psychological concerns. Programming includes: Adult Survivorship; Nutritional; Education and Support; Integrative Therapies; Sexual Health; Exercise Classes; Survivorship Related Services; Adult Social Work; Pediatric Social Work; Patient and Family Support; Social Relationships; and Resources.

**Factor 5: Relative Merit**

**F5.a.i** Describe the process of analysis and the conclusion that the Proposed Project, on balance, is superior to alternative and substitute methods for meeting the existing Patient Panel needs as those have been identified by the Applicant pursuant to 105 CMR 100.210(A)(1). When conducting this evaluation and articulating the relative merit determination, Applicant shall take into account, at a minimum, the quality, efficiency, and capital and operating costs of the Proposed Project relative to potential alternatives or substitutes, including alternative evidence-based strategies and public health interventions.

**Proposal:** The proposed Project is to acquire and install a RT-MRI simulator and a MRI-LINAC.

**Quality:** The proposed Project is a superior alternative for providing high quality RT services for certain cancers and improving health outcomes as patients will have access to cutting-edge technology that provides higher quality, expedited care that allows for the impact of radiation to be minimized and the ability to recover faster from treatment.

**Efficiency:** As discussed, the majority of RT planning is currently performed via CT-based imaging. Additionally, image-guided RT is delivered using X-ray imaging on conventional X-ray guided LINACs with alignment to bone implanted makers as surrogates for tumor location. These technologies cannot directly visualize soft tissue tumors and do not provide the most efficient care, as multiple MRIs are needed to obtain the necessary images to determine the best treatment. Additionally, current therapies can cause radiation toxicity and expose patients to more radiation than needed to treat the tumor. Accordingly, the acquisition and installation of the RT-MRI simulator and the MRI-LINAC will allow for the provision of more efficient and effective care.

**Capital Expense:** The capital expenses for the RT-MRI simulator and MRI-LINAC are approximately 50% more than comparable conventional CT simulators and X-ray guided LINACs. However, as discussed, the CT and X-ray technology cannot perform at the same level as the new modalities for certain cancers. Consequently, the cost savings and avoided costs generated by the new technology will balance any increase in capital costs.

**Operating Costs:** These costs are minimal as staff is the only ongoing cost associated with this project. As the RT-MRI simulator will replace an existing fluoroscopic simulator, there is no incremental increase in operating costs to BWH with the introduction of a RT-MRI simulator.

**List alternative options for the Proposed Project:****Option 1**

**Alternative Proposal:** The alternative option for the proposed Project would be to acquire a CT simulator to replace the fluoroscopic simulator and not acquire a MRI-LINAC.

**Alternative Quality:** As discussed, the quality of care that is provided by the CT simulator is less efficient and does not provide soft-tissue cancer patients with the most accurate treatment. Additionally, this technology may also cause radiation toxicity which

leads to co-morbid conditions, impacting overall health, quality of life and health outcomes.

**Alternative Efficiency:** Current technologies, such as the CT simulator, lack the efficiencies of a RT-MRI simulator and a MRI-LINAC, including the necessary precision to ensure that other body parts are not impacted by radiation.

**Alternative Capital Expenses:** Although purchasing this technology is currently less expensive, over time the cost savings generated by the RT-MRI simulator and MRI-LINAC will outpace the initial capital costs and ensure patients receive the most appropriate care for their cancer type.

**Alternative Operating Costs:** There are few operating costs associated with acquiring a CT simulator beyond staff. However, there is a cost to patients in receiving less efficient and accurate treatment.

**Attachment/Exhibit**

**2**

**TABLE 1: Total PHS Patient Panel**

	FY14		FY15		FY16		FY17Q1	
	Count	%	Count	%	Count	%	Count	%
<b>PHS Total</b>	1,211,361		1,255,589		1,299,981		635,069	
<b>Gender</b>								
Male	489,115	40%	510,882	41%	529,584	41%	249,171	39%
Female	699,356	58%	729,920	58%	756,941	58%	381,244	60%
Other/Unknown	22,890	2%	14,787	1%	13,456	1%	4,654	1%
<b>Age</b>								
0-17	125,049	10%	136,541	11%	149,313	11%	65,425	10%
18-64	748,259	62%	781,276	62%	809,642	62%	385,857	61%
65+	315,264	26%	323,115	26%	327,663	25%	179,162	28%
Unknown	22,789	2%	14,657	1%	13,363	1%	4,625	1%
<b>Race</b>								
White	888,884	73%	912,161	73%	924,332	71%	468,014	74%
Black or African American	71,921	6%	73,310	6%	74,127	6%	36,954	6%
American Indian or Alaska Native	1,416	0.1%	1,434	0.1%	1,417	0.1%	617	0.1%
Asian	49,087	4%	51,114	4%	51,921	4%	25,444	4%
Native Hawaiian or Other Pacific Islander	1,052	0.1%	987	0.1%	976	0.1%	441	0.1%
Hispanic/Latino	38,901	3%	32,611	3%	26,698	2%	15,804	2%
Other/Unknown	160,100	13%	183,972	15%	220,510	17%	87,795	14%
<b>Patient Origin</b>								
HSA_1	10,538	1%	11,058	1%	11,716	1%	5,073	1%
HSA_2	42,126	3%	41,549	3%	42,928	3%	19,117	3%
HSA_3	59,490	5%	60,456	5%	61,689	5%	28,734	5%
HSA_4	571,400	47%	581,662	46%	584,007	45%	307,015	48%
HSA_5	121,411	10%	149,729	12%	183,635	14%	81,469	13%
HSA_6	231,359	19%	234,332	19%	237,352	18%	125,405	20%
Outside of MA	147,646	12%	158,403	13%	162,301	12%	62,739	10%
Unknown	27,391	2%	18,400	1%	16,353	1%	5,517	1%

BRIGHAM AND WOMENS HOSPITAL

1. Brigham and Women's Hospital Emergency Department Volume

	Unique Visits	Unique Patients
FY 14	59,927	40,497
FY 15	60,958	41,189
FY 16	62,252	42,253
<b>FY 14-16 Total</b>	<b>183,137</b>	<b>101,058</b>
FY 17 Q1	15,406	12,595

2. Geographic Breakdown

	HSA 1	HSA 2	HSA 3	HSA 4	HSA 5	HSA 6	Outside MA	Unknown
FY 14	0.7% (n=302)	2.3% (n=929)	2.9% (n=1,175)	67.7% (n=27,401)	11.8% (n=4,789)	5.2% (n=2,087)	9.3% (n=3,775)	0.1% (n=39)
FY 15	0.6% (n=261)	2.4% (n=985)	2.7% (n=1,119)	68.3% (n=28,124)	11.4% (n=4,676)	5.0% (n=2,076)	9.5% (n=3,919)	0.1% (n=31)
FY 16	0.7% (n=296)	2.5% (n=980)	2.7% (n=1,146)	67.4% (n=28,480)	11.4% (n=4,807)	5.2% (n=2,188)	10.2% (n=4,321)	0.1% (n=35)
<b>FY 14-16 Total</b>	<b>0.8% (n=782)</b>	<b>2.5% (n=2,539)</b>	<b>2.9% (n=2,974)</b>	<b>65.1% (n=65,757)</b>	<b>12.4% (n=12,500)</b>	<b>5.3% (n=5,383)</b>	<b>10.9% (n=11,022)</b>	<b>0.1% (n=101)</b>
FY 17 Q1	0.6% (n=81)	2.2% (n=273)	2.7% (n=334)	69.5% (n=8,758)	11.1% (n=1,401)	5.0% (n=624)	8.8% (n=1,114)	0.1% (n=10)

3. Age at Visit (Encounter Level)

	0-17 years old	18-64 years old	65+ years old
FY 14	0.4% (n=269)	75.8% (n=45,452)	23.7% (n=14,206)
FY 15	0.4% (n=238)	75.3% (n=45,895)	24.3% (n=14,825)
FY 16	0.4% (n=267)	75.1% (n=46,779)	24.4% (n=15,206)
<b>FY 14-16 Total</b>	<b>0.4% (n=774)</b>	<b>75.4% (n=138,126)</b>	<b>24.2% (n=44,237)</b>
FY 17 Q1	0.5% (n=81)	73.6% (n=11,337)	25.9% (n=3,988)

4. Gender (Patient Level)

	Male	Female	Unknown
FY 14	40.3% (n=16,335)	59.7% (n=24,162)	0% (n=0)
FY 15	40.4% (n=16,649)	59.6% (n=24,539)	0% (n=1)
FY 16	40.1% (n=16,933)	59.9% (n=25,318)	0% (n=2)
<b>FY 14-16 Total</b>	<b>41.3% (n=41,773)</b>	<b>58.7% (n=59,282)</b>	<b>0% (n=3)</b>
FY 17 Q1	39.0% (n=4,911)	61.0% (n=7,684)	0% (n=0)

5. Race (Patient Level)

	American Indian or Alaska Native	Asian	Black or African American	Hispanic or Latino	Native Hawaiian or Other Pacific Islander	White or Caucasian	Other	Unavailable	Declined
FY 14	0.2% (n=62)	3.3% (n=1,325)	19.7% (n=7,986)	13.9% (n=5,646)	0% (n=12)	53.3% (n=21,605)	6.2% (n=2,513)	2.1% (n=856)	1.2% (n=492)
FY 15	0.2% (n=82)	3.3% (n=1,373)	19.9% (n=8,182)	15.6% (n=6,428)	0% (n=12)	52.3% (n=21,532)	4.8% (n=1,991)	2.7% (n=1,103)	1.2% (n=485)
FY 16	0.2% (n=90)	3.4% (n=1,432)	19.4% (n=8,186)	10.7% (n=4,520)	0.1% (n=25)	53.3% (n=22,501)	8.8% (n=3,703)	3.1% (n=1,290)	1.2% (n=506)
<b>FY 14-16 Total</b>	<b>0.2% (n=199)</b>	<b>3.6% (n=3,677)</b>	<b>18.1% (n=18,255)</b>	<b>11.1% (n=11,212)</b>	<b>0% (n=42)</b>	<b>55.9% (n=56,493)</b>	<b>6.9% (n=6,934)</b>	<b>3.0% (n=3,012)</b>	<b>1.2% (n=1,240)</b>
FY 17 Q1	0.2% (n=28)	3.1% (n=388)	20.5% (n=2,582)	11.4% (n=1,435)	0% (n=6)	52.1% (n=6,557)	9.5% (n=1,195)	2.2% (n=278)	1.0% (n=125)

6. Most Prevalent Conditions for Seeking Treatment in the BWH Emergency Department and Volume

	Behavioral Health	Heart Attack	Stroke	Trauma	Other	No Prin Dx
FY 14	3.7% (n=2,216)	0.1% (n=59)	0.7% (n=407)	10.7% (n=6,406)	84.7% (n=50,757)	0.1% (n=82)
FY 15	3.7% (n=2,227)	0.1% (n=44)	0.7% (n=454)	9.8% (n=5,984)	83.1% (n=50,646)	2.6% (n=1,603)
FY 16	2.5% (n=1,529)	0.1% (n=51)	0.7% (n=450)	8.6% (n=5,384)	82.3% (n=51,241)	5.8% (n=3,597)
<b>FY 14-16 Total</b>	<b>3.3% (n=5,972)</b>	<b>0.1% (n=154)</b>	<b>0.7% (n=1,311)</b>	<b>9.7% (n=17,774)</b>	<b>83.3% (n=152,644)</b>	<b>2.9% (n=5,282)</b>
FY 17 Q1	2.0% (n=302)	0.1% (n=13)	0.5% (n=83)	8.4% (n=1,287)	83.7% (n=12,898)	5.3% (n=823)

**Attachment/Exhibit**

**3**

**Attachment/Exhibit**

**A**

**BRIGHAM HEALTH**



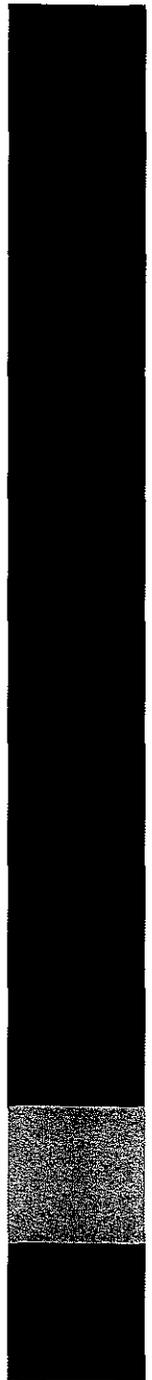
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# Summary of Community Outreach

**BRIGHAM HEALTH**



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# Factor 1 – Consult Level

The Department of Public Health's (DPH) Factor 1 requirements include "Consult level" engagement, "To obtain Community feedback on analysis, alternatives, and/or solutions." Brigham and Women Hospital executed on each of the examples outlined:

- ✓ Public comments- COMPLETED (see attached comments)
- ✓ Focus groups- (HOSPITAL ADVISORY COMMITTEE)
- ✓ Surveys – COMPLETED (see attachment)
- ✓ Community meetings – COMPLETED

# DPH Guidelines

- BWH worked to meet all of the engagement suggestions DPH outlined. See DPH suggestions along with BWH's corresponding actions below.

## DPH Suggestions

## BWH Engagement

Techniques and engagement methods to be used

A verbal presentation was made and printed handouts were distributed.

Need for independent facilitation

Independent facilitator, Sydney Asbury, presented and facilitated a question and answer session.

Location and accessibility of the venue

Community meetings were held at a convenient location for patients, staff, and neighbors. The event location was handicapped accessible.

The number and type of engagement events

Two community meetings held. One was held during the day and the other was in the evening.

Transport requirements

The event location was T accessible.

BRIGHAM HEALTH



BRIGHAM AND  
WOMEN'S HOSPITAL

## DPH Suggestions

Childcare needs  
Format and content of  
communication and publicity  
materials

Use of interpreters and signers

## BWH Engagement

NA  
Email invitation and flyers  
were distributed two weeks  
prior to the event. All  
neighbors, community  
groups, hospital staff, and  
patients were encouraged to  
attend events or email  
questions or comments to  
the event lead.

Interpreters were on site  
and available to meeting  
attendees. Flyers were  
distributed to the  
community were in Spanish  
and English.

## DPH Suggestions

Need for outreach activities

## BWH Engagement

Residents, staff, and patients received emails and flyers notifying them of the event. Flyers distributed to the neighborhood were in Spanish and English.

## **Additional Attachments**

- ***Flyer Attached – English and Spanish versions***
- ***Email Invitation- Attached***
- ***Feedback forms***
- ***Sign-in sheets***

# Community Meetings Held

## ***September 15, 2017 10:00 AM***

- 8 Attendees
- 6 Feedback Forms

## ***September 20, 2017 7:00 PM***

- 10 Attendees
- 4 Feedback forms

# Flyer

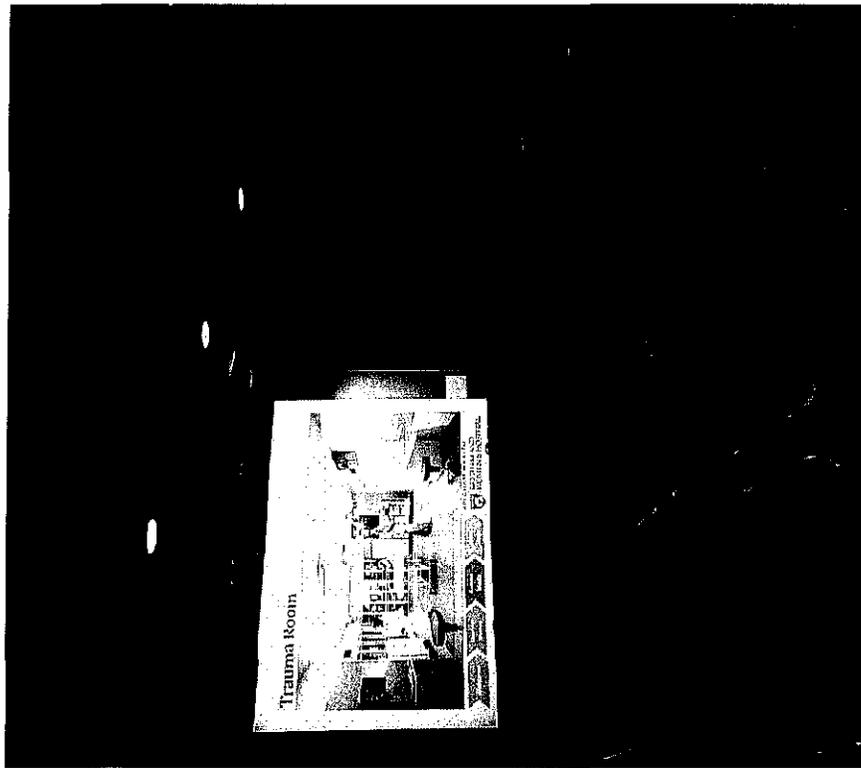
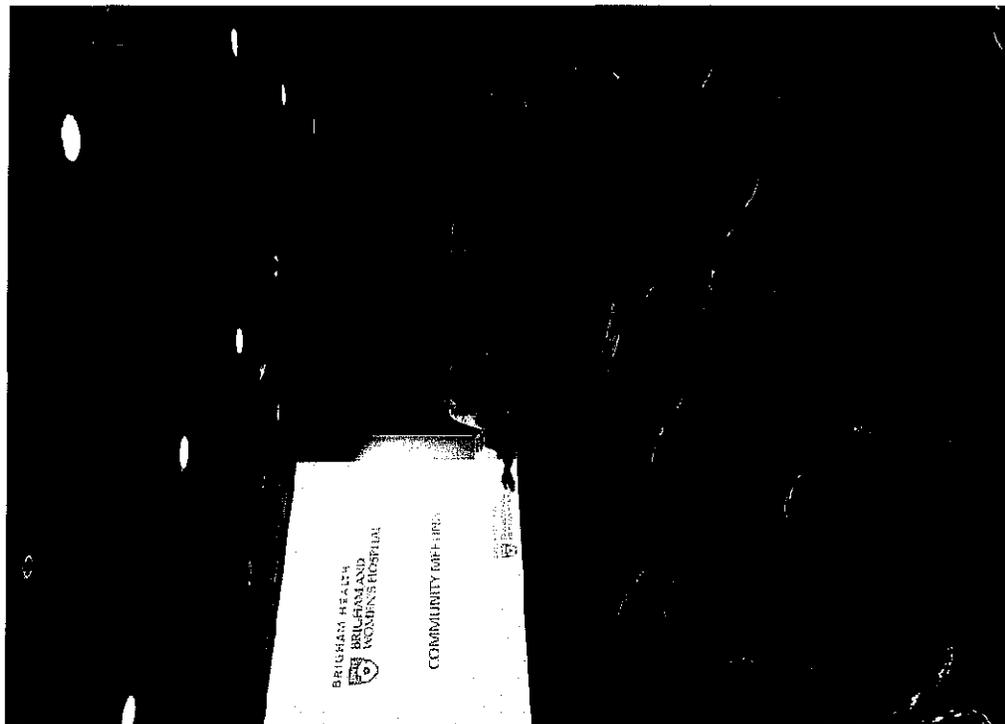


 BRIGHAM HEALTH  
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WOMEN'S HOSPITAL

# Signage for Event



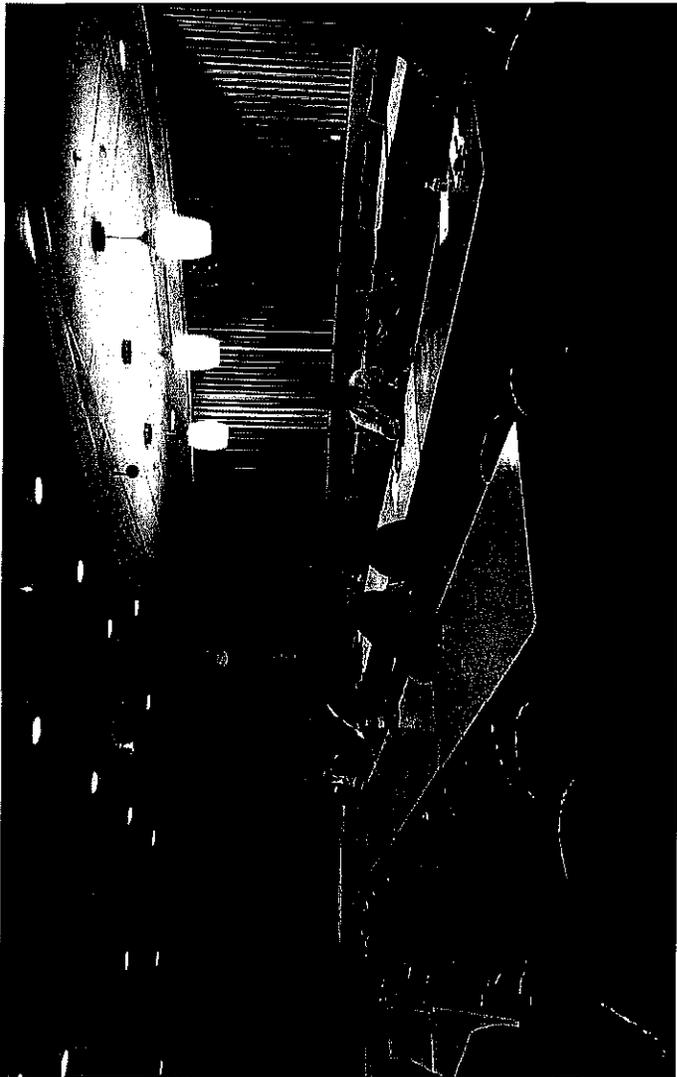
# Sept 15 Event



**BRIGHAM HEALTH**  
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# Sept 20 Event



BRIGHAM HEALTH  
BRIGHAM AND  
WOMEN'S HOSPITAL



**Attachment/Exhibit**

**B**

**Elliott, Deborah**

---

**From:** Elliott, Deborah  
**Sent:** Thursday, September 07, 2017 9:44 AM  
**To:**  
**Subject:** BWH Upcoming Community Presentations  
**Attachments:** BWH Flyer.pdf

Hi Pat,

I hope you had a great summer. I'm writing to let you know of two community meetings BWH is having in the coming weeks to present a few upcoming renovation projects taking place inside the main hospital. Please see attached flyer for dates and additional information. We invite you and your community to attend.

Deborah

**Deborah Elliott, LEED AP**

Project Executive, Real Estate and Facilities Planning

20 Kent Street, 1st Floor | Brookline, MA 02445

(O) 857-307-4032

(C) 781-726-0574

delliott2@bwh.harvard.edu

**BRIGHAM HEALTH**



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WOMEN'S HOSPITAL**

**Elliott, Deborah**

---

**From:** Elliott, Deborah  
**Sent:** Thursday, September 07, 2017 10:12 AM  
**To:**  
**Subject:** BWH Upcoming Community Presentations  
**Attachments:** BWH Flyer.pdf

Hi Mary Ann,

I hope you had a great summer. I'm writing to let you know of two community meetings BWH is having in the coming weeks to present a few upcoming renovation projects taking place inside the main hospital. Please see attached flyer for dates and additional information. We invite you and your community to attend.

Deborah

**Deborah Elliott, LEED AP**

Project Executive, Real Estate and Facilities Planning

20 Kent Street, 1st Floor | Brookline, MA 02445

(O) 857-307-4032

(C) 781-726-0574

delliott2@bwh.harvard.edu



**Elliott, Deborah**

---

**From:** Elliott, Deborah  
**Sent:** Thursday, September 07, 2017 9:44 AM  
**To:** |  
**Subject:** BWH Upcoming Community Presentations  
**Attachments:** BWH Flyer.pdf

Hi Lori,

I hope you had a great summer. I'm writing to let you know of two community meetings BWH is having in the coming weeks to present a few upcoming renovation projects taking place inside the main hospital. Please see attached flyer for dates and additional information. We invite you and your community to attend.

Deborah

**Deborah Elliott, LEED AP**

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**BRIGHAM HEALTH**



**BRIGHAM AND  
WOMEN'S HOSPITAL**

**Elliott, Deborah**

---

**From:** Elliott, Deborah  
**Sent:** Thursday, September 07, 2017 9:44 AM  
**To:**  
**Cc:**  
**Subject:** BWH Upcoming Community Presentations  
**Attachments:** BWH Flyer.pdf

Hi Sara,

I'm following up on a conversation you had a few weeks ago with Steve Dempsey regarding a couple of community meetings BWH is having to present a few upcoming renovation projects taking place inside the main hospital. Please see attached flyer for dates and additional information. We invite you and the MASCO community to attend. If this flyer can be included in upcoming MASCO distribution list emails we would appreciate it.

Deborah

**Deborah Elliott, LEED AP**

Project Executive, Real Estate and Facilities Planning

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(C) 781-726-0574

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**BRIGHAM HEALTH**



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**BRIGHAM HEALTH**



**BRIGHAM AND  
WOMEN'S HOSPITAL**

**Community Meeting**

*Join Brigham and Women's Hospital staff, patients, and neighbors for a presentation on renovations that will be made to the hospital's Emergency Department and additions to the Radiology and Cancer Care Departments*

***Friday, September 15, 2017***

**10:00 AM - 11:00 AM**

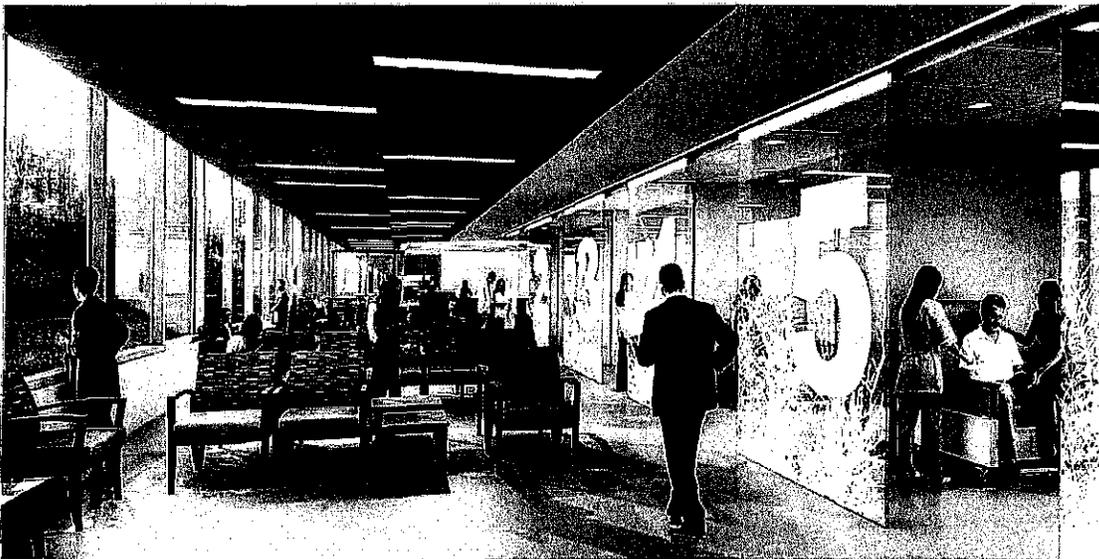
**One Brigham Circle, Ledge Room 4-002B**

**OR**

***Wednesday, September 20, 2017***

**7:00 PM - 8:00 PM**

**One Brigham Circle, Ledge Room 4-002B**



Light refreshments will be provided.

For questions, email [BWHDON@bwh.harvard.edu](mailto:BWHDON@bwh.harvard.edu) or call (857) 307-4032

**BRIGHAM HEALTH**



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Únete con los pacientes, empleados y vecinos del hospital Brigham and Women's para una presentación sobre las renovaciones que van a ocurrir al Departamento de Emergencias y a los Departamentos de Radiología y Cuido del Cancer

**Viernes, 15 de septiembre 2017**

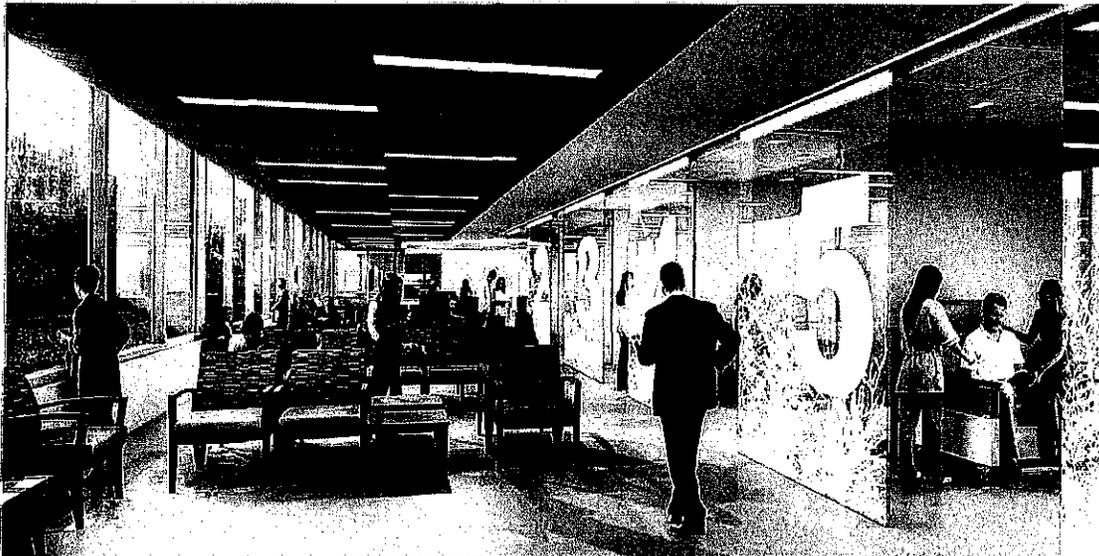
**10:00 AM - 11:00 AM**

**One Brigham Circle, Ledge Room 4-002B**

***Miercoles, 20 de septiembre 2017***

**7:00 PM - 8:00 PM**

**One Brigham Circle, Ledge Room 4-002B**



Refrescos ligeros. Si tiene preguntas porfavor envíe un correo electronico a [BWHDON@bwh.harvard.edu](mailto:BWHDON@bwh.harvard.edu) ó llame al (857) 307-4032

**Attachment/Exhibit**

**C**

9/15/17



Name	Address	Phone	Email
ROBERT CORMACK			
JENNIFER CARDEN			
Jonathan McCabe			
Steu Dempsey			
Michelle Keenan			

9/15/17

Name	Address	Phone	Email
Lani Kurata Robinson			
SARAH MARKANTZ			
Deborah Elliott			

9/20/17



Name	Address	Phone	Email
Steve Dempsey			
Alyssa Rotman			
Monica Hardman			
Jennifer Carcettino			
Lani Kuzo DeBoni			
Deborah Elliot			
Jonny McCabe			
RAY MAX			

9/20/17



Name	Address	Phone	Email
Patricia S. Flaherty			
Mary Ann Nels			

**Attachment/Exhibit**

**D**

**BRIGHAM HEALTH**



**BRIGHAM AND  
WOMEN'S HOSPITAL**

# COMMUNITY MEETING

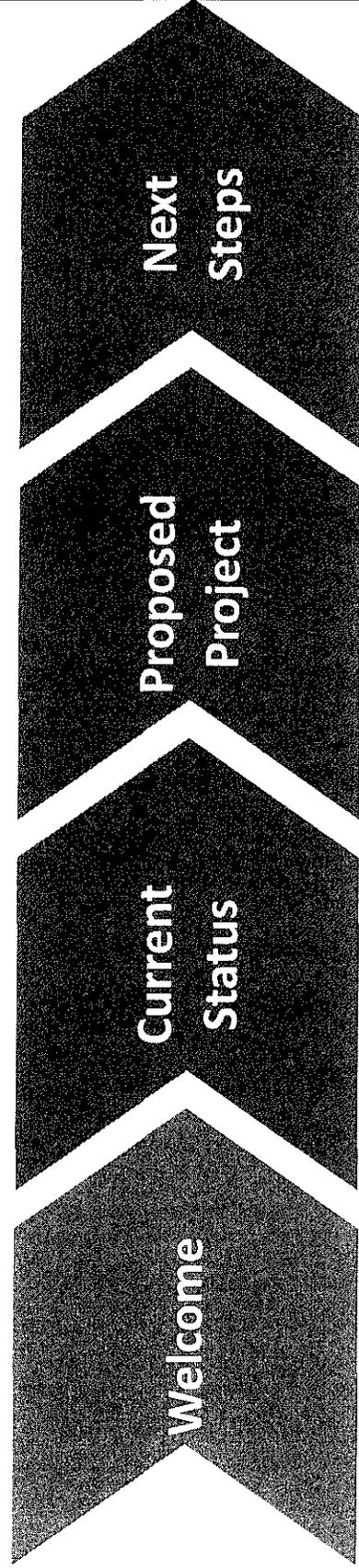
**BRIGHAM HEALTH**



**BRIGHAM AND  
WOMEN'S HOSPITAL**



# Agenda

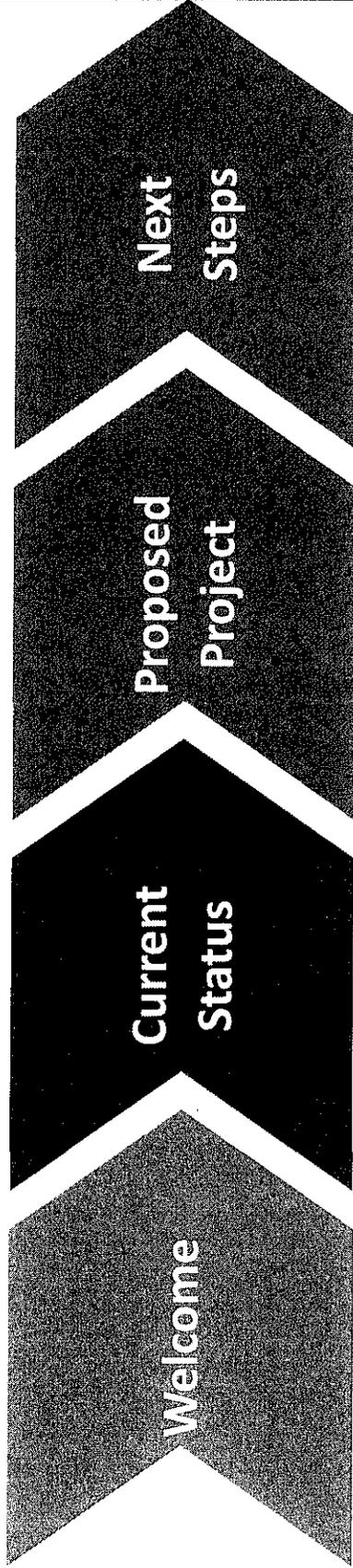


Welcome

Current  
Status

Proposed  
Project

Next  
Steps



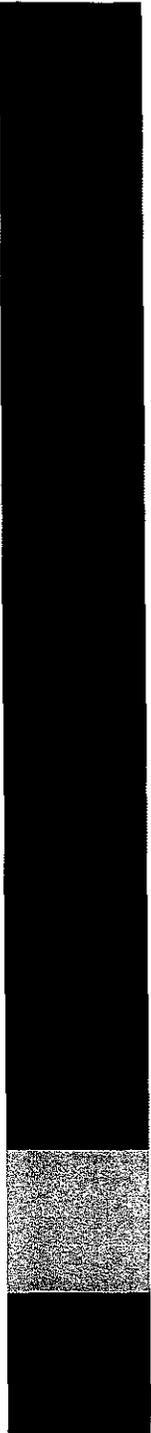
# Who We Are?

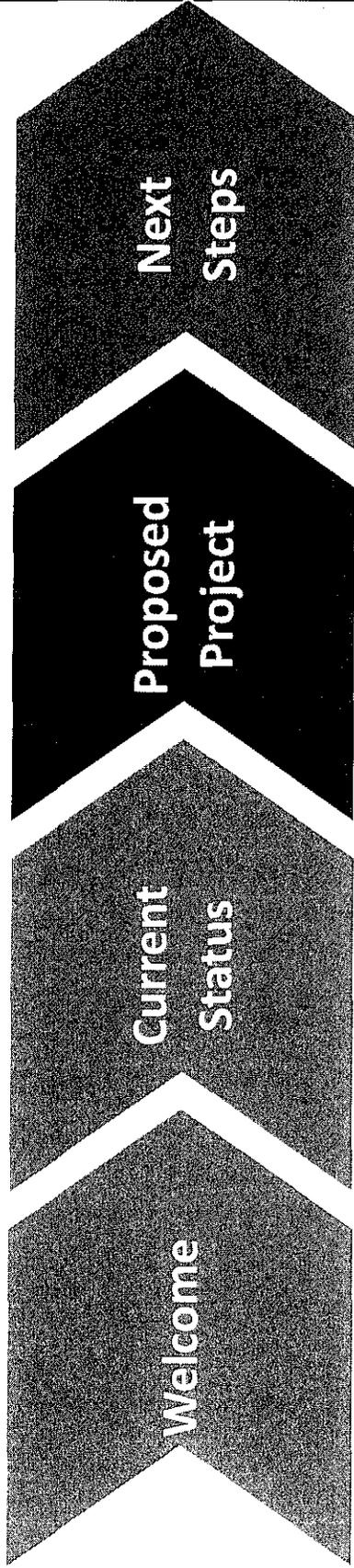
- Brigham and Women's Health Care includes 150 outpatient practices with over 1,200 physicians.
- US News and World Report consistently ranks us a top hospital and among the best in specialty areas including cancer, cardiology and heart surgery, gynecology, neurology and neurosurgery, orthopedics, and rheumatology.



# Beyond Our Walls

- At Brigham and Women's Hospital's we are committed to advancing systems of care, research, and community programs that elevate the health status of the communities we serve.
- Priorities in work beyond our doors
  - ✓ Addressing and reducing health care disparities
  - ✓ Increasing access to care for vulnerable populations
  - ✓ Fostering social and family support systems
  - ✓ Improving knowledge of healthy habits and behaviors
  - ✓ Supporting individuals who suffer with partner abuse





# Internal Modification Plans

1

Emergency Department Renovation

2

Radiation and Oncology Equipment Partnership



# Future Modifications

- Equipment purchases and two renovation projects planned over the next 18 months
- ALL updates are **happening within the walls of the hospital.**
- Construction will follow protocols that have been established in collaboration with you, our neighbors.



# Emergency Department

- We are planning to expand our ED by repurposing existing space that currently adjoins our emergency department.
- All work will be contained within the walls of the hospital.
- Maintain the walk-in entrance off of Francis Street and the ambulance drop off of Shattuck Street.



# Why expand the ED?

- The expansion and redesign of the ED will allow more patients to be seen in a timely fashion in appropriate clinical settings, reducing wait times and walkout rates and increasing overall satisfaction
- There have been other iterations of improvements done over the last ten years, with the most recent improvements being done approximately 6 years ago.



# Waiting Room



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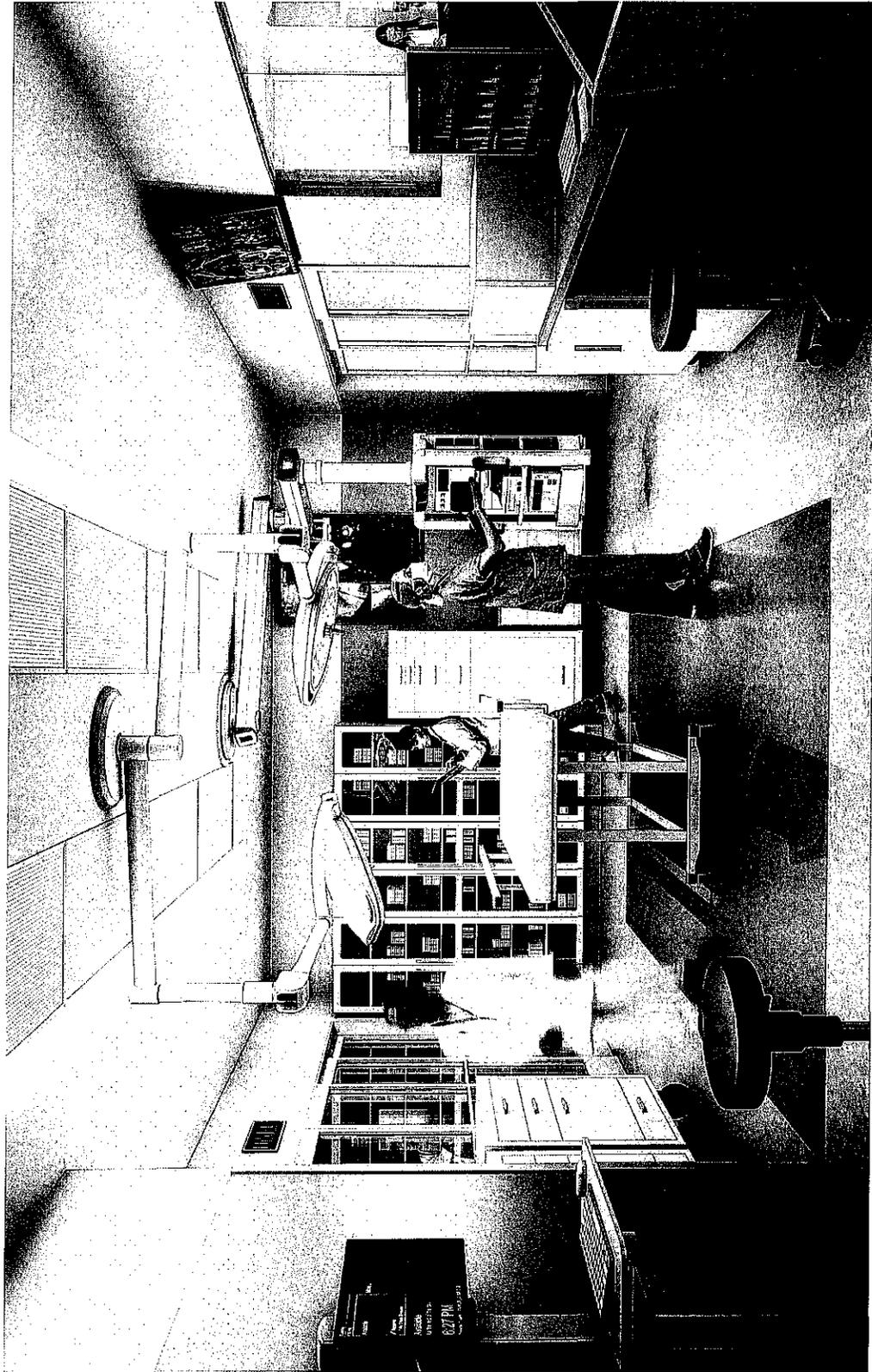
Next  
Steps

Proposed  
Project

Current  
Status

Welcome

# Trauma Room



BRIGHAM HEALTH  
BRIGHAM AND  
WOMEN'S HOSPITAL



Next  
Steps

Future  
Mods

Current  
Status

Welcome

# Radiation Oncology Department

- Renovation plans for 75 Francis Street to house next generation MRI based radiation therapy equipment.
- This project will utilize existing space within the hospital to provide our cancer patients with more precise and effective radiation treatments.



# Oncology Unit



## Oncology Unit

BRIGHAM HEALTH  
BRIGHAM AND  
WOMEN'S HOSPITAL



Next  
Steps

Future  
Mods

Current  
Status

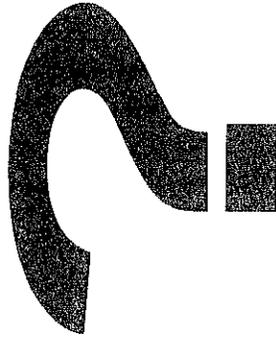
Welcome

# Equipment Modifications

- Planning to replace existing equipment within two new state of the art machines.
  - One 7T MRI will be used for research and clinical purposes.

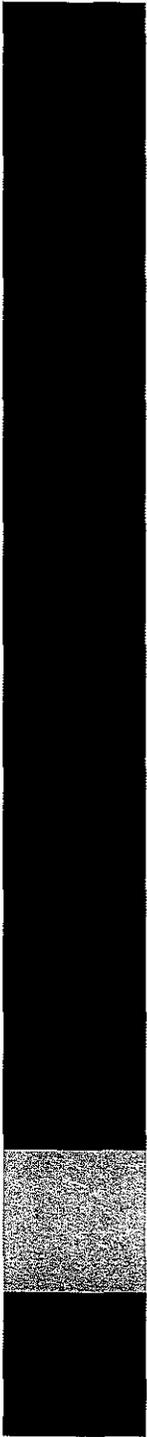


# Questions



# Continuing the Conversation

- We want your feedback. Please fill out a feedback form, or go to our website and let us know your thoughts at [BWHDON@bwh.harvard.edu](mailto:BWHDON@bwh.harvard.edu)



**Attachment/Exhibit**

**E**

**BRIGHAM HEALTH**



**BRIGHAM AND  
WOMEN'S HOSPITAL**

Name \_\_\_\_\_ Address \_\_\_\_\_

Please circle the following:

Staff

Patient

Neighbor

Other

Please describe any experiences or suggestions you have relating to the  
BWH Emergency Department?

---

---

---

Please describe any experiences or suggestions you have relating to the  
BWH Radiology and Cancer Care Departments?

---

---

---

Please provide your email address so we can continue to communicate  
with you in the future: \_\_\_\_\_

## **Community Meeting Feedback**

Given the personal nature of some of the comments received from community members, Feedback Forms received at each of the Community Meetings are on file with the Brigham and Women's Hospital – Center for Community Health and Health Equity.

**Attachment/Exhibit**

**F**



**ED patient and Family Centered Care Committee Meeting**

Facilitator: Jonathan McCabe, RN

Meeting Date: September 28, 2017

Meeting Location: Medical Records Conference Room

1. Introductions – see attached attendee list
2. DoN vs DPH Plan Review
  - Two different submissions. But can run concurrently once drawings get to a point for DPH submission.
3. ED Expansion Update
  - Current Behavioral Health patients treated throughout the department and must be watched by employees. 8 new Behavioral Health Beds with focused care will be in one pod and will have CCTV for monitoring. There will be a bathroom with a shower in this pod due to the population that is seen.
  - Oncology will be focused in the current Charlie Pod without renovation. The beds will be used if needed by non-oncology patients and if there is an over flow up oncology patients, then they won't be refused in the other pods either.
  - There will be 2 new x-ray rooms, relocated into Phase 1 and an additional CT will be added making it 2 for the department, it was decided that there will be no dedicated MRI in the ED.
  - The ambulance bay will not be relocated but there will be a new EMS entrance into the ED for better flow. The current EMS entrance will become their exit.
  - Currently, the Alpha pod is the only 24/7 pod. This function will move into the new space as they can fluctuate, and closedown beds as needed and is more in line with the Radiology function.
  - 18-22 months for Phase 1 new construction, 9-12 months to renovate the new front end in the existing ED space as well as 9-12 months for the behavioral health pod and reading room. If combined into one phase in the existing ED we may be able to save some time in the schedule.
  - Regarding boarder issues, home care for observation, Community Hospitals, Faulkner, NWH, Core Continuum management, project health
  - Current waiting room is down the hall and is not in direct view of staff, the new design will be at the front desk and all the intake areas, so the staff can observe the waiting area.

- 10 Care initiation areas may eliminate the need of putting a patient into a bed as assessment and a trip to x-ray, CT or point of care testing can be done in the immediate area, also added in sub waiting near there so the person can wait for the test results/readings to come back. The goal is not to go back to the main waiting room
- ED staff knows they cannot keep same processes
- All doors, no curtains as the barriers for the rooms
- Consult room for families will be built in







**Attachment/Exhibit**

**4**

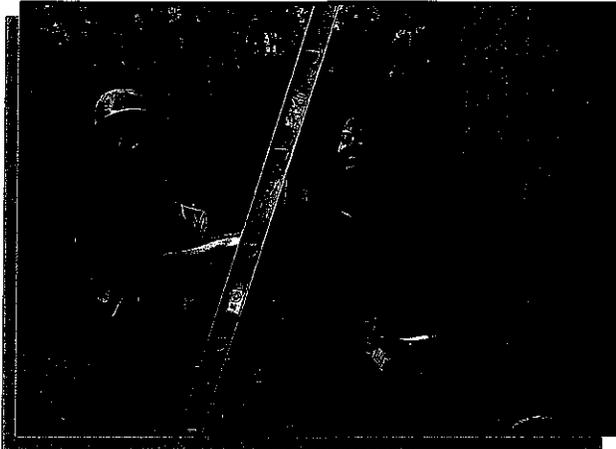
**Attachment/Exhibit**

**A**



# BRIGHAM AND WOMEN'S HOSPITAL

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Community Health  
Needs Assessment  
and Implementation Plan

2016

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## ACKNOWLEDGEMENTS

The Brigham and Women's Hospital 2016 Community Health Needs Assessment and implementation planning process required the contributions of a range of organizations and individuals and we are thankful for their assistance. The Community Health staff of Partners HealthCare provided valuable guidance and access to health and social data. We collaborated with hospitals of the Conference of Boston Teaching Hospitals (CoBTH) in planning, conducting and analyzing findings from neighborhood discussion groups and worked closely with Brigham and Women's Faulkner Hospital throughout the CHNA process. Dr. Justeen Hyde from the Institute for Community Health conducted and analyzed the external key informant interviews.

We also wish to express our gratitude to our community partners who made the community meetings possible. Thank you to David Aronstein at Boston Alliance for Community Health, Rev. Bill Loesch at Codman Square Neighborhood Council, Margaret Noce at Jamaica Plain Tree of Life/Arbol de Vita, Jasmin Johansen at Mattapan United, and Vivien Morris at Mattapan Food and Fitness. We would also like to acknowledge the advisory boards of Southern Jamaica Plain Health Center and Brookside Community Health Center for their participation in this assessment.

We are particularly grateful to the residents of the five neighborhoods who shared their insight and guidance during this process. We learned a great deal from you.

Special thanks to staff at the Center for Community Health and Health Equity who assisted in this process. For their considerable effort, acknowledgement is due to Michelle Keenan, Director for Community Programs, Shirma Pierre, Director for Community Health Operations & Projects, and importantly Sarah Ingerman, who provided invaluable support and expertise throughout the process.

All are welcome to use our findings to inform future practice and create healthier, equitable communities. We request that you please use the following citation: Brigham and Women's Hospital, Center for Community Health and Health Equity (2016). *Community Health Needs Assessment and Implementation Plan 2016*. Boston, MA.

## EXECUTIVE SUMMARY

In 2016, Brigham and Women's Hospital (BWH) embarked on a Community Health Needs Assessment (CHNA) and implementation planning process to inform community-based efforts as well as to adhere to requirements set by the *Patient Protection and Affordable Care Act (the Act)*. This work builds upon the foundation of past assessment work and current investments in advancing health in the BWH priority neighborhoods (Dorchester, Jamaica Plain, Mattapan, Mission Hill and Roxbury). These neighborhoods are cited in the hospital's community benefit mission as a focus for effort with residents who experience disproportionately high rates of poverty, unemployment and chronic disease.

### BWH COMMUNITY HEALTH COMMITMENT

BWH has a long-standing commitment to promoting health equity and reducing health disparities for patients, families, employees, and vulnerable members of the community. As part of this commitment, the BWH Center for Community Health and Health Equity (CCHHE) was established in 1991 to serve as the coordinating department for community health programs and to act as a liaison for community-based organizations and the hospital. The Center works in partnership with other hospital departments and with community health centers, schools, and community-based organizations to identify barriers to health and related services to address the social factors contributing to health and well-being. The Center's programs have evolved over the past two decades and include efforts aimed at eliminating inequities in infant mortality, and cancer; promoting youth development and employment through education and career opportunities; curbing the cycle of violence in our communities and improving knowledge of healthy habits and behaviors.

### ASSESSMENT METHODOLOGY

The *Act* requires hospitals to solicit input from broad interests within the community and those with knowledge and expertise in public health for their assessments. Applying a social determinants of health framework that looks at the social and economic factors that impact a community's health, BWH's community assessment used a mixed methods approach. This included an analysis of key quantitative data and the collection of primary data through key informant interviews, structured community discussion groups, as well as an online community engagement process that engaged a broad range of community residents. The community discussion groups were conducted collaboratively with several other Boston hospitals participating in the Conference of Boston Teaching Hospitals (CoBTH).

### KEY FINDINGS

- Residents of color experience greater poverty, unemployment, lower educational attainment and greater economic vulnerability. Unemployment rates were highest in Mattapan (18.2%) and Dorchester (17.7% in North Dorchester and 15.8% in South Dorchester) compared to Boston overall (10.3%).

- Hispanic/Latino households in Boston had the lowest median household income (\$27,461) and White households had the highest (\$70,644).
- Interpersonal violence and trauma was cited as a major concern among community residents and stakeholders, and in 2012, the homicide rate for Black residents was 19.9 per 100,000 residents in Boston, which was significantly higher than the rate for White residents (2.0).
- Behavioral health concerns emerged as key issues with a specific focus on the availability, cost and cultural accessibility of mental health and substance abuse services.
- Many Boston public high school students (30.1%) and adults (12.2%) reported persistent sadness (feeling sad, blue or depressed 15 or more of the past 30 days). Hispanic/Latino adults were more likely to self-report experiencing persistent sadness compared to White adults.
- Significant health inequities persist across all health conditions examined, including chronic disease, reproductive and sexual health as well as obesity.
- Black and Hispanic/Latino residents were more likely to report having diabetes (14.1% and 12.6% respectively) and hypertension (36.7% and 26.2% respectively) compared to White residents (5.1% and 18.6% respectively).
- Although the rate of uninsured residents in Massachusetts is at historically low levels, models of care that are responsive to the needs of underserved communities are an important area for development.
- Low income residents face multiple access issues, including transportation barriers and the potential negative impact of policy changes in 2016/17 to the Health Safety Net and MassHealth plan enrollment.
- Racial equity was identified as one of the key community health issues in BWH's 2015 on-line, community engagement process *What Matters for Health*. Nearly three-quarters (73%) of respondents to the question on equity indicated that they do not believe the City of Boston is a racially equitable place to live.
- Community residents and other stakeholders underscored the importance of working in partnership with communities and prioritizing sustainable investment that leverages existing community assets and strengths.

Based on these findings and considering the available resources, the interests of BWH's priority communities, and opportunities for collaboration, BWH identified the following priority areas for its implementation plan:

1. Social determinants of health (employment, education, economic stability, and transportation)
2. Interpersonal violence and trauma
3. Behavioral health
4. Health equity
5. Healthcare access

## BACKGROUND

### ABOUT BRIGHAM AND WOMEN'S HOSPITAL

Brigham and Women's Hospital (BWH) is a not-for-profit 793-bed academic medical center located in historic Boston, Massachusetts. A national leader in patient care, research, innovation, education and community health, BWH is a teaching affiliate of Harvard Medical School with specialty care for cancer, heart disease, orthopedic conditions and women's health, including the largest obstetrical program in Massachusetts. Along with its modern inpatient facilities, BWH offers extensive outpatient services and clinics, neighborhood primary care through its two licensed community health centers and primary care sites and state-of-the-art diagnostic and treatment technologies and research laboratories. BWH has more than 4.2 million annual patient visits and nearly 46,000 inpatient stays. Further, as the largest birthing center in Massachusetts, and a regional leader in high-risk obstetrics and newborn care, approximately 6,500 babies are born each year at BWH. Expert newborn care for nearly 3,000 premature and seriously ill babies and their families are provided each year.

To meet the needs of its patient population, BWH and Brigham and Women's Physicians Organization (BWPO) employs approximately 16,000 people. The hospital is a top recipient of research grants from the National Institutes of Health and has ranked on *US News and World Report's* Honor Roll of America's Best Hospitals for 23 consecutive years and in 2015, BWH ranked 6th in the nation.

### BWH COMMITMENT TO THE COMMUNITY

BWH has a long-standing commitment to promoting health equity and reducing health disparities for patients, families, employees and vulnerable members of the community. BWH is particularly committed to working with residents of Boston's diverse neighborhoods to break through the barriers to health – economic, social, educational and cultural – so often encountered by the individuals and families in our community. As part of that commitment, the Center for Community Health and Health Equity (CCHHE) was established in 1991 to serve as the coordinating department for community health programs and acts as a liaison for community-based organizations and the hospital. The CCHHE develops, implements, manages and evaluates initiatives that aim to address and minimize inequities in health status. To achieve these goals, the Center works in partnership with other hospital departments and with community health centers, schools and community-based organizations to identify barriers to healthcare and related services and to address the social factors contributing to health and well being.

The Center's programs have evolved over the past two decades and include efforts aimed at eliminating inequities in infant mortality, and cancer; promoting youth development and employment through education and career opportunities; curbing the cycle of violence in our communities; and improving knowledge of healthy habits and behaviors.

Community Health efforts in FY15 included:

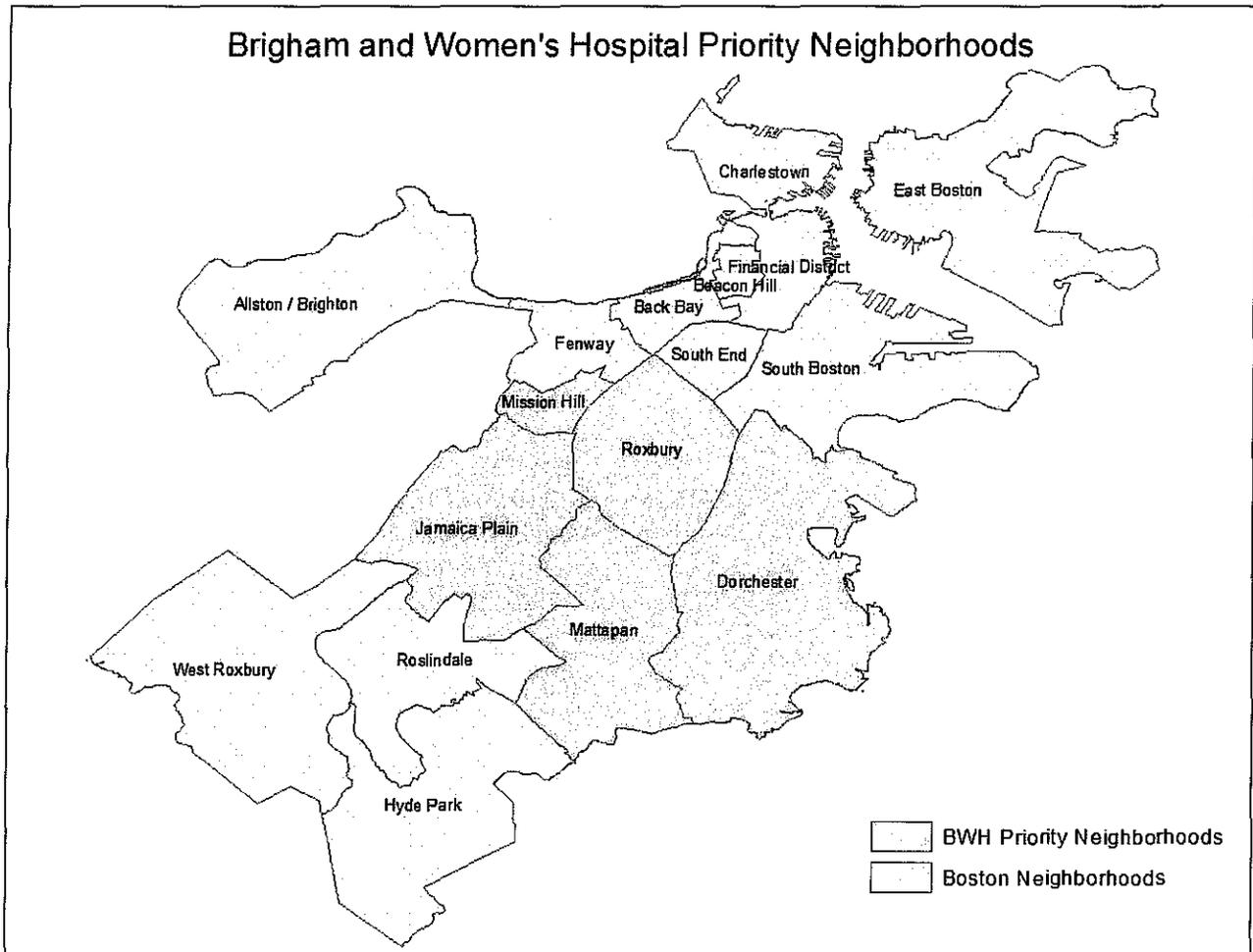
- The Passageway domestic violence program provided 8,322 service contacts to or on behalf of 1,295 clients of Brigham and Women's HealthCare.
- 100% of Student Success Jobs Program participants entered college after completion of the high school program.
- 484 patients were referred to a patient navigator for colorectal cancer screening and colonoscopy; completion rates of screening among health center patients increased from 49% at program inception to 70% in 2015.
- 101 low income women with breast cancer were provided financial assistance to cover expenses associated with their diagnosis that were not covered by insurance.
- Nearly 22,000 patients received care at our two BWH licensed health centers in Jamaica Plain (Brookside Community Health Center and Southern Jamaica Plain Health Center).
- 273 women received pregnancy and parenting services from health center based case managers through the Stronger Generations case management program.
- Over 500 young people received educational support and mentoring from nearly 300 Brigham and Women's employees.

## **BWH'S PRIORITY COMMUNITIES**

This assessment informs BWH's community activities and programs that address the health and well-being of residents of the hospital's priority neighborhoods of **Dorchester, Jamaica Plain, Mattapan, Mission Hill and Roxbury**. The BWH community benefit mission specifically cites these neighborhoods as a focus for effort with residents who experience disproportionately high rates of poverty, unemployment and chronic disease.

As discussed in greater detail in subsequent sections of this report, there are clear variations in the racial and ethnic diversity of Boston's neighborhoods. BWH's priority neighborhoods are home to many of Boston's communities of color. Mattapan, North and South Dorchester, and Roxbury are predominately Black communities (44.0% to 80.4%). Approximately one-quarter of the populations of Roxbury, Jamaica Plain, and North Dorchester are Hispanic/Latino (22.6% to 27.0%).

Figure 1. Map of Brigham and Women's Hospital Priority Neighborhoods, 2016



## THE COMMUNITY HEALTH NEEDS ASSESSMENT PROCESS

The goals of the 2016 Community Health Needs Assessment (CHNA) were to:

1. Identify the health and well-being needs and assets of BWH's target populations in the neighborhoods of Dorchester, Jamaica Plain, Mattapan, Mission Hill and Roxbury
2. Engage community members and other key stakeholders in the process
3. Determine the hospital's priorities for the next three years; and
4. Develop an implementation strategy to address the identified needs

Throughout the course of this CHNA, we worked collaboratively on community engagement and data collection with several other Boston hospitals participating in the Conference of Boston Teaching Hospitals (CoBTH). This assessment and implementation plan build upon the foundation from our last CHNA and our current investments in advancing the health of BWH's priority neighborhoods.

### PAST COMMUNITY HEALTH NEEDS ASSESSMENTS

A comprehensive CHNA was conducted in 2011/12 and in 2013, supplemental CHNA work was conducted to assess any changes and delve further into the themes that had been identified in the earlier assessment work. Our 2013 assessment work engaged over 150 residents and stakeholders in key informant interviews or one of the 13 focus groups conducted at community sites throughout BWH priority neighborhoods.

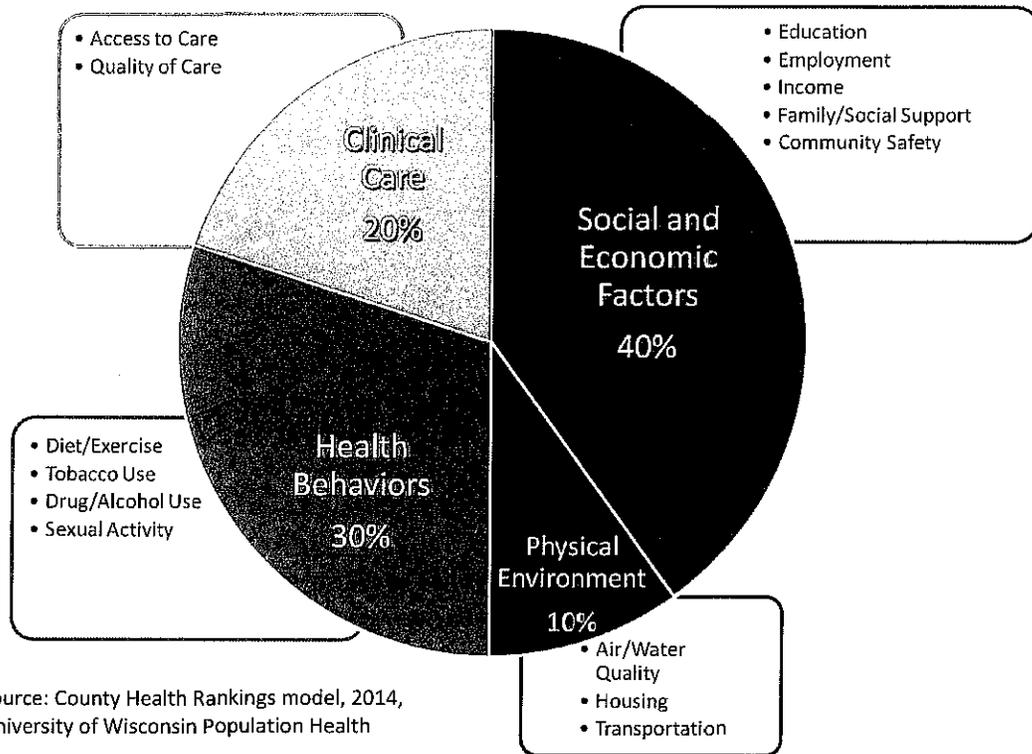
A report on progress on our previous CHNA can be found on the CCHHE's [website](#).

### METHODOLOGY

#### Overall Approach: Social Determinants of Health

The CHNA defines health in the broadest sense and recognizes that factors at multiple levels impact a community's health – from lifestyle behaviors (e.g. diet and exercise), to clinical care (e.g. access to medical services), to social and economic factors (e.g. employment opportunities), to the physical environment (e.g. open space) (Figure 2). This CHNA examined data at all these levels, but considerable focus was given to social determinants of health because of its significant influence on the health and long-term health outcomes of communities. As illustrated in Figure 2 on the following page, social and economic factors have the greatest impact on the health of individuals, and this understanding informed the data we sought and analyzed in the course of the assessment.

**Figure 2: Social Determinants of Health Model**



We understand that where we are born, grow, live, work, and age—from our environment in the womb to our community environment later in life—and the interconnections among these factors are critical to our health. While genes and lifestyle behaviors affect health, it is most profoundly influenced by more upstream factors such as quality of education, economic stability, employment status, quality of housing stock and issues of racial inequity. These factors determine the context in which people live and shape the opportunities that are available to them, which in turn impact their health and the health of their families.

We also approached this assessment with the knowledge that communities of color throughout the nation experience poorer health outcomes, which is very true in Boston as well. There is growing interest and body of research on the health impact of inequality and racism, and this has been a prominent feature of the work of the Boston Public Health Commission and other leading public health organizations in recent years. Racism, a system of advantage based on race, both intersects and compounds the negative impacts of social and economic challenges faced by community members. While people often think of the interpersonal manifestations of racism, the most profound impact of racism is experienced through the systems and institutions in our society, and over time it results in health enhancing opportunities being available to some groups, and not available to others. This is referred to as institutional and structural

racism. Disinvestment in community infrastructure, unequal educational resources and the legacy of redlining in the housing market are illustrations of the policies and structures that reproduce systemic forms of racism. Understanding the health impacts of racism, how it operates in societal structures and within organizations and taking steps towards dismantling these inequities is a crucial area of interest for those seeking to promote health equity. This understanding informs and shapes our community health work at BWH.

#### Data Collection Methods

A mixed methods approach was used for the 2016 CHNA. We included the analysis of key demographic, social, economic and health and well-being data. The Boston Public Health Commission (BPHC) was the primary source of our neighborhood level data. BWH utilization and emergency department data were also analyzed. Primary data were collected through interviews and structured community discussion groups. BWH embarked on an innovative on-line community engagement process entitled *What Matters for Health* that obtained extensive community input from 488 participants. Key reports that analyzed the health and social and economic status of Boston communities also provided valuable data to inform this CHNA. Through these multiple methods, we worked to identify the pressing health and wellness issues facing BWH's priority communities.

BWH collaborated with members of the Conference of Boston Teaching Hospitals (CoBTH) to plan, implement and analyze findings from community meetings in key neighborhoods identified by the group. A core set of questions was developed by participating hospitals to guide meeting discussions (Appendix A). The total number of participants at each meeting ranged from 9 to 20 residents and the meetings averaged 90 minutes in duration. Interpreters were provided at meetings when requested by our community partners. Furthermore, the input of the community advisory boards of Southern Jamaica Plain Health Center (SJPHC) and Brookside Community Health Center (BWH's two licensed health centers), both which are located in Jamaica Plain, was solicited for this CHNA. A forum was conducted with high school students from the CCHHE's Student Success Job Program (SSJP) to learn more about young peoples' perspectives on community health needs.

Key informant interviews were conducted with 6 internal and 9 external stakeholders (Appendix B). These stakeholders were selected based on their strategic areas of expertise and connection to BWH's priority communities. A series of interview questions was created to guide conversations with key informants and to solicit their input and feedback on the health and wellness issues facing BWH's priority communities (Appendices C and D).

**Table 1. Summary of Data Sources Informing 2016 BWH CHNA**

<b>Data Type</b>	<b>Data Source</b>	<b>Notes</b>
<b>Quantitative Data</b>	U.S. Census & American Community Survey	Obtained from and analyzed by Boston Public Health Commission (BPHC)
	Boston Behavioral Risk Factor Surveillance Survey (BBRFSS)	Obtained from and analyzed by BPHC
	Youth Risk Behavior Survey (YRBS)	Obtained from and analyzed by BPHC
	Vital Statistics	Obtained from and analyzed by BPHC
	BWH Utilization Data	Obtained from BPHC (an internal Partner's HealthCare service utilization and billing database)
	BWH Emergency Department Data	Obtained from Partner's HealthCare, Massachusetts Data Warehouse Database
<b>Qualitative Data</b>	Community meetings with residents of priority neighborhoods	5 conducted in the following neighborhoods: Jamaica Plain, Roxbury, Brighton Center (Dorchester), Mattapan, and Codman Square (Dorchester); 79 residents attended in total
	Meetings with community advisory boards at Southern Jamaica Plain Health Center and Brookside Health Center	2 conducted
	Forum with high school students involved with the Student Success Job Program	1 conducted
	Interviews with internal stakeholders	6 conducted
	Interviews with external stakeholders	9 conducted; interviews conducted by sub-contractor, the Institute for Community Health
<b>Reports</b>	BPHC's <i>Health of Boston</i> report	Published 2014-2015
	Federal Reserve Bank of Boston's <i>The Color of Wealth in Boston</i> report	Published 2015
	<i>What Matters for Health: A Community Health Planning Report</i>	Published 2015 and available on the CCHHE website, this report details the analysis of over 8,000 comments from 488 participants in an innovative on-line game that BWH undertook to explore perceptions and recommendations from community members on personal, neighborhood and citywide health issues.

In addition to the data sources listed above, information from the following sources informed sections of this CHNA:

- Brigham and Women’s Hospital (<http://www.brighamandwomens.org/>) and Partners HealthCare (<http://www.partners.org/>) websites
- The County Health Rankings & Roadmaps, which is a collaboration between the Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute (<http://www.countyhealthrankings.org/>)
- The U.S. Bureau of Labor Statistics (2014-2016) (<http://www.bls.gov/>)
- Fair Public Transportation Report: Community Health Center Directors Roundtable (December 2015)
- The Democracy Collaborative’s *Can Hospitals Heal America’s Communities?*, written by Tyler Norris and Ted Howard (December 2015) (<http://democracycollaborative.org/content/can-hospitals-heal-americas-communities-0>)
- The American Public Health Association’s website and section on “Racism and Health” (<https://www.apha.org/topics-and-issues/health-equity/racism-and-health>)
- The U.S. Department of Health and Human Services’ HealthyPeople 2020 website (<https://www.healthypeople.gov/>)
- The Blue Cross Foundation and the Urban Institute’s *Summary of Health Insurance Coverage and Health Care Access and Affordability in Massachusetts: 2015 Update* (March 2015) ([http://bluecrossfoundation.org/sites/default/files/download/publication/MHRS\\_2015\\_Summary\\_FINAL.pdf](http://bluecrossfoundation.org/sites/default/files/download/publication/MHRS_2015_Summary_FINAL.pdf))
- The Center for Health Information and Analytics (CHIA)’s “Annual Report Premiums Databook” (updated November 2015) (<http://www.chiamass.gov/premiums/>) and “The Performance of the Massachusetts Healthcare System Series – Massachusetts High Deductive Health Plan Membership” (Updated November 2015) (<http://www.chiamass.gov/the-performance-of-the-massachusetts-health-care-system-series/#hdhp>)

#### Limitations and Considerations

It is also important to note specific methodological considerations as we embarked on our CHNA work, as well as limitations that are characteristic of applied research efforts. Specifically;

- Every effort was made to ensure diverse and broad participation in the community throughout the CHNA data collection and analysis process.
- Community meetings were conducted to obtain more in-depth, meaningful conversations from a wide sampling of community members.
- Key informant interviews were held to ensure that the perspectives of specific internal and external sub-groups were represented.
- There was very limited health and other data specific to the neighborhood of Mission Hill. Available data typically includes Mission Hill within the larger community of Roxbury.

## NEEDS ASSESSMENT FINDINGS

This section presents key findings from the BWH's 2016 CHNA, which are organized into the following subsections:

- Community demographics
- Social determinants of health
- Interpersonal violence and trauma
- Behavioral health
- Health equity
- Access to healthcare; and
- Approach to working with communities.

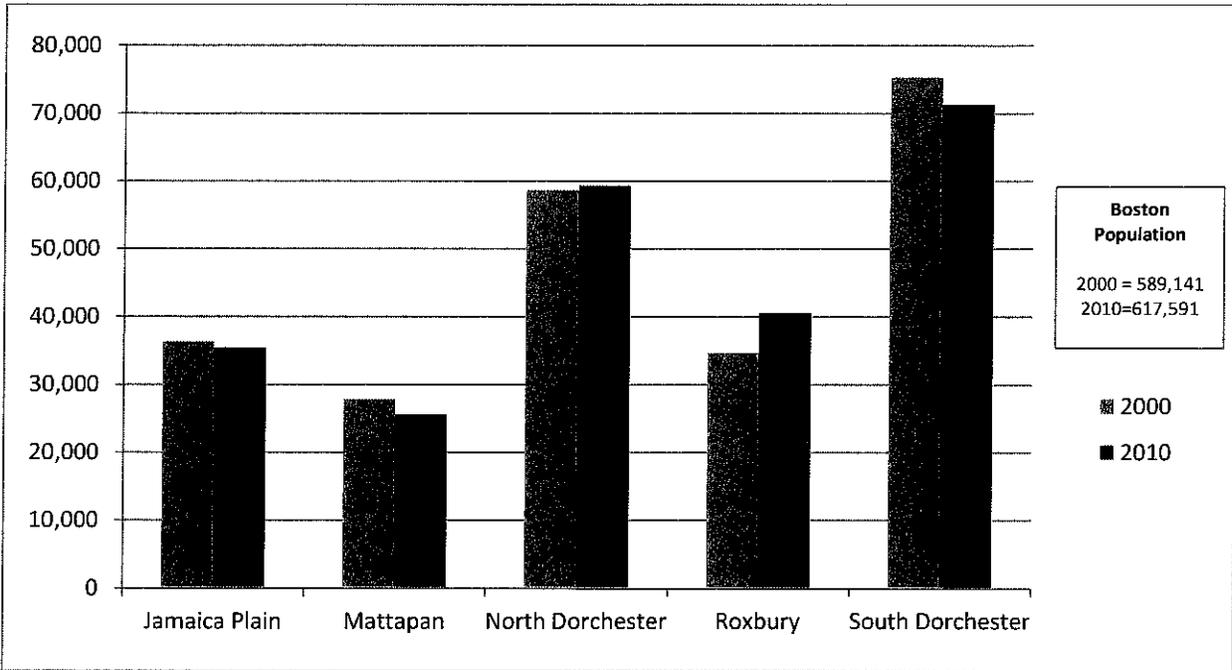
### COMMUNITY DEMOGRAPHICS

The health of a community is associated with numerous factors, including what resources and services are available (e.g. safe green space, access and affordability of healthy foods) as well as who lives in the community. The section below provides an overview of the population of Boston and of BWH's priority neighborhoods of Dorchester, Jamaica Plain, Mattapan, Mission Hill and Roxbury. The demographics of a community are important to understanding health outcomes and behaviors of that area. While age, gender, race and ethnicity are important characteristics that impact on an individual's health, the distribution of these characteristics in a community and the social and economic opportunities available (or not readily available) to a group are key to our understanding of what supports a healthy community. Please note, the population, age distribution, and race/ethnicity data included in this section are informed by the 2010 U.S. Census, the most recently available Census data.

#### Population

In 2010, Boston's total population was estimated to be 617,591 people, a growth of almost 5% since 2000, when the city's population was 589,141. Over the past decade, several Boston neighborhoods have experienced growth rates similar to that of the city overall. Notably, Roxbury, with a 16.9% increase in population, has seen the most substantial growth among BWH's priority neighborhoods. Of the seventeen neighborhoods that comprise the City of Boston, four experienced a decrease in their populations over the past decade—and three of which are BWH's priority neighborhoods (Jamaica Plain [-2.5%], Mattapan [-8.1%], and South Dorchester [-5.4%]). (Figure 3)

**Figure 3: Total Population by Priority Neighborhoods, 2000-2010**



DATA SOURCE: BPHC's *Health of Boston* Report 2014-2015

**Age Distribution**

While there have been fluctuations over time, the percent of residents aged 15-24 and 45-64 has generally increased since 1990. Residents aged 25-34 have seen the largest proportional decrease in total population between 1990 and 2010. Table 2 presents the age distribution in Boston by priority neighborhood. In 2010, Jamaica Plain was the neighborhood with the lowest percentage of youth aged 14 years and under (12.8%), while Roxbury had the highest (22.3%). Meanwhile, Mattapan had the highest percentage of adults aged 65-74 years (6.7%), while North Dorchester had the lowest (4.7%).

**Table 2: Age distribution by city and priority neighborhoods, 2010**

	<b>Boston</b>	<b>Jamaica Plain</b>	<b>Mattapan</b>	<b>North Dorchester</b>	<b>Roxbury</b>	<b>South Dorchester</b>
Under 5 years	5.2%	5.2%	6.9%	5.8%	7.5%	6.8%
5-14 years	8.6%	7.6%	14.6%	9.7%	14.8%	13.3%
15-24 years	22.4%	21.9%	16.6%	20.0%	17.7%	15.4%
25-34 years	20.7%	21.2%	13.1%	20.4%	14.5%	15.2%
35-44 years	12.5%	12.7%	13.4%	13.9%	12.6%	14.8%
45-64 years	20.4%	20.7%	24.6%	21.9%	23.6%	24.2%
65-74 years	5.3%	5.7%	6.7%	4.7%	5.5%	5.9%

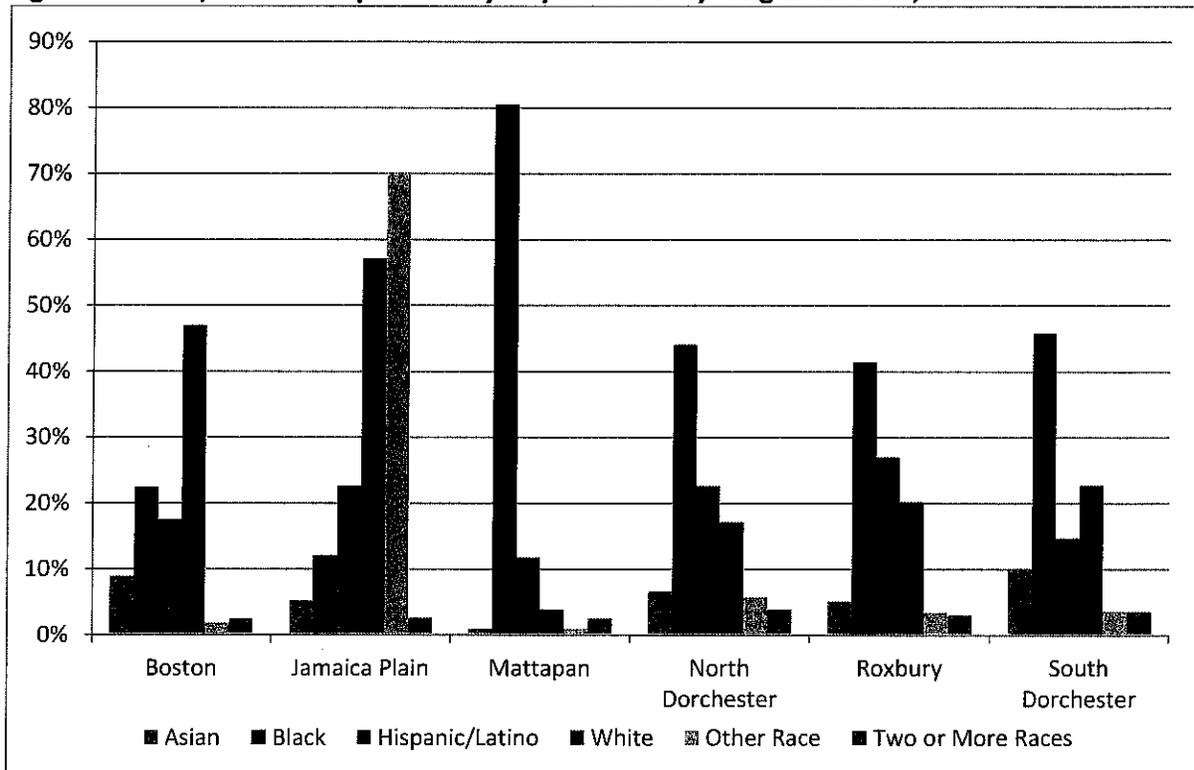
DATA SOURCE: U.S. Department of Commerce, Bureau of the Census, American FactFinder, 2010 Census

### Racial and Ethnic Diversity

Quantitative results illustrate that some neighborhoods exhibit greater resident diversity than others. Racial/ethnic diversity is also increasing; a greater proportion of the city identified as non-White than reported in the last several years. Although nearly half of all Boston residents were White (47%) in 2010, there is substantial variation in the racial and ethnic diversity stratified by neighborhood. (Figure 4)

For example, in the North End, South Boston, Back Bay, Charlestown, West Roxbury, Fenway, and Allston/Brighton, at least two-thirds of residents are White (64.7%-91.8%). In contrast, Mattapan, North and South Dorchester, Hyde Park, and Roxbury are predominantly Black communities (41.4%-80.4%). More than half of East Boston residents (52.9%) and about one quarter of Roxbury's population (27.0%), Roslindale's population (25.9%), Jamaica Plain's population (22.6%), and North Dorchester's population (22.6%) are Hispanic/Latino. In Chinatown, about half of residents are Asian (48.3%). Additionally, while English was the most common language spoke at home in Boston (63.4%), other languages included Spanish or Spanish Creole (15.9%), French Creole (5.1%), Chinese languages (4.2%), and Vietnamese (1.7%).

**Figure 4: Racial/Ethnic Composition by City and Priority Neighborhoods, 2010**



NOTE: 'Other Race' consists of American Indians/Alaskan Natives and Some Other Races

DATA SOURCE: BPHC's *Health of Boston* Report 2014-2015

### BWH Specific Data on Priority Communities

In FY2015, BWH served approximately 281,300 individuals<sup>1</sup>; one-quarter of BWH's patients during this time were residents of the City of Boston (24.7%, n=69,400). Of BWH's patients who resided in Boston, nearly half (49.0%) were residents of one of BWH's priority neighborhoods (Table 3). When examining payor information, we see that 37.6% of patients from BWH's priority neighborhoods were insured by public payors (i.e. Medicaid, Health Safety Net and CommCare/ConnectorCare) and 62.4% were insured by all other payors.<sup>2</sup> BWH patients from North Dorchester (54.0%), Roxbury (45.9%), Mattapan (43.2%), and South Dorchester (43.1%) were more likely to be insured through public payors compared to BWH patients from Jamaica Plain (27.2%) and patients citywide (16.2%) (Figure 5).

**Table 3: BWH Patient Population by City and Priority Neighborhood, FY 2015**

<b>Geography</b>	<b>Percentage of BWH Patients From Specified Geographies (Out of Total Patient Population)</b>
<b>City of Boston</b>	<b>24.7% (N=69,353)</b>
<b>BWH Priority Neighborhoods</b>	<b>12.1% (n=33,929)</b>
<b>Jamaica Plain</b>	<b>3.6% (n=10,027)</b>
<b>Mattapan</b>	<b>1.0% (n=2,820)</b>
<b>North Dorchester</b>	<b>2.4% (n=6,803)</b>
<b>Roxbury</b>	<b>2.6% (n=7,368)</b>
<b>South Dorchester</b>	<b>2.5% (n=6,911)</b>
<b>Other Boston Neighborhoods</b>	<b>12.6% (n=35,424)</b>

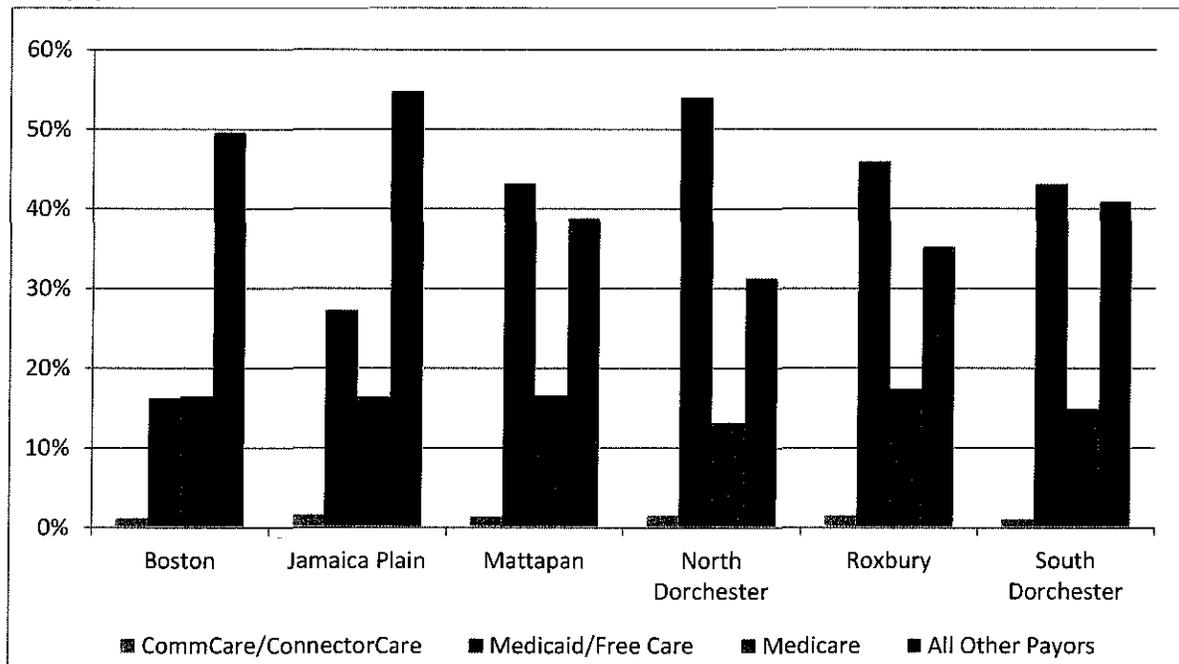
DATA SOURCE: EPSi (an internal Partners HealthCare service utilization and billing database)

NOTE: These data do not include patients served by BWPO

<sup>1</sup> These data do not include patients served by Brigham and Women's Physicians Organization (BWPO).

<sup>2</sup> These data do NOT include BWPO data. All other payors includes commercial insurance, self pay, other and unknown.

**Figure 5: Payor Information of BWH Patient Population by City and Priority Neighborhood, FY 2015**

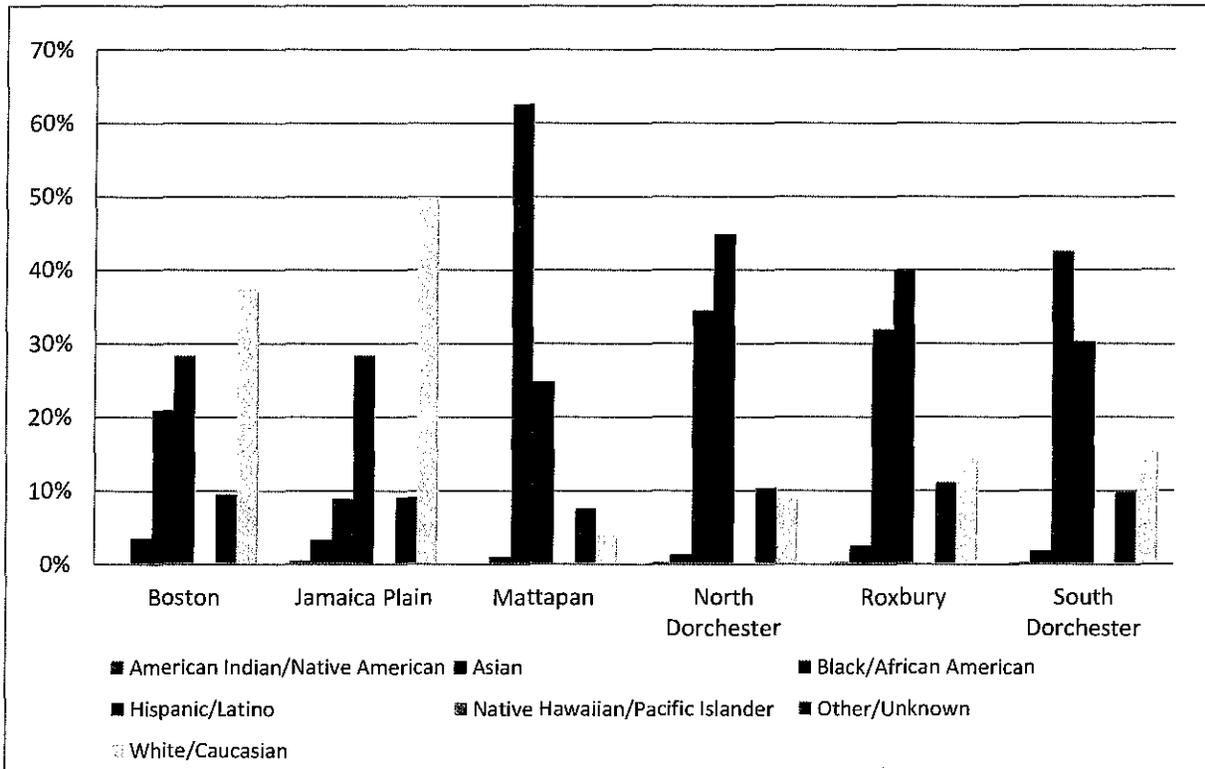


DATA SOURCE: EPSi (an internal Partners HealthCare service utilization and billing database)

NOTE: These data do not include patients served by BWPO

Looking at BWH patient data by race/ethnicity, there is substantial variation in the race/ethnicity of BWH's patient population across priority neighborhoods. For instance, in FY2015, Mattapan had the largest Black/African American patient population (62.6%) and North Dorchester and Roxbury had the largest Hispanic/Latino patient populations (44.9% and 39.9% respectively). (Figure 6)

**Figure 6: Race/Ethnicity of BWH Patient Population by City and Priority Neighborhood, FY 2015**



DATA SOURCE: EPSi (an internal Partners HealthCare service utilization and billing database)

NOTE: These data do not include patients served by the Brigham and Women’s Physicians Organization

**SOCIAL DETERMINANTS OF HEALTH**

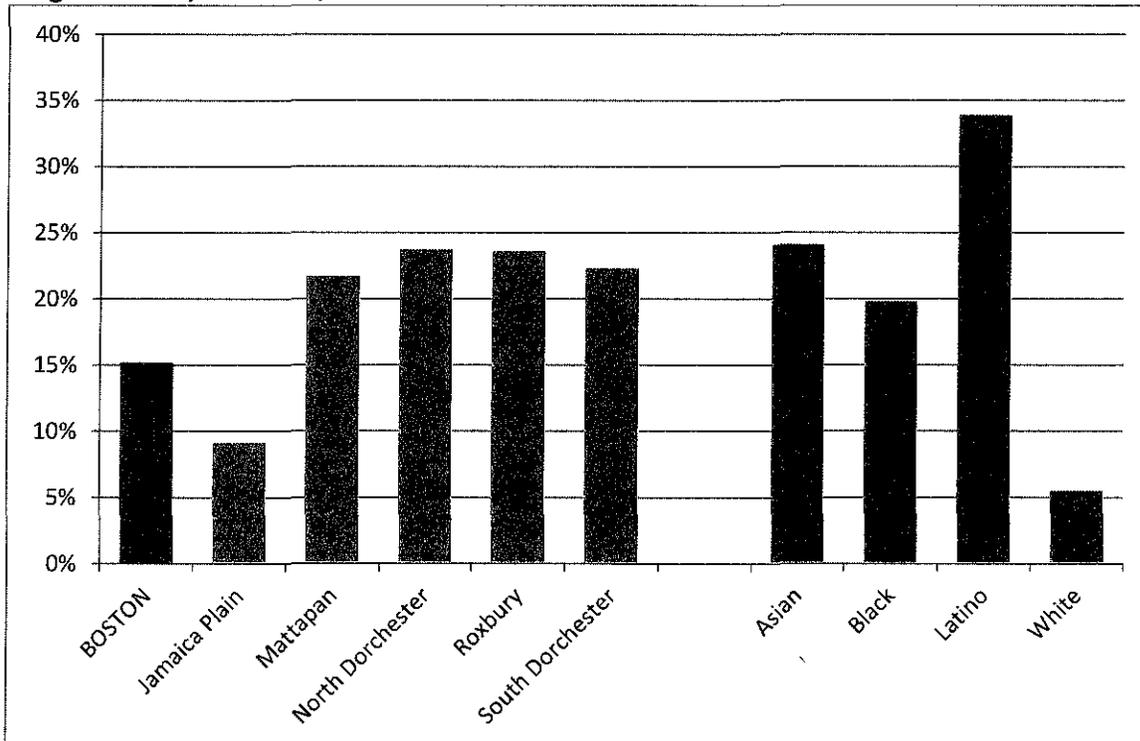
As previously noted, at the foundation of this report is an understanding of social determinants of health and the ways in which important contextual factors, including social, economic, and physical environments, have a significant impact on the health and well-being of individuals and communities. This section presents the findings on various social determinants of health that emerged strongly through the quantitative and qualitative data. These determinants include education, employment, economic stability, housing, transportation, community cohesion, and youth and youth development.

**Education**

Quantitative data demonstrate some variation in educational attainment across the priority neighborhoods and substantial variation by race (Figure 7). Nearly one-quarter of adults (18 years of age or older) in North Dorchester (23.7%), Roxbury (23.6%), South Dorchester (22.3%), and Mattapan (21.7%) had less than a high school diploma compared to 15.2% citywide. Jamaica Plain had the lowest percentage of adults with less than a high school diploma (9.1%).

The data also show that the percentage of residents in Boston with less than a high school diploma or GED is highly differentiated by race. Specifically, 33.9% of Hispanic/Latino adults, 24.1% of Asian adults and 19.8% of Black adults are without this qualification compared to 5.5% of White Boston residents.

**Figure 7: Percentage of Adults (18+) with Less than a High School Diploma by City, Priority Neighborhood, and Race, 2012**



DATA SOURCE: BPHC's *Health of Boston* Report 2014-2015

The Federal Reserve Bank of Boston's *The Color of Wealth in Boston* (2015) report analyzes educational attainment by specific racial and ethnic groups in the Boston Metropolitan Statistical Area. This report indicates that Puerto Ricans and Dominicans were the least likely to have a bachelor's degree or higher (17% and 11% respectively); these percentages are far less than that of White residents (55%) and other nonwhite groups.<sup>3</sup>

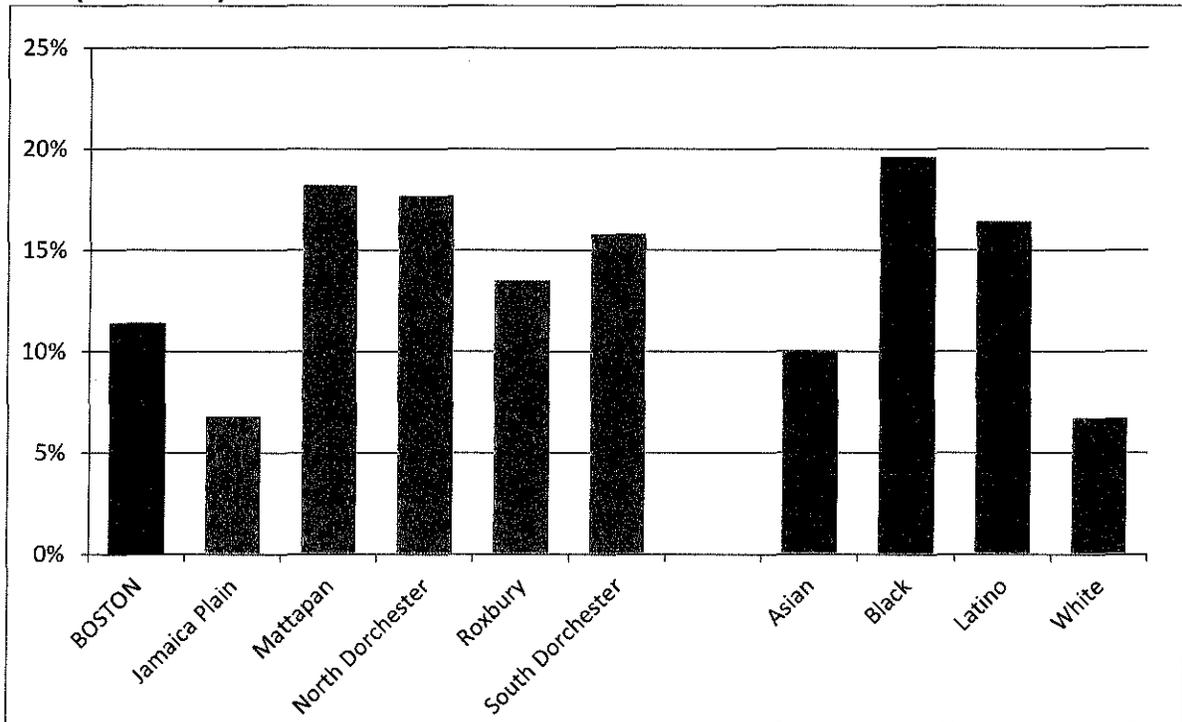
### Employment

Quantitative data show disproportionate unemployment rates among some population groups. The unemployment rate for Boston residents 16 years of age or older decreased from 4.9% in December 2014 to 4.4% as of March 2016.

<sup>3</sup> *The Color of Wealth in Boston* report targets the following nonwhite groups: multigenerational African Americans/U.S. Blacks; Caribbean Blacks; Cape Verdeans; Puerto Ricans; and Dominicans.

For the combined years of 2010 through 2012, the unemployment rate was highest among Black (19.6%) and Hispanic/Latino (16.4%) residents; these percentages were more than double the unemployment rate of White residents (6.7%). There were variations in the unemployment rate among BWH’s priority neighborhoods. For the combined years of 2008 through 2012, residents of Mattapan (18.2%), North Dorchester (17.7%), South Dorchester (15.8%), and Roxbury (13.5%) were all more likely to be unemployed compared to residents citywide (10.3%)<sup>4</sup> and of Jamaica Plain (6.8%). (Figure 8)

**Figure 8: Unemployment Rate by City (2010-2012), Priority Neighborhood (2008-2012) and Race (2010-2012)**



DATA SOURCE: BPHC’s *Health of Boston Report 2014-2015*

### Economic Stability

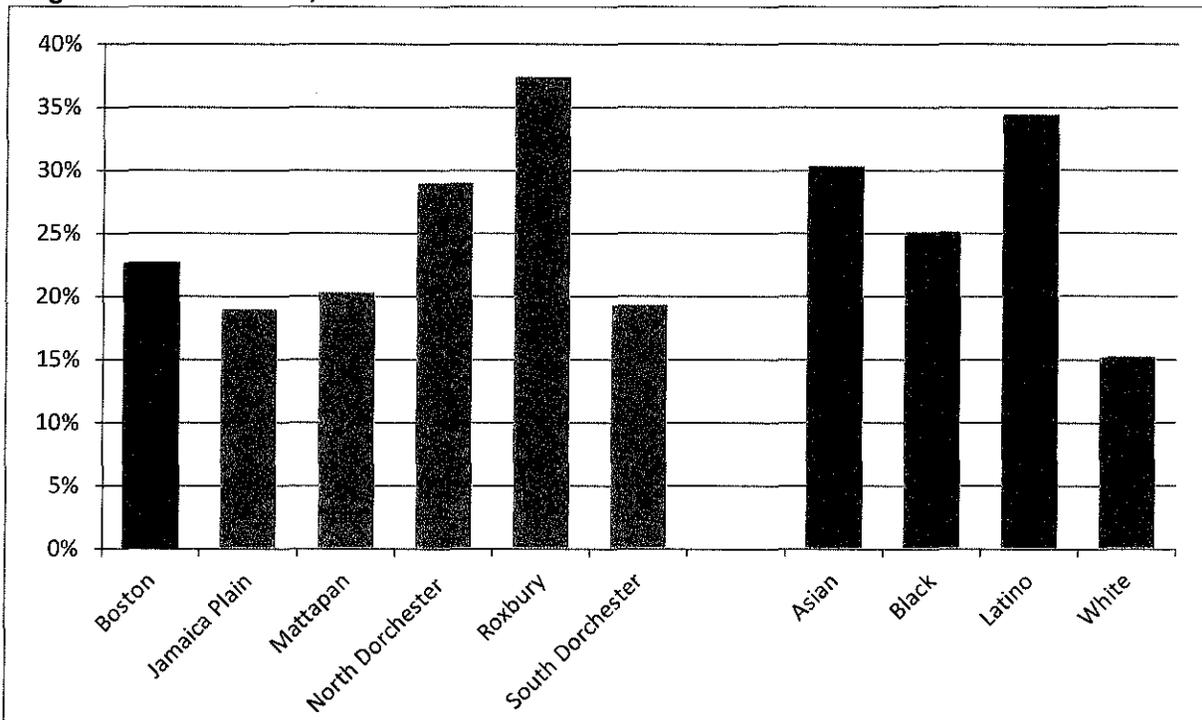
Economic data demonstrate considerable proportions of neighborhood residents living in poverty and substantial income inequities by race and ethnicity. For the combined years of 2008 through 2012, the median household income in Boston was \$51,452. Yet, the median income for Hispanic/Latino households (\$27,461) was less than half of the median income for White households (\$70,644). The median income for Asian households (\$36,419) and Black households (\$37,385) was also considerably less than that of White households.

<sup>4</sup> This citywide unemployment rate is based off data from the U.S. Census Bureau’s American Community Survey, 2008-2012. Please note: the U.S. Census Bureau utilizes a different methodology for calculating unemployment rates compared to the Bureau of Labor Statistics.

Furthermore, in the Boston Metropolitan Statistical Area<sup>5</sup>, Dominicans and Puerto Ricans have the lowest median family income (\$37,000 and \$25,000 respectively); this is substantially lower compared to the median family income of White residents (\$90,000). Differences in median household income by priority neighborhood were evident as well. Households in Roxbury (\$27,051 for ZIP Code 02119 and \$32,367 for 02120) and North Dorchester (\$30,419 for ZIP Code 02121 and \$30,823 for 02215) had the lowest median household incomes, followed by Mattapan, South Dorchester (\$48,329 for ZIP Code 02122 and \$51,798 for 02124) and Jamaica Plain (\$74,198).

Additionally, poverty rates vary by race and by priority neighborhood (Figure 9). Hispanic/Latino families (34.4%) and Asian families (30.3%) were more likely to live below the Federal Poverty Level (FPL) than families citywide (23.0%). Comparing BWH's priority neighborhoods, the greatest percentage of families living in poverty were residents of Roxbury (37.4%) and North Dorchester (29.0%).

**Figure 9: Percentage of Families Living Below the Federal Poverty Level by City, Priority Neighborhood and Race, 2010-2012**



DATA SOURCE: BPHC's *Health of Boston* Report 2014-2015

According to the National Asset Scorecard for Communities of Color (NASCC), White households were more likely to hold every type of asset (i.e. savings and checking accounts, money market funds, government bonds, stocks, retirement accounts, business equity, life insurance, houses,

<sup>5</sup> *The Color of Wealth in Boston* report provides an analysis of data for the Boston Metropolitan Statistical Area, which includes counties outside of the City of Boston and Suffolk County.

vehicles and other real estate) in comparison to the other racial and ethnic group in the Boston Metropolitan Statistical Area. In general, Puerto Ricans and Dominicans were the most asset poor. Additionally, Whites had a substantially higher total median wealth (\$247,500) compared to nonwhite groups; Dominicans and U.S. Blacks had the lowest net worth at a median wealth of close to zero. Overall, these data highlight the severe financial vulnerability faced by nonwhite households in the Boston Metropolitan Statistical Area.

Poverty and income inequality were strong themes that emerged across key informant stakeholder interviews. Stakeholders specifically discussed the implications of poverty on the ongoing health and wellness of BWH's priority communities. Interviewees mentioned the growing gap between rich and poor communities in Boston, unemployment, the impact of gentrification, and the slow economic recovery in Boston's poorest communities. Stakeholders noted that these structural issues frequently take precedent over health concerns for many residents. Moreover, members of one of the health center community advisory boards discussed the impact of parents working multiple jobs in order to support their families, specifically to pay for rising housing and food costs. Members noted that this economic pressure results in children and youth being left at home alone or "out on the streets."

### Housing

Concerns regarding housing were voiced in the key informant interviews and community meetings. Key informant stakeholders highlighted issues surrounding the skyrocketing housing costs and unstable housing situations for many of Boston's low-income residents. Interviewees

*"We are seeing more [housing] instability than we have ever seen, especially in our early childhood programs. When your housing is unstable, everything else becomes unstable – your connections to schools, your healthcare, everything."*  
-- Key Informant Stakeholder

also spoke to, what they believe are, historic levels of displacement and instability. Finally, stakeholders expressed concern regarding the poor quality of low-income housing in Boston, and named the high rates of childhood asthma and unintentional injuries among seniors as some of the health problems that residents face living in low-income housing.

Additionally, community residents spoke strongly of their concern regarding a lack of affordable housing in their neighborhoods and the stress that high housing costs can impose on a community. In reference to the challenge seniors' face paying for rising housing costs, one resident stated, "Do I get a reverse mortgage, or do I move out of this community?" Advisory board members of the community health centers echoed these concerns and also discussed the impact of gentrification on their community. These sentiments were raised in the BWH *What Matters for Health* process as well. Participants reported that increasing the availability of affordable housing would improve the health of neighborhoods and the City of Boston overall.

The cost of housing is a particular concern for renters. A greater percentage of Boston residents rent (66.0%) than own homes (34.0%). While this is consistent across Boston, percentages vary by neighborhood. Among the priority neighborhoods, Roxbury has the highest

percentage of residences that are renter-occupied (84.0%), while Jamaica Plain has the highest percentage of residences that are owner-occupied (46.0%).

### Transportation

Participants of community meetings, health center community advisory board discussions, and the Students Success Jobs Program (SSJP) student forum underscored the need to improve transportation systems across BWH's priority neighborhoods. Residents specifically cited insufficient and unreliable modes of transportation, which can impact community members' ability to travel to healthcare appointments and access health care. Participants noted that elderly residents have a particularly difficult time accessing transportation services. Participants mentioned that for elderly community members interested in accessing services in the community, there are limited transportation options to access these services. SSJP students also voiced concerns regarding transportation access and stated that some communities feel very isolated.

There are several direct negative impacts of poor public transportation, including: missed primary care appointments and decreased pharmacy access; increased stress due to long commutes and unreliable service; increased chronic hospitalizations and ER visits if primary care is delayed; decreased levels of physical activity; increased air pollution; among other impacts. In 2015, the Southern Jamaica Plain Health Center, in collaboration with community partners Alternatives for Community and Environment (ACE) and the Center for Community Health Education Research and Service (CCHERS), surveyed approximately 1,000 patients at 11 community health centers in Boston on their transportation and healthcare access. Key findings from this survey include:

- Nearly half of respondents (49.0%) indicated that they have missed an appointment in the last year due to issues with transportation
- More than half of respondents (51.7%) reported that they rely on the Massachusetts Bay Transportation Authority (MBTA) to access healthcare services
- Nearly half of respondents (47.8%) indicated that they typically get to healthcare appointments by bus, which was the most common method of transportation among respondents
- Non-White patients reported higher percentages of public transit use (by bus and/or train) for travel to healthcare appointments in comparison to White respondents
- Respondents 65 years of age and older were the most likely to report using MBTA bus service as their mode of transportation to healthcare appointments
- When looking at race/ethnicity and age group, Hispanic/Latino respondents and respondents 65 years of age and older were the most likely to travel more than 30 minutes for their healthcare appointments; and
- Non-White respondents were more likely to miss or be late for healthcare appointments due to 'out of service' or 'overcrowded' buses compared to White respondents.

In addition, at the community meeting in Jamaica Plain, the unreliability of service with subsidized transportation for those with a disability was an issue of notable concern.

### Community Cohesion

Community meeting participants voiced their concern regarding a lack of community cohesion in their neighborhoods. Many cited this to be a change in recent years and felt it connected to other issues that impacted community connections, including fears associated with community violence as well as having limited time and opportunity for neighborhood engagement (often due to working multiple jobs to get by). Specific concerns regarding community cohesion included:

- A lack of trust and neighborliness among community members; one resident stated that neighbors are *“not looking out for each other”*;
- A mixed level of engagement among community members as well as a mixed level of investment in community improvement efforts (i.e., some community residents are very engaged and others are not at all engaged); and
- The disruption of the family unit, which some feel has been the root cause of many of the social problems in their community.

*“It is difficult to get people to do things in the community together.”*  
-- Community meeting participant

At the health center community advisory board meetings, participants discussed the need to build community capacity and foster opportunities for community members to connect with one another. Community participants in the BWH *What Matters for Health* process similarly expressed a desire for activities that strengthen social relationships within and across neighborhoods and suggested that these activities would promote community health and well-being. As community cohesion has a positive ‘protective’ effect on health and well-being, this is an important area of consideration.

### Youth and Youth Development

Key informant stakeholders and community meeting participants discussed the need for a greater investment in and engagement around youth development. Key stakeholders identified

*“There are parks and playgrounds, but no one goes to them because there is a lot of trash.”*  
-- SSJP High School Student

the importance of early exposure to career options and opportunities for youth as well as the need to engage parents and caregivers in non-traditional ways (e.g., gardening, cooking classes, and embedding those with community health expertise into these activities).

Interviewees also recommended that efforts to support young people, particularly young people of color living in low-income communities, need to be holistic, engaging, and begin at an early age.

Community meeting participants and community advisory board members highlighted the need for more youth programs and physical spaces for youth to gather in BWH’s priority communities. Participants suggested implementing additional after-school and employment-based programming for youth and

*“Youth need to come out and be involved”*  
-- Community meeting participant

other supports for young adults between the ages of 18 and 24 was very important. There was also conversation around a need for both inside and outside spaces for youth programming and encouraging physical activity. Student Success Job Program (SSJP) students voiced similar concerns regarding the limited availability of and access to activities for youth and younger children. Students stated that trash and inadequate lighting in outdoor “play” areas is a problem as well.

Youth and workforce development was a key community health issue identified through the BWH *What Matters for Health* process. Participants made connections between youth engagement and active participation in the workforce as adults. Participants also emphasized the need to keep youth engaged in their neighborhoods and communities as well as provide high quality education and social supports to youth.

### INTERPERSONAL VIOLENCE AND TRAUMA

The presence of interpersonal violence and trauma throughout BWH’s priority communities was a strong theme across both the quantitative and qualitative data. These data demonstrate that violence disproportionately affects communities of color.

Black and Hispanic/Latino residents were more affected by certain types of violence compared to White residents. In 2012, the Boston nonfatal assault-related gunshot/stabbing emergency department visit rate was 0.8 per 1,000 residents. This rate was higher for Black (2.3) and Hispanic/Latino (0.7) residents compared to White residents (0.3). The Boston homicide rate in 2012 was 6.6 per 100,000 residents. The homicide rate for Black residents was 19.9 and 7.7 for Hispanic/Latino residents, both of which were significantly higher than the rate for White residents (2.0).

Additionally, more than one-quarter of Boston children (0-17) lived in households where their parent or caregiver felt that her or his child was unsafe in their neighborhood (26%). Asian, Black and Hispanic/Latino children were more likely to live in households where their parent or caregiver felt her/his neighborhood was unsafe compared to White children. The 2013 Youth Risk Behavior Survey results show 17.0% of Boston public high school students indicated that they have been bullied at school or electronically in the past 12 months. Asian high school students were the most likely to identify being bullied on school property (15.6%) and White students were the most likely to identify being bullied electronically (13.1%).

Concerns surrounding violence and trauma were emphasized across the key informant interviews and community meetings. Key informants vocalized concerns regarding the pervasiveness of interpersonal violence and the impacts such violence can have on a community. Stakeholders specifically raised concerns about the impact of violence on youth development and on long-term health outcomes in adults. Women and the transgender community were specifically mentioned as groups disproportionately affected by

*“More likely to know someone who has been murdered than someone who has cancer”*  
-- Community meeting participant

interpersonal violence. Interviewees mentioned a lack of cohesive linkages between service sectors addressing interpersonal violence and the need to reinforce messages and provide supports as early as possible after violence exposure.

Stakeholders interviewed highlighted concerns regarding community violence in BWH's priority communities. Stakeholders reiterated that communities of color and individuals living in poverty are disproportionately affected by community violence. They noted that investment in quality education, meaningful employment opportunities for young people, and community-building activities are important prevention strategies.

Participants in all of the five community meetings spoke to the impact of different types of violence on the fabric of their neighborhoods. Residents specifically mentioned:

- The presence of high-level violence and trauma impacting both adults and children in their communities, including domestic violence, child abuse and neglect, and community violence
- The intergenerational impact of collective trauma and the effects of such trauma on mental health
- The connection between crime and violence specifically among young adults between the ages of 18 and 24; and
- The lack of a comprehensive and/or holistic response to community violence.

*"Brigham and Women's Hospital has been doing a great job of screening people for domestic violence. What happens once people are identified is the next phase of work. Efforts need to be made to strengthen relationships and linkages to quality community-based programs that can accept a referral from the hospital and then provide wrap around supports for that individual or family."*  
-- Key Informant Stakeholder

Health center community advisory board members shared concerns regarding trauma and violence in their communities. Participants indicated that there are insufficient resources and services to address the trauma experienced by community members and that trauma is not being addressed in a holistic manner. Board members also spoke to violence, specifically gang violence, present in their neighborhoods and general concerns about community safety.

*"People know it isn't safe, but at the same time, what can you really do about it?"*  
-- SSJP High School Student

SSJP students discussed the presence of violence in their communities; specifically gang violence, street violence and drug use that contribute to feelings of a lack of safety.

In the BWH *What Matters for Health* process, participants identified violence prevention and intervention as a key community health issue. Many participants commented on the need to address violence within their communities and in the City of Boston; gun violence was specifically mentioned in this context. Respondents indicated the need for both individual and community-based services to deal with crisis and tragedy in their communities. Participants reported that improving public safety and preventing violence in all communities is essential to enhancing community health and the health of residents citywide. Relevant data findings include:

- Among residents of priority neighborhoods, one-third (33.0%) of participants indicated that having one-on-one counseling offered on a drop-in basis for those who experience or are affected by trauma or violence in their neighborhoods would be helpful.
- One-fifth (20.0%) of participants indicated that programs and services that support or facilitate community activism around violence prevention would be helpful in their neighborhoods.

It is important to note that health and social services are increasingly recognizing the value of and need for trauma informed care and planning for the provision of care that is trauma informed. BWH participates in a working group of providers within the Partners HealthCare system that is working on this issue and seeking to develop coordinated system response.

## BEHAVIORAL HEALTH

Behavioral health needs, including mental health and substance abuse disorders, remain primary concerns for BWH’s priority communities as evidenced by both quantitative and qualitative data collected.

*“Behavioral health is so poorly taken care of on the healthcare side”*  
 -- Community Meeting Participant

### Mental Health

Quantitative data demonstrate the presence of symptoms of depression and anxiety among adults and youth in Boston. More than one in ten (12.2%) adults and three in ten (30.1%) public high school students in Boston reported persistent sadness (feeling sad, blue, or depressed 15 or more of the past 30 days). Female high school students (37.0%) were more likely to experience persistent sadness compared to male students (23.1%). For adults, this percentage did not vary substantially across BWH’s priority neighborhoods, however, was highest among residents of North Dorchester (16.5%) and South Dorchester (14.5%). Also, Hispanic/Latino adults were more likely to self-report experiencing persistent sadness (16.7%) compared to White adults (10.8%).

One-fifth of Boston adults reported feeling tense or anxious more than 15 days within the past 30 days (20.2%). Residents of Roxbury were the most likely to self-report feeling tense or anxious (29.1%). White adults had the highest percentage of self-reported persistent anxiety in 2013 (23.1%). Additionally, citywide, the average annual suicide rate from 2009 to 2013 was 6.7 per 100,000 population.<sup>6</sup> This rate was higher in North Dorchester (8.7) and in South Dorchester (7.7).

In 2012, the rate of mental health hospitalizations per 1,000 residents was 8.2. White residents had the highest rates of mental health hospitalizations compared to Asian, Black, and Hispanic/Latino residents.<sup>7</sup> Additionally, among BWH’s priority neighborhoods, Roxbury (10.1) and South Dorchester (9.9) had the highest mental health hospitalization rates.

<sup>6</sup> This rate is per 100,000 of the population. Average annual age-adjusted rates shown.

<sup>7</sup> Age-adjusted rates shown.

Participants across the key informant interviews and community meetings highlighted mental health as an ongoing issue that requires increased attention. Key informant stakeholders cited the following concerns related to mental health:

- Depression, anxiety, and trauma
- The need for greater access to mental health services
- A lack of awareness of symptoms of distress
- Stigma associated with mental health challenges
- Limited access to culturally appropriate resources
- Over-reliance on “quick fixes,” such as medication; and
- The need for innovative approaches to supporting positive mental health.

Community meeting participants expressed similar concerns regarding the mental health of residents within their neighborhoods and the lack of access to mental health services. These concerns came up in four of the five community meetings. Community residents spoke to the following issues related to mental health:

- Trauma, isolation, persistent sadness and depression; unemployment and joblessness, hopelessness, and the challenges of immigration integration (or lack thereof) as contributing factors
- The link between untreated mental health issues and substance abuse, as well as the impact of these factors on community violence
- The insufficient accessibility and high cost of mental health services;
- The ongoing stigma associated with mental illness; and
- The historical neglect of communities of color by local government, which has contributed to community isolation and feelings of powerlessness.

Concerns surrounding mental health were also raised at one of the two meetings with community health center advisory board members. Participants mentioned that the need for mental health services does not line up with the capacity of existing services. They noted that Spanish speaking mental health providers are hard to find.

Furthermore, mental health was identified as one of the key community health issues by participants of the BWH *What Matters for Health* process. Managing stress and anxiety were two of the most commonly noted areas that people struggle with in their lives. Participants indicated that stress is often the result of the difficulty of balancing work, family life and personal time and managing personal responsibilities. Healthy aging and experiencing tragic events also came up in the context of mental health. The main themes of these community health issues focused on the need to build strong support networks at the individual and neighborhood levels.

#### Substance Use

The following types of substance abuse are addressed in this section: binge drinking, cigarette smoking, marijuana use, other drug use, unintentional overdoses, substance abuse treatment,

substance abuse hospital patient encounters, and deaths due to substance use disorders (SUDs).

One-quarter of Boston adults reported binge drinking<sup>8</sup> in 2013 (25.4%). This percentage did not vary much across BWH priority neighborhood. White adults were the most likely to report binge drinking (33.1%) by race and ethnicity. Among Boston public high school students, 14.9% reported binge drinking. White and Hispanic/Latino students reported higher rates of binge drinking (21.5% and 19.2% respectively).

In 2013, smoking rates were higher among North Dorchester residents (24.9%), Roxbury residents (22.5%), and South Dorchester residents (20.9%) than Boston residents overall (18.7%). Also, White public high school students were the most likely to have smoked cigarettes in the past 30 days (22.9% compared to 9.0% in Boston).<sup>9</sup> Approximately one-quarter of Boston public high school students reported using marijuana in the past 30 days in 2013 (25.6%); this number has been increasing since 2005. More than four in ten high school students reported having used marijuana at some point during their lifetime (41.9%). After marijuana, in 2013, Boston public high school students reported prescription drugs (e.g. Vicodin and OxyContin) (used without a prescription or not as prescribed) (7.8%) and ecstasy (MDMA) (4.6%) as the next most commonly tried drugs.

In 2013, the unique-person substance abuse treatment admission rates<sup>10</sup> were substantially lower for Asian, Black and Hispanic/Latino residents compared to White residents. The unique-person treatment admission rates (for substances identified as primary, secondary, or tertiary drugs of abuse) were highest for alcohol followed by heroin and cocaine. The unique-person admission rates for alcohol, cocaine and marijuana were notably higher for Black residents compared to White residents. White residents had the highest unique-person admission rates for heroin and prescription drugs. Hispanic/Latino residents also had a significantly higher admission rates for marijuana in comparison to White residents. Examining unique-person substance abuse treatment admissions by geography, it is evident that Roxbury and South Dorchester had the highest rates for all five types of substances listed on Table 4. It should be noted that we do not have an illustration of trends over time, but just the single year of 2014.

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<sup>8</sup> Binge drinking is defined as a pattern of alcohol consumption that brings the blood alcohol concentration level to 0.08% or more. It usually corresponds to 5 or more drinks for men and 4 or more drinks for women on a single occasion, generally within 2 hours.

<sup>9</sup> These percentages reflect combined data from 2011 and 2013.

<sup>10</sup> These rates reflect the number of unduplicated persons (12 years of age or older) being admitted to treatment for substance abuse per 1,000 residents per year. These rates are age-adjusted as well.

**Table 4: Unique-Person Treatment Admissions per 1,000 Residents 12+ by Drug\*, City and Neighborhood, 2014**

Geography	Alcohol	Heroin	Cocaine	Prescription Drugs	Marijuana
<b>Boston</b>	8.6	7.2	4.8	3.2	2.8
<b>Jamaica Plain</b>	7.8	6.3	4.4	2.7	2.4
<b>Mattapan</b>	7.0	4.2	3.2	1.2	3.1
<b>North Dorchester</b>	8.3	6.7	5.1	2.8	2.9
<b>Roxbury</b>	14.2	14.0	9.9	4.1	5.8
<b>South Dorchester</b>	13.2	13.4	9.2	5.6	6.4

\*Self-identified as primary, secondary, or tertiary drug of abuse

NOTE: Age-adjusted rates per 1,000 population ages 12+ shown

DATA SOURCE: Bureau of Substance Abuse Services, Massachusetts Department of Public Health

DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

Hospital patient encounter rates due to unintentional overdose/poisoning among Boston residents increased for opioids (including heroin) and for benzodiazepines from 2007 to 2012. These rates were highest among White residents. Table 5 demonstrates that Roxbury had the highest rates of substance abuse hospital patient encounters (for both alcohol and drug abuse) of residents 12 years of age and older.

**Table 5: Substance Abuse Hospital Patient Encounters\* per 1,000 Residents 12+ by Type, City and Neighborhood, 2013**

Geography	Overall	Alcohol	Drug
<b>Boston</b>	24.4	17.7	6.8
<b>Jamaica Plain</b>	17.3	13.8	3.5
<b>Mattapan</b>	15.3	9.9	5.3
<b>North Dorchester</b>	19.9	13.4	6.5
<b>Roxbury</b>	34.9	22.6	12.2
<b>South Dorchester</b>	24.4	16.1	8.3

\*Includes ED visits, observational stays and inpatient hospitalizations

NOTE: Age-adjusted rates per 1,000 population ages 12+ shown

DATA SOURCE: Bureau of Substance Abuse Services, Massachusetts Department of Public Health

DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

Looking at emergency department (ED) data specific to BWH, there were 260 ED visits with a primary diagnosis of mental health or SUDs among individuals with a Boston ZIP Code in FY2014. Of all ED visits for Boston residents, 5.8% received a primary diagnosis of mental health or SUDs in FY2014. Of this 5.8%, 3.2% of ED visits received a primary diagnosis of SUDs (n=144). Among ED visits with SUDs diagnoses, approximately 85% of diagnoses were described as alcohol-related (n=122).

South Dorchester, Mattapan and Roxbury had the highest rates of substance deaths due to drugs of BWH’s priority neighborhoods and South Dorchester, Roxbury and North Dorchester had the highest rates due to alcohol. For unintentional drug overdose deaths, South Dorchester and Mattapan had the highest rates of BWH’s priority neighborhoods for all drugs and South Dorchester had the highest rate of opioid overdoses. (Table 6)

**Table 6: SUD Related Deaths of Residents Ages 12+ per 100,000 Population by City and Neighborhood**

Geography	Substance Abuse Deaths		Unintentional Drug Overdose Deaths		
	Drugs	Alcohol	All Drugs	Opioids	Cocaine
<b>Boston</b>	19.1	8.8	15.5	12.6	5.4
<b>Jamaica Plain</b>	18.0	6.2	15.0	11.6	3.7
<b>Mattapan</b>	23.6	2.5	18.8	13.5	6.8
<b>North Dorchester</b>	16.7	10.1	13.9	9.6	7.7
<b>Roxbury</b>	21.4	10.3	15.9	10.5	7.3
<b>South Dorchester</b>	24.0	12.6	19.2	17.6	5.4

NOTE: Average annual age-adjusted rates shown with 2009, 2010, 2011, 2012, 2013 data combined

DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health

DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

Key stakeholders indicated that substance abuse and access to treatment are major issues for residents of BWH’s priority neighborhoods. Interviewees acknowledged the strong link between substance use disorders and housing instability, homelessness, unemployment, and interpersonal and community violence. Stakeholders identified the following specific concerns:

- Widespread opioid use and the need for BWH to increase its current efforts to address the opioid epidemic
- The lack of immediately available detox beds; and
- The lack of communication between clinical and community-based support services.

In addition, community meeting participants in three of the community meetings spoke strongly of their concerns and impact of substance abuse in their neighborhoods. Meeting participants cited the following:

- The abuse of alcohol and drugs and the prevalence of cigarette smoking
- The link between substance abuse and untreated mental health issues
- The connection between drug activity and homelessness; and
- The need for affordable and accessible services (e.g., outreach and treatment programs).

*“Substance use affects the whole family”*  
-- Community meeting participant

Concerns regarding substance abuse arose as strong themes across the meetings with health center community advisory board members as well. Participants discussed the need to educate

community members on the effects of drug and alcohol use as well as the need for culturally and linguistically appropriate treatment services. In addition, Student Success Jobs Program (SSJP) students mentioned that there are liquor stores on every corner and that alcohol is widely available.

## HEALTH EQUITY

This assessment applies a health equity lens and examines not only who is at greater risk for disease, but also why some populations are at greater risk of preventable illness, injury and death compared to others. According to the Democracy Collaborative's *Can Hospitals Heal America's Communities?* (December 2015), health equity is the opportunity for everyone to achieve their full health potential through an environment where there is not disadvantage associated with social position (e.g. socioeconomic status) or socially assigned circumstances (e.g. race, gender, ethnicity, sexual orientation, geography, etc).

Findings from this assessment illustrate that health inequities persist across BWH's priority neighborhoods and specifically impact communities of color. Boston's Black and Hispanic/Latino residents experience higher levels of poor health outcomes when compared to White residents. This section discusses the many areas in which we see troubling and ongoing inequities in health, particularly for communities of color. These topic areas include the impact of racism; obesity, active living and healthy eating; chronic disease; reproductive and maternal health; and sexual health.

### Impact of Racism

Recent work of the American Public Health Association (APHA) (2016) identifies that racism fundamentally impacts social determinants of health (e.g., housing, education and employment) and stands as a major barrier to health equity. Structural and institutional racism and other exclusionary practices are significant contributors to social inequities among particular racial/ethnic groups. Black and Hispanic/Latino adults reported a substantially higher likelihood of experiencing a form of stress as a result of their race in comparison to White residents. Specifically, Black and Hispanic/Latino residents were more likely to:

- Feel emotionally upset by perceived race-related treatment once or more per day (19.3% of Black residents and 16.1% of Hispanic/Latino residents compared to 7.6% of White residents);
- Experience physical symptoms based on perceived race-related treatment once or more per day (12.5% of Black residents and 11.6% of Hispanic/Latino residents compared to 2.7% of White residents); and
- Perceive they were treated worse than other races when seeking healthcare (11.1% of Black residents and 6.8% of Hispanic/Latino residents compared to 2.5% of White residents).

Inequity in health, namely by race/ethnicity, was a reoccurring theme across the key informant stakeholder conversations. Stakeholders spoke to the troubling inequities and disparities in

health outcomes experienced by communities of color in Boston. One stakeholder specifically discussed the institutionalized racism and segregation present citywide, which has had a particularly harmful effect on BWH's priority communities. Interviewees mentioned inequities in income, housing, neighborhood infrastructure, employment opportunities, food access, feelings of belonging in one's neighborhood, among others, which are concentrated in communities of color and impact the overall health and well-being of individuals.

Moreover, racial equity was identified as one of the key community health issues in the BWH *What Matters for Health* Initiative. Nearly three-quarters (73%) of respondents to the question on equity indicated that they do not believe the City of Boston is a racially equitable place to live. These perceptions did not vary based on neighborhood affiliation, racial/ethnic characteristics, or other demographic information.

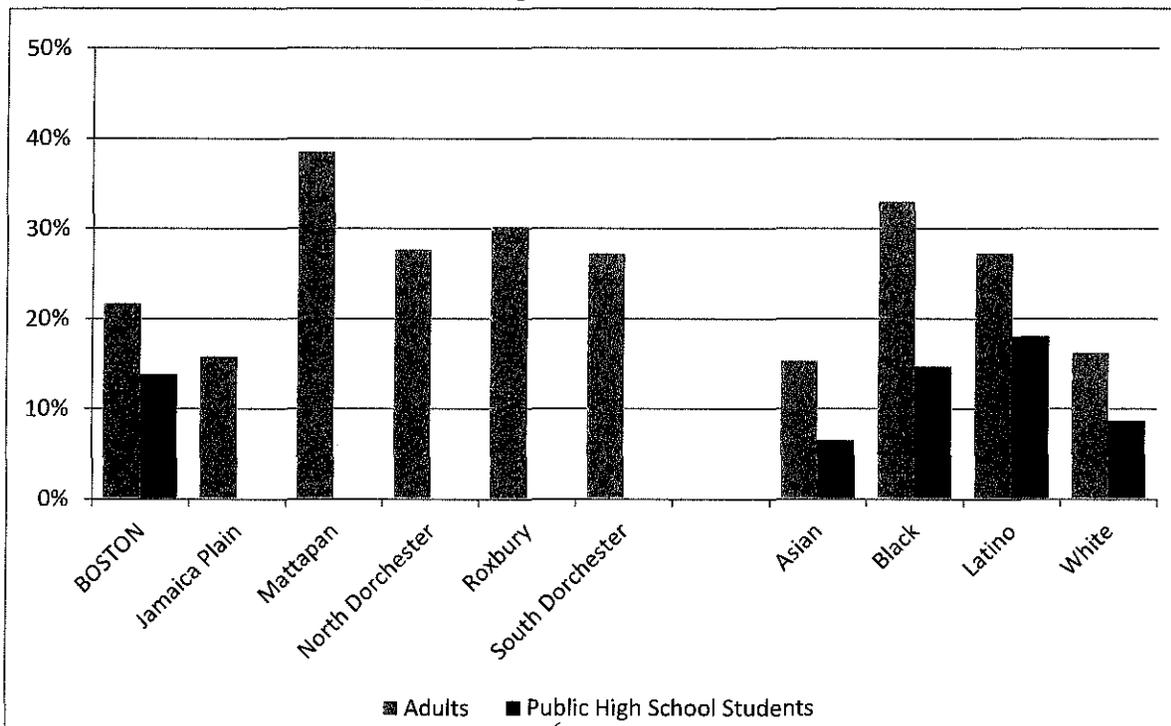
### Obesity, Active Living, and Healthy Eating

This section examines the quantitative and qualitative data pertaining to obesity, physical activity, fruit and vegetable consumption, and soda consumption. These data demonstrate that residents of color are more likely to be obese, less likely to be physically active, less likely to consume fruits and vegetables, and more likely to drink soda. These behaviors, as demonstrated by Figure 2, have an important impact on overall health and well-being and are strongly linked to the social and economic context in which people live. In neighborhoods where people are fearful to exercise outside because of community violence or access to healthy, affordable food is limited, the 'health promoting' opportunities available are greatly diminished. In health promotion parlance, the 'healthy choice' is not by any means the 'easy choice.'

In 2013, 21.7% of Boston adults (18+) were obese. Obesity rates are disproportionately higher in BWH's priority communities, Mattapan, Roxbury, North Dorchester, and South Dorchester. Black and Hispanic/Latino adults were more likely to be obese compared to White adults. Among public high school students in Boston, 13.8% were considered obese in 2013. Obesity rates are highest among Hispanic/Latino high school students. (Figure 10) One internal key informant discussed the concern of obesity among pregnant women and children in particular. Obesity was also raised as a concern by residents in one of the community meetings and among SSJP students.

Center for Disease Control (CDC) recommends 150 minutes of aerobic physical activity a week. Nearly six in ten Boston residents met these guidelines in 2013 (57.5%). Residents of Mattapan (49.5%), North Dorchester (54.0%), and South Dorchester (54.5%) were less likely to have met the CDC's guidelines for physical activity. Hispanic/Latino and Black adults were less likely to have met these guidelines (46.9% and 53.4% respectively) compared to White residents (62.3%). Health center community advisory board members and community meeting participants stressed the need for additional spaces for community members to engage in physical activity. Furthermore, getting regular exercise was one of the most commonly identified personal health priorities by participants of the BWH *What Matters for Health*

process. Participants recommended expanding opportunities that promote physical activity to improve the health and well-being of neighborhoods.



**Figure 10. Percentage of Adults and Public High School Students who are Obese by City, Neighborhood and Race, 2013**

NOTE: Data by neighborhood is unavailable for high school students.

DATA SOURCE: BPHC’s *Health of Boston* Report 2014-2015 and population health data obtained from BPHC.

One-quarter of Boston adults consumed less than one serving of vegetables per day (24.8%) in 2013 and 37.5% consumed less than one serving of fruits per day. These percentages were higher among four of five BWH priority neighborhoods—North Dorchester, South Dorchester, Roxbury and Mattapan. Black residents were more likely to have consumed less than one serving of vegetables per day (34.0%) and Hispanic/Latino, Black and Asian residents were more likely to have consumed less than one serving of fruits per day (42.9%, 42.0%, and 41.5% respectively).

Participants from two of the five community meetings communicated that residents are interested in eating healthier foods, but there is an ongoing need for nutrition education in their communities. Residents from one community specifically indicated a need for education around how to read and understand food labels. SSJP high school students pointed out that there are corner stores at every block, but few grocery stores. According to *County Health Rankings & Roadmaps*, corner stores generally sell unhealthy and non-perishable food items. SSJP students also noted that healthy foods are often more expensive than unhealthy foods. Participants of the BWH *What Matters for Health* process also identified eating healthy as a top

personal health priority and indicated that neighborhoods would be healthier with increased access to healthy and affordable food.

Approximately 13% of Boston adults consumed one or more sodas per day in 2013 (12.7%). This percentage is higher among Hispanic/Latino (20.6%) and Black (16.8%) residents. In addition, 16.8% of Boston public high school students consumed one or more sodas per day. Hispanic/Latino high school students were the most likely to consume at least one soda daily (20.3%). The consumption of soda and other sugar-sweetened beverages is the largest source of empty calories for children and youth in the United States. Many leading health organizations (e.g. the Centers for Disease Control and Prevention, the American Academy of Pediatrics) have recommended reduced consumption of these beverages for health-related reasons and due to their tie to obesity.

#### Chronic Disease and Mortality

The following section provides an overview of quantitative and qualitative data on several chronic diseases, including heart disease, cancer, diabetes, asthma, hypertension, as well as stroke. Similar to the health behaviors discussed above, the data presented indicate that communities of color are disproportionately impacted by chronic disease.

Concerns regarding chronic diseases were evident across the qualitative data. Internal key informant interviews specifically highlighted diabetes, asthma and high blood pressure as areas of particular concern. An interviewee spoke to missed opportunities to prevent chronic diseases early on, which results in uncontrolled conditions and complications later on in life. Numerous interviewees suggested that BWH needs to take the responsibility for the coordination of care for patients with chronic health issues who are coming in and out of BWH's emergency department; this involves linking them to a primary care provider. In the BWH *What Matters for Health* process, nearly 30% of participants reported that more education on health and prevention would be helpful to reduce chronic diseases. Participants also focused on the link between chronic disease and poverty or income inequalities.

The heart disease hospitalization rate for Boston was 9.8 per 1,000 residents in 2012, a decrease from 11.3 per 1,000 in 2008. Black and Hispanic/Latino residents had higher rates hospitalization due to heart disease (13.6 and 9.9 per 1,000 residents respectively) in comparison to White residents (9.0). Among priority neighborhoods, Roxbury and North Dorchester had the highest heart disease hospitalization rates.

Data from the Behavioral Risk Factor Surveillance Survey (BRFSS) show diabetes disproportionately affecting residents in certain neighborhoods. It should be noted that these BRFSS data are in crude rates and are not age-adjusted. In 2013, 8.6% of Boston adults (18+) reported that they had been diagnosed with diabetes. The percentage of Mattapan residents surveyed that reported that they have

*"Diabetes feels like it just came out of nowhere. It feels normal for people to have it now."*  
-- Community Meeting Participant

diabetes is more than double that of the Boston average (19.1%). Also, 15.1% of Roxbury residents, 12.4% of North Dorchester residents, and 10.0% of South Dorchester residents reported having diabetes. Black and Hispanic/Latino residents were more likely to report having diabetes (14.1% and 12.6% respectively) compared to 5.1% of White residents. Residents at one community meeting shared their concern regarding the prevalence of diabetes in their community.

In 2013, 11.1% of Boston adults (18+) had asthma. This percentage was higher among residents of North Dorchester (17.7%), Jamaica Plain (16.0%), and Roxbury (13.8%). Nearly one-quarter of Boston adults (18+) had hypertension in 2013 (24.0%). This percentage is substantially higher for Black residents (36.7%) and higher for Hispanic/Latino residents (26.2%) as well.

Overall, cancer ranked as the City of Boston’s most common cause of death, with 176.1 deaths per 100,000 population, followed by heart disease (133.6 deaths per population), and stroke (26.6 per 100,000 population). Among BWH’s priority neighborhoods, residents of South Dorchester experience death due to cancer at a higher rate (199.6 deaths per 100,000 population) than residents citywide. In addition, residents of Roxbury (148.3 deaths per 100,000 population) have heart disease mortality rates above that of the City of Boston (133.6 deaths per 100,000 population). Mattapan has the highest mortality rate due to stroke (40.8 deaths per 100,000 population). (Table 7)

**Table 7: Rate of the Leading Causes of Death per 100,000 Population by City and Neighborhoods, 2013**

<b>Geography</b>	<b>Cancer</b>	<b>Heart Disease</b>	<b>Cerebrovascular Disease (Stroke)</b>
<b>Boston</b>	176.1	133.6	26.6
<b>Jamaica Plain</b>	126.7	133.6	28.3
<b>Mattapan</b>	170.6	131.3	40.8
<b>North Dorchester</b>	147.9	133.2	23.6
<b>Roxbury</b>	170.8	148.3	29.4
<b>South Dorchester</b>	199.6	123.1	29.8

NOTE: Age-adjusted rates shown

DATA SOURCE: Boston Resident Deaths, Massachusetts Department of Public Health

DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

While community meeting participants (with the exception of Mattapan) did not generally identify cancer as a key community health issue unprompted, when asked specifically about cancer, some individuals expressed the following concerns:

- Concentrated areas of incidences of cancer in communities, including citing a two-to-three block radius in which many men have died of prostate cancer

- A lack of health literacy and trust as major barriers to regular cancer screening and prevention; and
- Confusion around insurance coverage of specific cancer screenings and the need for more education and support around this issue.

*"I can't think of one male in my age group [on a particular street] that didn't get cancer"*  
 -- Community Meeting Participant  
 [Meeting comprised largely of seniors]

### Reproductive and Maternal Health

Racial and ethnic disparities exist in mortality and morbidity for mothers and children, particularly among African Americans. This section highlights some of these disparities and specifically discusses infant mortality, low birth weight births, Women, Infant, and Children (WIC) enrollment<sup>11</sup>, pre-term births, and births to women ages 15-19.

From 2008 to 2012, there was a significant decrease in the infant mortality citywide and among Black infants. The infant mortality rate for Black infants in 2008 was nearly 15 infant deaths per 1,000 births; this rate decreased to 6.5 in 2012. Despite this decline in the Black infant mortality rate, infant death rates for Black (6.5 per 1,000) and Latino (6.5 per 1,000) infants were still higher than White infants (3.3 per 1,000). In addition, in 2012, 11% of Black women and 9% of Hispanic/Latino women gave birth to low birth weight babies compared to 7% of White women. Data on WIC enrollment demonstrate that Hispanic/Latino (39%) and Black (37%) children ages 0 to 5 have higher WIC enrollment rates than White (11%) and Asian (11%) children.

In 2013, Mattapan, Roxbury, North Dorchester, and South Dorchester had higher rates of pre-term births (before 37 weeks gestation), low birth weight births (less than 2,500 grams), infant mortality, and repeat births to women ages 15 to 19<sup>12</sup> when compared to the rates citywide (Table 8).<sup>13</sup> Looking at births to women aged 15 to 19, Mattapan, North Dorchester, South Dorchester, and Jamaica Plain had the highest rates. The rate of births to women ages 15 to 19 in Mattapan (30.9 per 1,000 women) and North Dorchester (29.6) were nearly triple that of the rate citywide (11.7). Dorchester ranked in the highest quartile of the Poor Birth Outcomes Index<sup>14</sup> and Mattapan ranked in the second highest quartile.

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<sup>11</sup> WIC provides supplemental nutritious foods, nutrition education and counseling, and screening and referrals to other services for low-income women and children who are assessed as nutritionally at-risk.

<sup>12</sup> According to the Centers for Disease Control and Prevention (2013), a repeat "teen" birth is the 2<sup>nd</sup> (or more) pregnancy ending in a live birth before the age of 20.

<sup>13</sup> These rates are the average annualized aggregate rates from 2009 to 2013.

<sup>14</sup> The Poor Birth Outcome Index is based on infant deaths, low birth weight births, and preterm births.

**Table 8: Maternal and Child Health Indicators by City and Priority Neighborhood**

	Boston	Jamaica Plain	Mattapan	North Dorchester	Roxbury	South Dorchester
<b>Pre-term births (before 37 weeks gestation)*</b>	9.4%	8.3%	11.6%	10.5%	10.5%	10.7%
<b>Low birth weight births (less than 2,500 grams)*</b>	9.0%	7.9%	11.4%	10.7%	10.5%	10.4%
<b>Infant mortality rate**</b>	5.0	1.9	6.5	6.4	5.5	6.5
<b>Birth rate of women ages 15 to 19***</b>	11.7	16.2	30.9	29.6	9.4	21.3
<b>Repeat birth(s) to women ages 15 to 19*</b>	12.0%	7.2%	10.7%	13.3%	11.5%	11.6%

\*Average annualized rate (2009-2013)

\*\*Average annualized rate (2009-2013); infant deaths per 1,000 live births

\*\*\*Births per 1,000 women (2013)

DATA SOURCE: Boston Resident Births, Massachusetts Department of Public Health

DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

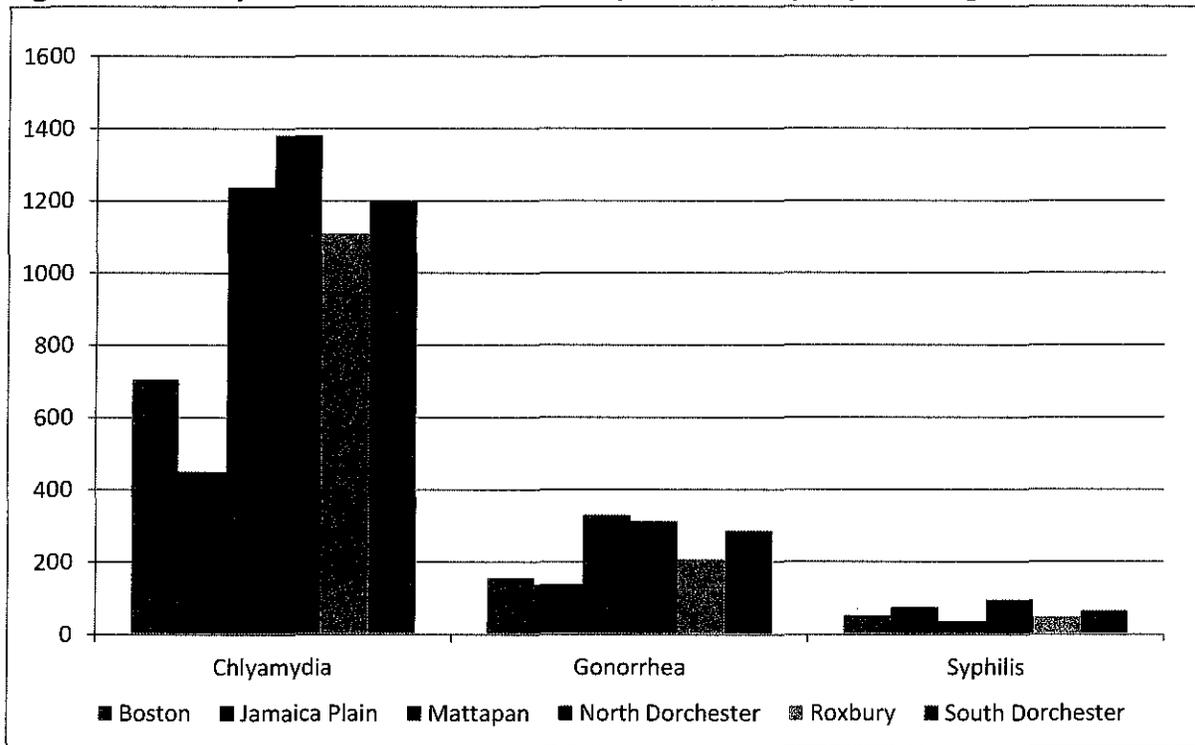
Two key informant stakeholders highlighted prenatal health as a key health and well-being issue for BWH's priority communities. In addition, when BWH *What Matters for Health* process participants were asked about recommendations for delivering healthy babies, respondents indicated that expecting parents should consult their primary care providers for information on how to maintain a healthy pregnancy.

#### Sexual Health

Inequities persist in the area of sexual health with communities of color disproportionately burdened by sexually transmitted infections (STIs). Based on data from the Youth Risk Behavior Survey (YRBS), in 2013, the percentage of high school students who have ever had sex was highest among Hispanic/Latino students (57.4%) and substantially higher than among White (35.0%) and Asian (22.0%) students. Also, the percentage of sexually active Boston public high school students who reported using a condom during the last time they had sex decreased from 76.3% in 2005 to 66.5% in 2013.

According to the Division of STD Prevention of the Massachusetts Department of Public Health, the Chlamydia rate in Boston was 705.5 new cases per 100,000 residents in 2013. This rate varies substantially across BWH priority neighborhood (Figure 11). In 2013, the Gonorrhea rate in Boston was 156.1 new cases per 100,000 and the Syphilis rate was 52.6. All three of these rates increased since 2009.

**Figure 11: Sexually Transmitted Infection Rates per 100,000 by City and Neighborhood, 2013**



NOTE: Rates per 100,000 population

DATA SOURCE: Division of STD Prevention, Massachusetts Department of Public Health

DATA ANALYSIS: Boston Public Health Commission Research and Evaluation Office

In 2011, the incidence rate for newly diagnosed HIV/AIDS cases was 31.0 per 100,000 Boston residents. The incidence rate for Black residents (66.9) and Hispanic/Latino residents (34.6) was higher than for White residents (18.2). The total number of individuals living with HIV/AIDS in Boston increased from 2007 to 2011. The rate for individuals living with HIV/AIDS in Boston was 858.3 per 100,000 residents in 2011. This rate was higher among Black and Hispanic/Latino residents compared to White residents. The neighborhoods of North Dorchester (46.5) and Roxbury (43.3) had the highest average annualized rates (2009-2013) per population of newly diagnosed cases of HIV infection. The rate for Boston citywide was 30.3.

#### ACCESS TO HEALTHCARE

An additional key theme evident in the qualitative and quantitative data focuses on access, or lack of access, to healthcare. Several key informant interviewees discussed concerns surrounding access to care for BWH's priority communities. There was specific mention of issues related to under-insurance and barriers to accessing healthcare services for those with government sponsored healthcare plans. Access to primary care and needed social services was also discussed.

While the rate of uninsured in Massachusetts is now at a historic low, roughly 37% of insured Massachusetts residents said they went without necessary medical care in 2015, and this number is significantly higher amongst low-income residents (52% for individuals at or below 138% of the Federal Poverty Level). Trouble finding a provider, trouble getting an appointment in a timely manner and costs were the three main reasons care was not received. Health insurance premium rates continue to grow year-on-year and as a result, 19% of Massachusetts commercial market members are in high deductible health plans which offer lower premium costs up front in exchange for high cost sharing/out of pocket costs later on.

Regulatory changes for the Health Safety Net (HSN) that went into effect in June 2016 and changes to MassHealth plan enrollment rules that will go into effect in October 2016 have the potential to impact the access low income people have to care. HSN changes increased both the cost sharing and the administrative burden for patients to prove that they have paid their annual deductible. Given that this fund is to a large extent used by undocumented residents who are already an underserved population, these changes may further expand health inequities in communities across the state. Changes to MassHealth are planned that will have the effect of stabilizing the caseload and reducing churn – important outcomes for providers who will soon be taking financial risk on these populations. Members in MCO plans will be locked into their plan until the next annual open enrollment period (in line with what commercially insured and ConnectorCare members must commit to). Further changes to MassHealth may also come in 2017 as the state prepares to launch its MassHealth ACO.

*“As we move into the brave new world of ACOs [Accountable Care Organizations], there will have to be strong community partners that can help ensure proper care and resources for an individual. These partnerships are the only ways that you get the cost savings that are hoping for and, frankly, to make a difference in any of these issues.”*

-- Key Informant Stakeholder

### APPROACH TO WORKING WITH COMMUNITIES

Throughout the course of the qualitative data collection, key informant interview and meeting participants shared their suggestions for how BWH and hospitals in general can best approach their work and engagement with communities. These suggestions are important findings from this CHNA and described in detail below.

#### Leverage Community Assets and Focus on Partnership

One theme that came through the key informant interviews, community meetings, and discussions with health center advisory board members and SSJP students centered on learning from and leveraging the expertise of community members and leaders. Participants suggested that hospitals draw upon and build on the existing strengths of communities, specifically the ongoing and fruitful community building and community development efforts taking place across BWH’s priority neighborhoods. Partnering with individuals and organizations that have the trust of residents and a deep understanding of the community would be valuable assets in addressing the significant health inequities faced by residents.

In addition, community meeting participants mentioned that there are numerous community organizations and neighborhood groups dedicated to improving community health, yet more collaboration and coordination across organizations and providers is needed. They suggested that hospitals take a lead role in these collaborations and in promoting consistent education about the services that are available. Stakeholders stressed hospitals should avoid the duplication of services and should tailor programs and interventions to the unique needs of community members.

*“When we do work around community health we usually try to figure out how we are going to ‘fix’ communities. Instead we need to start taking a look at ourselves. How can we fix ourselves because we might be part of what is causing problems within some of our most distressed communities.”*

– Key Informant Stakeholder

Stakeholders encouraged hospitals to focus on efforts that build trust with communities, develop cohesion among community members, and empower residents “to get to know each other.” At one community meeting, participants suggested utilizing peer to peer empowerment models, which allow residents to learn from others with similar experiences.

Similarly, stakeholders stressed the importance of hospitals partnering *with* communities to improve health and wellness. Interview and meeting participants suggested that hospitals invest their time and resources in developing long-lasting and sustainable partnerships with communities. A specific suggestion included expanding and developing new partnerships with community-based organizations. A community advisory board for the hospital was also seen as a valuable step.

Another suggested approach for leveraging community assets and partnering with community members is through the use of community health workers (CHWs). Stakeholders across the meetings and interviews noted the value of CHWs, who can connect with communities, develop trust with residents, and understand patients’ needs. Key informant interviewees discussed BWH’s current work with CHWs (specifically in primary care) and suggested expansions of CHW projects, namely in in-patient settings. One stakeholder noted that CHWs are currently a largely under-resourced support service across the Commonwealth of Massachusetts. Also, community meeting participants emphasized the importance of outreach workers and CHWs who are culturally competent and speak the languages of BWH’s diverse priority communities.

#### Increase Hospital Presence in Priority Communities

Community and other stakeholders highlighted the need for BWH and other hospitals to “be more present in neighborhoods” and engage in the experiences and challenges of residents. It was suggested that hospitals embed services where

*“We often don’t know what we need and once we need it, we need it immediately and don’t know who to contact”*

– Community meeting participant

residents live and congregate, and conduct additional community outreach to residents most in need. Community meeting participants stated that it is important for healthcare providers to understand the neighborhoods they are serving, specifically the social and community stressors many patients in those neighborhoods face. At one meeting, residents suggested having a hospital point person for community members to help improve communication, coordination and collaboration between health systems and communities.

SSJP students in particular had a number of suggestions for increasing BWH's presence in its priority communities. These include:

- Reach out to young people as well as adults in their 40s and 50s who spend more time at home and in the community and hold a valuable understanding
- Hold community fairs, host or sponsor community events (e.g. sports events)
- Implement a mobile "clinic truck" that provides services in the neighborhoods (e.g. flu shots)
- Increase hospitals' presence in schools and develop new mentoring opportunities
- Utilize SSJP students as community liaisons and/or navigators for other youth in their communities; and
- Engage in more prevention efforts, specifically around community violence.

#### Prioritize Sustainable Investment in Communities

A strong theme throughout the key informant interviews was the need to improve, expand, and prioritize BWH's relationships with its target neighborhoods. These individuals highlighted the opportunity for a greater commitment to and investment in community-driven work by hospital leadership as well as an integration of community benefit work into BWH's strategic planning efforts. Key informants also suggested inviting community members to actively participate in the decision-making and planning processes of BWH's community-based work.

In the key informant interviews, some advocated for an increase in resources and staff to address the ongoing community health needs, including CHWs, social workers, community resource specialists, trained lay people, among others. In addition, interviewees recommended increasing the presence of the CCHHE's work throughout the BWH institution. These interviewees underscored the importance of engaging and partnering with other BWH departments to increase the presence, scope and shared responsibility of the Center's work. Similarly, stakeholders specified the need to make hospital staff more universally aware of the hospital's commitment to its five priority neighborhoods.

#### Other Approaches

Meeting and interview participants provided a number of additional suggestions for how BWH can best serve its priority communities and improve the health and wellness of its residents. These approaches included the following:

- Start young and educate children on health literacy and the importance of prevention
- Develop inter-generational interventions and programs

- Implement cancer education and support groups
- Address violence and trauma in a comprehensive manner
- Consider ways to improve structural factors for residents, including housing and transportation
- Support families with children with disabilities
- Focus on a holistic approach to wellness (e.g. yoga, meditation)
- Consider partnerships with vocational organizations, housing authorities and tenant associations, and the Massachusetts Bay Transportation Authority (MBTA)
- Develop a forum at BWH for providers and professionals (e.g. nurses, physicians, CHWs, social workers, community resource specialists, etc.) dedicated to community health and health equity work.

## OVERALL CONCLUSIONS AND SIGNIFICANT HEALTH ISSUES

On all major **social determinants of health**, residents of color in our priority neighborhoods experience greater poverty, unemployment, lower educational attainment and greater economic vulnerability. The association of these social and economic challenges with poorer health outcomes makes it imperative for programs and systemic approaches that provide a pathway to economic stability. The ever increasing cost of housing in Boston and unreliability of transportation were also noted as key issues for community members.

**Interpersonal violence and trauma** which disproportionately affect communities of color, was cited as a major concern in community meetings and among community stakeholders. Residents of our priority neighborhoods described short and long-term impacts of violence including increased stress and persistent feelings of anxiety, safety fears that greatly limited their free movement in the community (including outdoor physical activity), negative impacts on community cohesion and significant fears for children in the community and their future.

**Behavioral health issues** emerged as key issues facing BWH's priority neighborhoods. The availability, cost and cultural accessibility of mental health services were cited as challenges for community members needing support. Dealing with stigma was also noted and the need for trust in those providing the support. This is enhanced when caregivers have a deep cultural understanding or shared language with those seeking support. Community members and interviewees also cited the need for more accessible and affordable treatment for substance use disorders. With behavioral health issues, it was noted that failure to provide support and treatment results in more entrenched problems (including overdose risk), impacts community safety and also results in challenges in treating other medical conditions, as untreated behavioral health challenges make it very difficult to implement a care plan for other health conditions.

**Significant health inequities persist across priority neighborhoods** and disproportionately impact communities of color in our neighborhoods across all health conditions examined in the quantitative data including chronic disease and mortality, reproductive and sexual health and obesity. While efforts should continue to address specific health conditions, the systemic nature of these inequities necessitates a wider approach to have sustained impact. A racial equity 'lens' is key to understanding and working in partnership with communities on these issues.

Although the rate of uninsured residents in Massachusetts is at historically low levels, **models of care that are responsive to the needs of underserved communities** are an important area for development. The role and contribution of community health workers are key in this effort. Low income residents also face other access issues including transportation barriers and the potential negative impact of policy changes in 2016/17 to the Health Safety Net and MassHealth plan enrollment.

Community residents and stakeholders underscored the importance of working in **partnership with communities by supporting existing community assets and efforts**, focusing on partnership and collaboration and increasing the hospital's presence "on the ground" in communities, and prioritizing sustainable investment in communities.

## STRATEGIES AND IMPLEMENTATION PLAN

### THE HEALTH EQUITY IMPERATIVE

The imperative to address inequities in health continues to drive BWH's community health work. As a leading healthcare institution, we are responsive to the changes in the healthcare environment taking place at the local, state, and national levels, and ensure these changes inform our policies and practice. We also understand the urgency to address the health inequities in Boston that are particularly evident in our priority communities. Our Implementation Plan has been developed with a context of a rapidly changing healthcare landscape that prioritizes Population Health Management (PHM) as a strategy to meet national standards and fulfill its commitment to improving care and reducing healthcare costs. At BWH, the implementation of the Patient-Centered Medical Home and the Integrated Care Management Program are two examples of PHM in primary care.

### CRITERIA FOR PRIORITIZATION

The five priority areas selected were based on: 1) community need 2) potential for impact 3) community interest, will and readiness, 4) available resources; and 5) institutional readiness.

### ISSUES NOT ADDRESSING

For the majority issues raised in this report, we have identified implementation plan actions. In the area of the high cost of housing, however, resources and available expertise, limit our capacity to respond directly to this issue. We will, however, continue to monitor this issue and contribute a healthcare perspective to the City-wide dialogue on this issue as described in our plan.

## IMPLEMENTATION PLAN

<b>Priority 1</b>	<b>Interpersonal Violence and Trauma</b> <b>Address the public health issue of interpersonal violence in our communities</b>
<b>Strategies</b>	<p><b>1.1.1 Interpersonal Violence</b></p> <ul style="list-style-type: none"> <li>• Provide advocacy, safety planning and supportive counseling for patients who experience interpersonal violence (domestic violence and community violence)</li> <li>• Offer free and confidential advocacy services to the wider community through a domestic violence advocate based at a community site</li> <li>• Provide direct intervention to patients who are impacted by sexual violence and human trafficking</li> <li>• Collaborate with key community partners to offer supportive violence prevention education to young people in high risk environments</li> <li>• Coordinate and collaborate with the City of Boston and local hospitals on issues of interpersonal violence prevention and intervention</li> <li>• Develop and implement strategies to further integrate the BWH response with the City of Boston Streetworker program</li> <li>• Develop and implement a hospital wide policy on interpersonal violence inclusive of domestic, sexual, community violence and human trafficking</li> </ul> <p><b>1.1.2 Trauma Informed Care (TIC)</b></p> <ul style="list-style-type: none"> <li>• In collaboration with the Partners TIC network, provide learning opportunities for BWHC staff to develop awareness, skills and confidence in providing trauma informed care</li> <li>• Develop and implement an effective hospital-wide policy on the provision of trauma informed care</li> </ul>

<b>Priority 2</b>	<b>Access to Healthcare</b> Strengthen access for community members to enable improved health outcomes
	<p><b>2.1.1 Utilize Certified Application Counselors (Financial Counselors) to Improve Patient Access</b></p> <p><b>2.1.2 Supporting and Utilizing Community Health Workers (CHWs)</b></p> <ul style="list-style-type: none"> <li>• Provide structured opportunities to increase communication among existing community health workers, patient navigators and community resource specialists at BWH to identify shared needs and resources and inform community health strategy</li> <li>• Share best practices of community health workers within the BWH community to increase understanding of the benefits of CHWs in the delivery of culturally responsive care</li> <li>• Identify next steps in assessing opportunities and potential resources for community health workers in selected clinical areas</li> <li>• Assess opportunities to engage CHWs and other staff in ‘place-based’ approaches with residents in a specific geographical area within our priority communities</li> </ul> <p><b>2.1.3 Enhance Structures to Incorporate Patient and Community Input</b></p> <ul style="list-style-type: none"> <li>• Establish a community advisory structure that builds upon and extends our existing networks, and recruit members with strong community experience and connection to inform hospital programs and priorities in priority neighborhoods</li> <li>• Expand community representation on BWH Patient Advisory Councils</li> </ul>
<b>Priority 3</b>	<b>Behavioral Health</b> Develop an integrated and culturally responsive system of assessment, care and referral for behavioral health needs
<b>Strategies</b>	<p><b>3.1.1 Support Innovative Community Efforts to Promote Community Psychological Wellness</b></p> <ul style="list-style-type: none"> <li>• Provide Health Equity Grants to community based organizations to support innovative models to: <ul style="list-style-type: none"> <li>○ Build support networks to strengthen the conditions of community psychological wellness</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>○ Implement culturally and linguistically responsive models to assist community members to reduce and manage stress</li> </ul>
	<p><b>3.1.2 Integrated Behavioral Health, Wellness and Primary Care</b></p> <ul style="list-style-type: none"> <li>● Expansion of the Patient Centered Medical Home model across primary care to provide coordinated care delivery to encourage patient engagement in decision making and self management</li> <li>● Implement a Collaborative Care Model in Primary Care for screening and care for patients who have depression and/or anxiety</li> <li>● Explore expansion of health promotion activities (support groups, yoga, fitness, etc) in clinical settings or within partnering organizations to address sadness, social isolation, trauma, depression and other behavioral health needs</li> <li>● Continue to provide a self help group meeting space for community members with substance use disorders at Brookside CHC</li> </ul>
	<p><b>3.1.3 Comprehensive Opioid Response</b></p> <ul style="list-style-type: none"> <li>● Continue and explore expansion of community health center based substance abuse treatment</li> <li>● Continue opioid intervention B-CORE: The Brigham Comprehensive Opioid Response and Education Program which includes a senior level Executive Committee, a Prescribing Task Force and an Addiction Task Force</li> <li>● Work with the Partners Clinical Opioid Task Force to integrate measures and data collection</li> <li>● Provide patients and employees a “MedSafe” drop-off location for unwanted or expired medications</li> <li>● Dispense nasal Narcan to patients who request this life-saving medication that can stop or reverse the effects of an opioid overdose</li> </ul>
<p><b>Priority 4</b></p>	<p><b>Advance Health Equity within BWH and Our Community</b></p>

<b>Strategies</b>	<p><b>4.1.1 Collect Data on Health Inequities</b></p> <ul style="list-style-type: none"> <li>• Collect and share data on significant health inequities, populations most affected and intersectional responses with the BWH community and community members and organizations</li> <li>• Develop a plan for moving forward on all the steps for the American Hospital Association #123forEquity Pledge to eliminate health care disparities</li> <li>• Explore the feasibility of incorporating standardized screening tools into eCare for assessing the health-related social needs of patients</li> </ul>
	<p><b>4.1.2 Foster a Culture of Collaborative Learning and Advancement</b></p> <ul style="list-style-type: none"> <li>• Identify interest and seek to establish a BWH learning community for those engaged or interested in health equity research and community informed practice</li> <li>• Participate in BWH innovation efforts and identify strategies to integrate health equity into those efforts</li> <li>• Collaborate across BWH departments on organizational efforts to advance equity, diversity and inclusion</li> <li>• Communicate and share experiences with other health systems also seeking to strengthen institutional commitment and expertise to advance health equity</li> </ul>
	<p><b>4.1.3 Interventions to Address Identified areas of Health Inequity</b></p> <p><u>Cancer</u></p> <ul style="list-style-type: none"> <li>• Provide patient navigation support for colorectal cancer screening targeted to patients at BWH community health centers</li> <li>• Leverage expertise at Dana Farber Cancer Institute (DFCI) and BWH to improve health and well-being of women of color cancer survivors</li> <li>• Provide financial resources to low income women with breast cancer for costs of treatment not covered by insurance</li> </ul> <p><u>Birth Outcomes</u></p> <ul style="list-style-type: none"> <li>• Continue to address the social and medical needs of pregnant women by offering comprehensive programs including the Stronger Generations Case Manager Program, the Centering Pregnancy Program and the Midwifery Program</li> </ul> <p><u>Additional Community Health Equity Interventions</u></p> <ul style="list-style-type: none"> <li>• Provide Health Equity Grants to community based organizations to implement programs that engage with residents to develop practical strategies to improve health outcomes for communities of color</li> </ul>

	<ul style="list-style-type: none"> <li>• Identify how our community approach can strengthen the health protective factors of community cohesion and resilience in partnership with other institutions, organizations and community members</li> <li>• Establish an annual BWH ‘health equity champions’ award where community members working to advance health equity can get a contribution towards their efforts and are recognized for their commitment and skill</li> </ul>
	<p><b>4.1.4 Advance Racial Equity in our Health System and in our Communities</b></p> <ul style="list-style-type: none"> <li>• Continue racial equity training and advocacy work based at Southern Jamaica Plain Health Center and identify opportunities and potential resources to further advance these efforts</li> <li>• Participate in the Boston Alliance for Racial Equity and continue to work with government partners and health and community partners to advance racial equity</li> <li>• Support community-based efforts through the BWH Health Equity grants and use evaluation results to inform future strategy and resource allocation</li> <li>• Look at potential application of the Racial Equity Impact Assessment tool within our health care environment and in our community efforts</li> </ul>
<b>Priority 5</b>	<p><b>Social Determinants of Health (Employment, Education, Economic Stability, Housing, Transportation)</b>  <b>Contribute proactively to build the community conditions for improved health outcomes, health system access and full civic engagement</b></p>
<b>Strategies</b>	<p><b>5.1.1 Employment, Education and Economic Stability</b>  <u>Employment</u></p> <ul style="list-style-type: none"> <li>• Provide youth employment and mentoring opportunities for Boston Public School students and a pathway for a skilled and diverse health care workforce and communicate evaluation results</li> <li>• Develop a resource to share best practices on youth employment with other employers and stakeholders</li> </ul>

	<ul style="list-style-type: none"> <li>• Provide community residents with employment and career counseling, referrals to job skills development programs and facilitate job interviews of qualified community residents</li> <li>• Pilot and evaluate a CHC based intervention that incorporates referral and participation in job training and support from a career center as part of the care plan</li> <li>• Support Jamaica Plain Neighborhood Development Corporation to establish a youth employment program focused on out of school youth</li> </ul> <p><u>Education</u></p> <ul style="list-style-type: none"> <li>• Enhance literacy, science skills development and career exploration by programs that partner with employee volunteers with students in Mission Hill elementary and middle schools</li> <li>• Provide college scholarship support to graduates of our Student Success Jobs program and provide support and guidance to encourage their success in college</li> </ul> <p><u>Economic Stability</u></p> <ul style="list-style-type: none"> <li>• Provide job skill development as well as educational and employment opportunities for pregnant and parenting young people to enable family economic stability and self-sufficiency</li> <li>• Continue to monitor the impacts of poverty, inequity and housing affordability for neighborhood residents and contribute to the city- wide dialogue and advocacy on its impact</li> <li>• Consider opportunities for ‘two generation’ approaches in our community efforts (benefiting parents/caregivers and their children) and discuss these with CHCs and local pediatric providers</li> </ul> <p><b>5.1.2 Transportation</b></p> <ul style="list-style-type: none"> <li>• Share findings from the Fair Public Transportation Report: Community Health Center Directors Roundtable</li> <li>• Seek to further understand transportation barriers for low income patients and identify ways to improve transportation to facilitate health care access</li> <li>• Continue to provide CharlieCards and cab vouchers to low income women through the Perinatal Transportation Assistance Program to increase their access to care and explore other cost effective transportation options</li> </ul> <p><b>5.1.3 Partnerships for addressing health-related social needs</b></p> <ul style="list-style-type: none"> <li>• Explore opportunities for partnerships with social service agencies to strengthen our response to the health-related social needs of patients</li> </ul>
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## **APPENDICES**

## APPENDIX A: Community Meeting Question Guide

### Qualitative Data Collection Questions for COBTH Hospitals 2016 Community Health Needs Assessments Final Version

#### **Background**

The Introduction and questions below are to be used as the 'core set' of questions for the neighborhood discussion/focus groups and community meetings that are being conducted to inform the 2016 Community Health Needs Assessments (CHNAs) of several of the CoBTH hospitals.

#### **Verbal Introduction (this will assist in framing the discussion questions below)**

When our hospitals did their needs assessments a few years ago, community members identified several things that impact their personal health and the health of their community. We heard that many social factors affect them such as employment and financial stress, community violence and lack of access to healthy, affordable food. In more recent assessments we have found more community members speaking about their emotional health, as well as difficulties with substance use. Health data in Boston also show high rates of conditions such as diabetes, asthma, cancer, obesity and heart disease. Community members expressed the importance of better coordination and integration of services, and responses that are relevant to their cultures. They voiced a strong desire to address these issues in equal partnership.

In our time together, we will be exploring four key questions about health and wellness issues for your community. Your input will inform our community health needs assessments and we will be taking notes of the discussion, but no individuals will be identified. We value everyone's participation today/tonight in this discussion, and encourage you to share your thoughts openly so we can learn from you.

#### **Questions for the group:**

1. What do you see as the most pressing health and wellness issues in your community today? Would you say things have gotten better, worse or pretty much the same from a few years ago?
2. What resources and/or supports currently exist in your community to address barriers to health and wellness for residents? What is working well?
3. What would be helpful in your neighborhood to address the most pressing health and wellness issues affecting your community?
4. What is important for hospitals to know so we can work collaboratively with residents and local community organizations?

APPENDIX B: List of Key Stakeholders Interviewed

Internal (BWH) Stakeholders	
▪ Jessica Dudley, MD	BWPO Chief Medical Officer, Vice President Care Redesign
▪ Audra Meadows, MD, MPH	Dept of Obstetrics and Gynecology
▪ Christin Price, MD	Clinical Consultant, BWPO
▪ Rose Kakoza, MD	Assistant Medical Director of Operations, The Phyllis Jen Center for Primary Care
▪ Jackie Somerville, RN	Senior Vice President of Patient Care Services and Chief Nursing Officer, Brigham and Women’s Hospital
▪ Ali Salim, MD	Division Chief, Trauma, Burns, and Surgical Critical Care
External Stakeholders	
▪ Sharon Scott-Chandler, Esq., Executive Vice President ▪ Christina Sieber, Director of Institutional Advancement, Planning, and Grants	ABCD: Action for Boston Community Development
▪ Monica Valdes Lupi, JD, MPH ▪ Gerry Thomas, MPH, Director, Community Initiatives Bureau	Boston Public Health Commission
▪ S. Atyia Martin, PhD, Chief Resiliency Officer	City of Boston
▪ Myechia Minter-Jordan, MD, President and CEO	Dimock Community Health Center
▪ Carlene Pavlos, Director, Bureau of Community Health and Prevention	Massachusetts Department of Public Health
▪ Maura Pensak, Director, Client Services ▪ Molly Cain, Assistant Director, Operations	Metropolitan Boston Housing Partnership

## APPENDIX C: Internal Key Informant Interview Question Guide

### Community Health Assessment One-on-One Guide for INTERNAL Key Informant Interviews

#### Introduction

- Thank you for taking the time to talk with us today and contributing to our community health assessment.
- In our time together, I will be asking about the current needs of BWH's priority neighborhoods, which are Dorchester, Jamaica Plain, Mattapan, Mission Hill, and Roxbury. We understand your knowledge of these specific neighborhoods may vary, and that is fine.
- We are also interested in hearing your perspective on opportunities for the hospital to address these community needs.
- In addition to interviews with BWH staff, we are analyzing community level health data and conducting interviews with external stakeholders and focus groups with residents of the neighborhoods mentioned above.

#### Background

1. I'd like to start by asking you to provide a brief overview of your primary role(s) and responsibilities at BWH.
2. As mentioned, the CHNA is focused on the neighborhoods of Dorchester, Jamaica Plain, Mattapan, Mission Hill, and Roxbury. What do you see as the key health issues in these communities, as well as the factors impacting overall health and well-being?
3. From your vantage point, what ***emerging*** community public health concerns are important for our priority neighborhoods to focus on in the near future?

#### Brigham and Women's Hospital Role

4. What role do you see Brigham and Women's Hospital playing in efforts to improve the health and well-being of individuals who live in our priority neighborhoods?
  - a. What is your perception of the community-based outreach and programming currently offered?
  - b. Are there BWH departments or staff that you believe should be specifically involved in future efforts?
5. What programs or partnerships do you think would help us better meet the needs of the individuals living in our priority neighborhoods?
6. We are always interested in learning from the experience of others. Are there any particularly impactful community health approaches that you would like us to be aware of (could be either happening at BWH or elsewhere)?
7. What additional information or feedback do you have to offer as we go through the process of understanding community health interests and needs at this point in time?

#### Closing

Thank you very much for your time. Our next steps will be to summarize the information we learn from each of the individuals we interview and prepare a final report and Implementation plan, which will be presented to the Board of Trustees in early summer.

## APPENDIX D: External Key Informant Interview Question Guide

### Community Health Assessment

#### One-on-One Guide for EXTERNAL Key Informant Interviews

##### Introduction

Thank you for taking the time to talk with me today and contributing to Brigham and Women's Hospital community health assessment. The purpose of this assessment is to gain a better understanding of the health issues of people who live and work in Boston, how those issues are currently being addressed, and your opinion about what more could be done to address them. Our ultimate goal for these interviews is to gather a broad range of input on community health issues that will help inform future programming and how they provide community-based services.

As you may or may not know, Brigham and Women's Hospital serves a broad range of individuals and communities, but has 5 specific neighborhoods in Boston where they have prioritized their community outreach and programming. These neighborhoods include: Dorchester, Jamaica Plain, Mattapan, Mission Hill, and Roxbury. Throughout this interview I will be asking some general questions about the health assets and needs for people who live in Boston, and then some specific questions about what is happening in these priority neighborhoods. Your knowledge of these specific neighborhoods may vary, so we will adjust our questions as we go along to make sure we are asking questions that are appropriate for you. At the conclusion of the interview we will write up summary notes. We will then synthesize the information we learn across all the people we interview and provide Brigham and Women's Hospital a summary report.

Do you have any questions about the purpose of the interview and how the information will be used?

Before we begin, I would like to request your permission to record our conversation today. The recording will help us develop a more accurate reflection of your input as we write up our notes. It will only be used by our team and not shared with anyone else. Would it be OK with you to record our conversation?

##### Background

1. I'd like to start by asking you provide a brief overview of your primary roles and responsibilities within your agency/institution.
2. What would you say are the major priorities that your agency/organization is focusing on to improve the health and well-being of the people your agency/organization serves?
  - a. How are you addressing these priority areas?
  - b. Who are you working in partnership with to address these issues? What other partners do you think are important to the success of your efforts?
  - c. What do you see as the strengths/challenges of addressing these issues to-date?

3. How successful do you think your agency's work in these areas has been in improving the health and well-being of people who live in Brigham and Women's Hospital's priority neighborhoods?
4. From your vantage point at [state/city government, CBO], what other emerging health or public health concerns are important for local communities, especially those in Boston, to focus on in the near future?

### **Role of Hospitals**

5. I'd like for you to think about the role that hospitals might play in addressing some of the issues we have discussed. What do you think hospitals (or healthcare delivery systems more broadly) are doing now that contributes to community health (*may want to focus in on those issues we have been discussing*)?
  - a. What more do you think hospitals could do to support community health improvements (like those we have discussed)? In other words, what additional programs, services, investments, or roles could hospitals play in efforts to improve community health?

### **Questions Specific to Brigham and Women's Hospital**

In this final set of questions, I'd like to focus specifically on Brigham and Women's Hospital and its community programs.

6. What role do you see Brigham and Women's Hospital playing in efforts to improve the health and well-being of individuals who live in their priority neighborhoods?
  - a. What is your perception of the community-based outreach and programming currently offered?
7. How might Brigham and Women's Hospital provide programs or partner with others to better meet the needs of the individuals who are living in their priority neighborhoods?
8. What additional information or feedback do you have to offer Brigham and Women's Hospital as they go through the process of understanding community health interests and needs at this point in time?

### **Closing**

Thank you very much for your time. Our next steps will be to summarize the information we learn from each of the individuals we interview and prepare a report for Brigham and Women's Hospital. This information will be included as part of their overall needs assessment.

**Attachment/Exhibit**

**B**

## **Supplemental Information to the CHNA/CHIP Self-Assessment Form**

This narrative is to supplement the responses outlined on the Community Health Initiative (“CHI”) *CHNA/CHIP Self-Assessment Form* and provide an overview of the Brigham and Women’s Hospital – 2016 Community Health Needs Assessment (“CHNA”), including the methodology employed to obtain community feedback, such as relevant data; key informant interviews; and references. There was a particular focus in the last CHNA on the social determinants of health and how these areas may be impacted.

BWH’s 2016 CHNA defines health in the broadest sense and recognizes that factors at multiple levels impact a community’s health – from lifestyle behaviors (e.g. diet and exercise), to clinical care (e.g. access to medical services), to social and economic factors (e.g. employment opportunities), to the physical environment (e.g. open space) (Figure 2, page 11). This CHNA examined data at all these levels, but considerable focus was given to the social determinants of health due to their significant influence on the health and long-term health outcomes of communities. As illustrated in Figure 2 of the 2016 CHNA (page 11), social and economic factors have the greatest impact on the health of individuals, and this understanding informed the data BWH sought and analyzed in the course of the assessment.

BWH’s staff understand that where individuals are born, grow, live, work, and age—from our environment in the womb to our community environment later in life—and the interconnections among these factors are critical to overall health. While genes and lifestyle behaviors affect health, it is most profoundly influenced by more upstream factors, such as quality of education, economic stability, employment status, quality of housing stock and issues of racial inequity. These factors determine the context in which people live and shape the opportunities that are available to them, which in turn impact their health and the health of their families.

BWH also approached this assessment with the knowledge that communities of color throughout the nation experience poorer health outcomes, which is very true in Boston. There is growing interest and a body of research on the health impact of inequality and racism, and this has been a prominent feature of the Boston Public Health Commission’s work and other leading public health organizations in recent years. Racism, a system of advantage based on race, both intersects and compounds the negative impacts of social and economic challenges faced by community members. While people often think of the interpersonal manifestations of racism, the most profound impact of racism is experienced through the systems and institutions in our society, and over time it results in health enhancing opportunities being available to some groups, and not available to others. This is referred to as institutional and structural racism. Disinvestment in community infrastructure, unequal educational resources and the legacy of redlining in the housing market are illustrations of the policies and structures that reproduce systemic forms of racism. Understanding the health impacts of racism, how it operates in societal structures and within organizations, and taking steps towards dismantling these inequities, is a crucial area of interest for those seeking to promote health equity. This understanding informs and shapes the community health work at BWH.

### **A. CHNA – Data Collection Methods**

A mixed methods approach was used for the 2016 CHNA with BWH including the analysis of key demographic, social, economic, health and well-being data. The Boston Public Health Commission (“BPHC”) was the primary source of the CHNA’s neighborhood level data. BWH utilization and emergency department data were also analyzed. Primary data were collected through interviews and structured community discussion groups. BWH embarked on an

innovative online community engagement process with The Institute for Community Health and Emerson College entitled *What Matters for Health* that obtained extensive community input from 488 participants. Key reports that analyzed the health and social and economic status of Boston communities also provided valuable data to inform the 2016 CHNA. Through these multiple methods, BWH staff have worked to identify the pressing health and wellness issues facing BWH's priority communities (Dorchester, Jamaica Plain, Mattapan, Mission Hill and Roxbury).

Moreover, BWH collaborated with members of the Conference of Boston Teaching Hospitals ("CoBTH") to plan, implement and analyze findings from five community meetings in key neighborhoods identified by the group with 79 resident participants. A core set of questions was developed by participating hospitals to guide meeting discussions. (see the 2016 CHNA – Appendix A). The total number of participants at each meeting ranged from 9 to 20 residents and the meetings averaged 90 minutes in duration. Interpreters were provided at meetings when requested by our community partners. Furthermore, the input of the community advisory boards of Southern Jamaica Plain Health Center (SJPHC) and Brookside Community Health Center (BWH's two licensed health centers), both which are located in Jamaica Plain, was solicited for the 2016 CHNA. A forum was conducted with high school students from the CCHHE's Student Success Job Program ("SSJP") to learn more about young peoples' perspectives on community health needs.

Key informant interviews were conducted with six internal and nine external stakeholders (see the 2016 CHNA – Appendix B). These stakeholders were selected based on their strategic areas of expertise and connection to BWH's priority communities. A series of interview questions was created to guide conversations with key informants and to solicit their input and feedback on the health and wellness issues facing BWH's priority communities (see the 2016 CHNA – Appendices C and D). Table 1 below summarizes BWH's data sources for the 2016 CHNA.

**Table 1. Summary of Data Sources Informing 2016 BWH CHNA**

<b>Data Type</b>	<b>Data Source</b>	<b>Notes</b>
<b>Quantitative Data</b>	U.S. Census & American Community Survey	Obtained from and analyzed by Boston Public Health Commission (BPHC)
	Boston Behavioral Risk Factor Surveillance Survey (BBRFSS)	Obtained from and analyzed by BPHC
	Youth Risk Behavior Survey (YRBS)	Obtained from and analyzed by BPHC
	Vital Statistics	Obtained from and analyzed by BPHC
	BWH Utilization Data	Obtained from EPSi (an internal Partners HealthCare service utilization and billing database)
	BWH Emergency Department Data	Obtained from Partner's HealthCare, Massachusetts Data Warehouse Database

**Qualitative Data**

Community meetings with residents of priority communities	5 conducted in the following neighborhoods: Jamaica Plain, Roxbury, Bowdoin Geneva (Dorchester), Mattapan, and Codman Square (Dorchester); 79 residents attended in total
Meetings with community advisory boards at Southern Jamaica Plain Health Center and Brookside Health Center	2 conducted
Forum with high school students involved with the Student Success Job Program	1 conducted
Interviews with internal stakeholders	6 conducted
Interviews with external stakeholders	9 conducted; interviews conducted by sub-contractor, the Institute for Community Health

**Reports**

BPHC's <i>Health of Boston</i> report	Published 2014-2015
Federal Reserve Bank of Boston's <i>The Color of Wealth in Boston</i> report	Published 2015
<i>What Matters for Health: A Community Health Planning Report</i>	Published 2015 and available on the CCHHE website, this report details the analysis of over 8,000 comments from 488 participants in an innovative on-line game that BWH undertook to explore perceptions and recommendations from community members on personal, neighborhood and citywide health issues.

In addition to the data sources listed above, information from the following sources informed sections of the 2016 CHNA:

- Brigham and Women's Hospital (<http://www.brighamandwomens.org/>) and Partners HealthCare (<http://www.partners.org/>) websites.
- The County Health Rankings & Roadmaps, which is a collaboration between the Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute (<http://www.countyhealthrankings.org/>).
- The U.S. Bureau of Labor Statistics (2014-2016) (<http://www.bls.gov/>)
- Fair Public Transportation Report: Community Health Center Directors Roundtable (December 2015).
- The Democracy Collaborative's *Can Hospitals Heal America's Communities?*, written by Tyler Norris and Ted Howard (December 2015). (<http://democracycollaborative.org/content/can-hospitals-heal-americas-communities-0>)
- The American Public Health Association's website and section on "Racism and Health" (<https://www.apha.org/topics-and-issues/health-equity/racism-and-health>)
- The U.S. Department of Health and Human Services' HealthyPeople 2020 website (<https://www.healthypeople.gov/>)

- The Blue Cross Foundation and the Urban Institute's *Summary of Health Insurance Coverage and Health Care Access and Affordability in Massachusetts: 2015 Update* (March 2015). ([http://bluecrossfoundation.org/sites/default/files/download/publication/MHRS\\_2015\\_Summary\\_FINAL.pdf](http://bluecrossfoundation.org/sites/default/files/download/publication/MHRS_2015_Summary_FINAL.pdf))
- The Center for Health Information and Analytics (CHIA)'s "Annual Report Premiums Databook" (updated November 2015) (<http://www.chiamass.gov/premiums/>) and "The Performance of the Massachusetts Healthcare System Series – Massachusetts High Deductive Health Plan Membership" (Updated November 2015) (<http://www.chiamass.gov/the-performance-of-the-massachusetts-health-care-system-series/#hdhp>)

### Limitations and Considerations

It is also important to note specific methodological considerations as patients embarked on our 2016 CHNA work, as well as limitations that are characteristic of applied research efforts.

Specifically;

- Every effort was made to ensure diverse and broad participation in the community throughout the 2016 CHNA data collection and analysis process.
- Community meetings were conducted to obtain more in-depth, meaningful conversations from a wide sampling of community members.
- Key informant interviews were held to ensure that the perspectives of specific internal and external sub-groups were represented.
- There was very limited health and other data specific to the neighborhood of Mission Hill. Available data typically includes Mission Hill within the larger community of Roxbury.

**Attachment/Exhibit**

**C**

**Acknowledgement of the Submission of Community Engagement Stakeholder  
Assessment Forms**

Per the Department of Public Health's submission process, stakeholders associated with the Brigham and Women's Hospital – 2016 Community Health Needs Assessment have personally submitted Community Engagement Stakeholder Assessment Forms.

**Attachment/Exhibit**

**D**

## Community Health Initiative Narrative

### A. Community Health Initiative Monies

The breakdown of Community Health Initiative (“CHI”) monies for the proposed Project is as follows:

- Maximum Capital Expenditure: \$73,186,747.20
  - Community Health Initiative: \$3,659,337.35 (5% of Maximum Capital Expenditure)
  - CHI Administrative Fee to be retained: \$109,780.12 (3% of the CHI monies)
  - CHI Money – less the Administrative Fee: \$3,549,557.24
- 
- CHI Funding for Statewide Initiative: \$887,389.31 (25% of CHI monies – less the administrative fee)
  - CHI Local Funding: \$2,662,167.93 (75% of CHI monies – less the administrative fee))

### B. History – Discussion of Previous CHNA/DoN Process

The Community Health Initiative (“CHI”) processes and community engagement for the proposed Determination of Need (“DoN”) Project<sup>1</sup> will be conducted by the Brigham and Women’s Hospital (“BWH”) – Center for Community Health and Health Equity (“CCHHE”). The CCHHE works to improve health outcomes by providing community health programs, as well as addressing the underlying social issues of individual and community health. Whether CCHHE is expanding school-based programs, enhancing educational and career opportunities, or supporting victims of violence, the CCHHE’s work is centered around improving health and equity in BWH’s priority communities.

BWH’s 2016 Community Health Needs Assessment (“CHNA”) was conducted in tandem with the submission and approval of a DoN. In May 2013, BWH filed a DoN for a substantial capital expenditure and in June 2013 a Ten Taxpayer Group filed correspondence with the Department of Public Health (“Department”) on the DoN Project. In regard to the community benefit funding from the 2013 DoN, the Department placed specific conditions on BWH around community engagement activities, specifying that the following organizations should participate in the planning process: the Department’s – Office of Healthy Communities, the Boston Alliance for Community Health, the Boston Public Health Commission and the Ten Taxpayer Group that filed correspondence with the Department in regard to the 2013 DoN (collectively known as the “DoN Planning Committee”). Based upon interviews with experienced consultants in the area of community engagement, the DoN Planning Committee selected the Institute for Community Health and Emerson College to help BWH launch the *What Matters for Health* planning process

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<sup>1</sup> Partners HealthCare System, Inc. (“Applicant”) located at 800 Boylston Street, Suite 1150, Boston, MA 02199 is filing a Notice of Determination of Need (“Application”) with the Massachusetts Department of Public Health for a substantial capital expenditure and acquisition of new technology by Brigham and Women’s Hospital (“BWH”) located at 75 Francis Street, Boston, MA 02115. The project includes the renovation and expansion of the existing BWH emergency department (“ED”); the acquisition of a magnetic resonance imaging (“MRI”) simulator and a linear accelerator/MRI; and, the conversion of a research-only 7T MRI to part-time clinical use (“Project”).

to ensure appropriate community involvement and engagement in the disbursement of community benefit monies. BWH received and analyzed over 8,000 comments from 488 participants via an innovative online tool that BWH implemented to explore perceptions and recommendations from community members and neighborhood leaders on citywide health issues.

Shortly after this planning process ended, BWH began its CHNA process, building on the efforts of the DoN Planning Committee. BWH, in collaboration with other members of the Conference of Boston Teaching Hospitals (“CoBTH”), held five community meetings with various stakeholders, including 79 residents from designated priority communities (Roxbury, Dorchester – Codman Square, Jamaica Plain, and Mattapan). Consequently, the 2016 CHNA reflects a thorough focus on the social determinants of health after engaging a large group of stakeholders from the community (as evidenced by the CHNA/CHIP Self-Assessment Form).

### C. Advisory Committee Duties

Given that this is a Tier 2 CHI, the scope of work that the Advisory Committee will carry includes:

- Based upon BWH's 2016 CHNA and Implementation Plan, and aligned with the Department's Health Priorities and the EOHHS Focus Areas, the Advisory Committee is tasked with the determining the Health Priorities for funding and submitting the Health Priorities Form to the Department for review and approval.

### D. Allocation Committee Duties

The Allocation Committee is comprised of individuals from the Advisory Committee who do not have a conflict of interest in regard to funding. The scope of work that the Allocation Committee will carry out includes:

- Determining If there is a conflict of interest for any Allocation Committee member, and if so, asking the member to recuse him/herself (a Conflict of Interest Form is in the process of being developed).
- Carrying out a formal request for proposal (“RFP”) process for the disbursement of CHI funds.
- Engaging resources that can support and assist applicants with their responses to the RFP.
- Disbursement of CHI funding.
- Providing oversight to a third-party vendor that is selected to carry out the evaluation of CHI-funded projects.

### E. Timeline for CHI Activities

Upon a Notice of Determination of Need being issued by the Public Health Council, the Advisory Committee will commence meeting and begin the CHI Process. The timeline for CHI activities is as follows:

- One-month post-approval: The Advisory Committee will begin meeting and reviewing the 2016 CHNA to commence the process of selecting Health Priorities.
- Three months post-approval: The Advisory Committee has determined Health Priorities for funding and submits the Health Priorities Form to the Department.
- Four-five months post-approval: The Allocation Committee is developing the RFP process and determining how this process will work in tandem with CCHHE's current grant RFP process.
- Four-five months post-approval: CCHHE will seek to work with the University of Massachusetts – Donahue Institute on evaluation and serve as a technical resource to grantees
- Nine months post-approval: The RFP for funding is released.
- Ten months post-approval: Bidders conferences are held on the RFP.
- Twelve months post-approval: Responses are due for the RFP.
- Fifteen months post-approval: Funding decisions are made, and the disbursement of funds begins.
- Eighteen months post-approval: The UMass Donahue Institute will begin evaluation work.

The aforementioned process is longer than the process outlined in the DoN Guidelines for Tier 2 projects. However, given CCHHE's previous experience with a similar project for BWH's 2013 DoN, staff feel strongly that it will take twelve months to develop a RFP process that is transparent, fair and appropriate.

#### F. Request for Additional Years of Funding

BWH is seeking additional time to carry out the disbursement of funds for CHI. Based on BWH's 2016 CHNA, as well as previous experience with providing grant funding, BWH will offer larger, potentially multi-year grants with CHI funding. Consequently, BWH is seeking to disburse these monies over a 6-8-year period to ensure the greatest impact for the largest number of individuals.

#### G. Evaluation Overview

BWH is seeking to use 10% of all CHI funding (\$266,216.79) for evaluation. These monies will allow BWH to engage the UMass Donahue Institute to carry out technical assistance and ensure appropriate evaluation of the CHI-funded projects.

**Attachment/Exhibit**

**5**

+

15

**PUBLIC ANNOUNCEMENT CONCERNING  
A PROPOSED HEALTH CARE PROJECT**

Partners HealthCare System, Inc. ("Applicant") located at 800 Boylston Street, Suite 1150, Boston, MA 02199 intends to file a Notice of Determination of Need ("Application") with the Massachusetts Department of Public Health for a substantial capital expenditure and acquisition of new technology by Brigham and Women's Hospital ("BWH") located at 75 Francis Street, Boston, MA 02115. The project includes the renovation and expansion of the existing BWH emergency department; the acquisition of a magnetic resonance imaging ("MRI") simulator and a linear accelerator/MRI; and, the conversion of a research-only 7T MRI to part-time clinical use ("Project"). The total value of the Project based on the maximum capital expenditure is \$73,186,747. The Applicant does not anticipate any price or service impacts on the Applicant's existing Patient Panel as a result of the Project. Any ten Taxpayers of Massachusetts may register in connection with the intended Application no later than 30 days of the filing of the Notice of Determination of Need by contacting the Department of Public Health, Determination of Need Program, 250 Washington Street, 6th Floor, Boston, MA 02108.

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TUESDAY, OCTOBER 17, 2017 BOSTON HERALD

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**PUBLIC ANNOUNCEMENT CONCERNING  
A PROPOSED HEALTH CARE PROJECT**

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www.bostonherald.com

**DEPARTMENT OF ENVIRONMENTAL PROTECTION  
WATERWAYS REGULATION PROGRAM**

**Notice of License Application pursuant to M.G.L. Chapter 91  
Amendment to Waterways License Number 9342b**

**Applicant:** LCTB Fort Point, LLC  
**Project Location:** 253 Summer Street, (South) Boston, Suffolk County  
**Scheduled Public Hearing:** November 1, 2017  
**Public Comments Deadline:** November 21, 2017

**NOTIFICATION DATE:** October 17, 2017

Public notice is hereby given of the Waterways License Amendment Application by LCTB Fort Point, to construct and maintain a patio with associated grading and landscaping for seasonal outdoor dining and make improvements to the existing onsite Harborwalk located on filled tidelands of the Fort Point Channel at 253 Summer Street, Boston, Suffolk County. The Department has determined that said project is nonwater-dependent.

The Department of Environmental Protection, Waterways Regulation Program, will conduct a public hearing on the aforesaid Project proposal on Wednesday, November 1, 2017 at 3:00pm at MassDEP Headquarters, Room 2212-A, One Winter Street, Boston. The Department will conduct this public hearing in order to receive information to be used in its decision on whether to grant a Waterways License pursuant to M.G.L. Chapter 91.

The Department will consider all written comments on this Waterways Application received by Tuesday, November 21, 2017 (Public Comments Deadline). Failure of any aggrieved person or group of ten citizens or more to submit written comments to the Waterways Regulation Program by the Public Comments Deadline will result in the waiver of any right to an adjudicatory hearing in accordance with 310 CMR 9.13(4)(c). The group of citizens must include no less than five citizens who are residents of the municipality in which the Project is located.

Additional information regarding this application may be obtained by contacting the Waterways Regulation Program at (617) 292-5551. Project plans and documents for this application are on file for public viewing, by appointment only, at the address below. Written comments must be addressed to: Frank Taormina, MassDEP Waterways Regulation Program, One Winter Street - 5th Floor, Boston, MA 02108 or to frank.taormina@state.ma.us

Oct 17

BOSTON HERALD TUESDAY, OCTOBER 17, 2017

RETURN OF PUBLICATION

I, the undersigned, hereby certify under the pains and penalties of perjury, that I am employed by the publishers of the Boston Herald and the following Public/Legal announcement was published in two sections of the newspaper on October 17, 2017 accordingly:

- 1) "Public Announcement Concerning a Proposed Health Care Project" page 30 Legal Notice Section.

(check one) [X] Size at least two inches high by three columns wide
Size at least three inches high by two columns wide

- 2) "Public Announcement Concerning a Proposed Health Care Project" page 15, Section.

(check one) [X] Size at least two inches high by three columns wide
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PUBLIC ANNOUNCEMENT CONCERNING A PROPOSED HEALTH CARE PROJECT

Partners HealthCare System, Inc. ("Applicant") located at 800 Boylston Street, Suite 1150, Boston, MA 02199 intends to file a Notice of Determination of Need ("Application") with the Massachusetts Department of Public Health for a substantial capital expenditure and acquisition of new technology by Brigham and Women's Hospital ("BWH") located at 75 Francis Street, Boston, MA 02115. The project includes the renovation and expansion of the existing BWH emergency department; the acquisition of a magnetic resonance imaging ("MRI") simulator and a linear accelerator/MRI; and, the conversion of a research-only 7T MRI to part-time clinical use ("Project"). The total value of the Project based on the maximum capital expenditure is \$73,186,747. The Applicant does not anticipate any price or service impacts on the Applicant's existing Patient Panel as a result of the Project. Any ten Taxpayers of Massachusetts may register in connection with the intended Application no later than 30 days of the filing of the Notice of Determination of Need by contacting the Department of Public Health, Determination of Need Program, 250 Washington Street, 6th Floor, Boston, MA 02108.

Mary Hallahan
Signature

Mary Hallahan
Name

Legal Advertising Representative
Title

PUBLIC ANNOUNCEMENT CONCERNING A PROPOSED HEALTH CARE PROJECT

Partners HealthCare System, Inc. ("Applicant") located at 800 Boylston Street, Suite 1150, Boston, MA 02199 intends to file a Notice of Determination of Need ("Application") with the Massachusetts Department of Public Health for a substantial capital expenditure and acquisition of new technology by Brigham and Women's Hospital ("BWH") located at 75 Francis Street, Boston, MA 02115. The project includes the renovation and expansion of the existing BWH emergency department; the acquisition of a magnetic resonance imaging ("MRI") simulator and a linear accelerator/MRI; and, the conversion of a research-only 7T MRI to part-time clinical use ("Project"). The total value of the Project based on the maximum capital expenditure is \$73,186,747. The Applicant does not anticipate any price or service impacts on the Applicant's existing Patient Panel as a result of the Project. Any ten Taxpayers of Massachusetts may register in connection with the intended Application no later than 30 days of the filing of the Notice of Determination of Need by contacting the Department of Public Health, Determination of Need Program, 250 Washington Street, 6th Floor, Boston, MA 02108.

**Attachment/Exhibit**

**6**

**Partners HealthCare System, Inc.**

**Analysis of the Reasonableness of  
Assumptions Used For and  
Feasibility of Projected Financials of  
Partners HealthCare System, Inc.  
For the Years Ending September 30, 2017  
Through September 30, 2021**

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VI. FEASIBILITY .....	5

# BERNARD L. DONOHUE, III, CPA

Chestnut Green  
8 Cedar Street, Suite 62  
Woburn, MA 01801

(781) 569-0070  
Fax (781) 569-0460

November 1, 2017

Mr. Brian Huggins  
Partners HealthCare Systems, Inc.  
399 Revolution Drive STE 645  
Somerville, MA 02145

**RE: Analysis of the Reasonableness of Assumptions and Projections Used to Support the Financial Feasibility and Sustainability of the Proposed Capital Projects at Brigham and Women's Hospital**

Dear Mr. Huggins:

I have performed an analysis of the financial projections prepared by Partners HealthCare System, Inc. ("Partners") detailing the projected operations of Partners including the projected operations of Brigham and Women's Hospital ("BWH" or "the Brigham"). This report details my analysis and findings with regards to the reasonableness of assumptions used in the preparation and feasibility of the projected financial information of Partners as prepared by the management of Partners ("Management"). This report is to be included by Partners in its Determination of Need ("DoN") Application – Factor 4(a) and should not be distributed or relied upon for any other purpose.

## **I. EXECUTIVE SUMMARY**

The scope of my analysis was limited to an analysis of the five year consolidated financial projections (the "Projections") prepared by Partners as well as the actual operating results for Partners for the fiscal years ended 2015 and 2016 ("Base Budget"), and the supporting documentation in order to render an opinion as to the reasonableness of assumptions used in the preparation and feasibility of the Projections with regards to the impact of certain capital projects at BWH.

The impact of the proposed capital projects at BWH, which are the subject of this DON application, represent a relatively insignificant component of the projected operating results and financial position of Partners. As such, I determined that the Projections are not likely to result in a scenario where there are insufficient funds available for capital and ongoing operating costs necessary to support the ongoing operations of Partners. Therefore, it is my opinion that the Projections are financially feasible for Partners as detailed below.

*Member: American Institute of CPA's  
Massachusetts Society of CPA's*

[www.bld-cpa.com](http://www.bld-cpa.com)

## **II. RELEVANT BACKGROUND INFORMATION**

Refer to Factor 1 of the application for description of proposed capital projects at BWH and the rationale for the expenditures.

## **III. SCOPE OF REPORT**

The scope of this report is limited to an analysis of the Projections, Base Budget and the supporting documentation in order to render an opinion as to the reasonableness of assumptions used in the preparation and feasibility of the Projections with regards to the impact of certain capital projects at BWH. My analysis of the Projections and conclusions contained within this report are based upon my detailed review of all relevant information (see Section IV which references the sources of information). I have gained an understanding of Partners and BWH through my review of the information provided as well as a review of Partners website, annual reports, and the DoN application.

Reasonableness is defined within the context of this report as supportable and proper, given the underlying information. Feasibility is defined as based on the assumptions used, the plan is not likely to result in insufficient “funds available for capital and ongoing operating costs necessary to support the proposed project without negative impacts or consequences to [Partners] existing patient panel” (per Determination of Need, Factor 4(a)).

This report is based upon historical and prospective financial information provided to me by Management. If I had audited the underlying data, matters may have come to my attention that would have resulted in my using amounts that differ from those provided. Accordingly, I do not express an opinion or any other assurances on the underlying data presented or relied upon in this report. I do not provide assurance on the achievability of the results forecasted by Partners because events and circumstances frequently do not occur as expected, and the achievement of the forecasted results are dependent on the actions, plans, and assumptions of management. I reserve the right to update my analysis in the event that I am provided with additional information.

## **IV. PRIMARY SOURCES OF INFORMATION UTILIZED**

In formulating my opinions and conclusions contained in this report, I reviewed documents produced by Management. The documents and information upon which I relied are identified below or are otherwise referenced in this report:

1. Five-Year Pro-Forma Statements for the fiscal years ending 2017 through 2021, provided September 27, 2017;
2. Audited Financial Statements of Partners HealthCare System, Inc. and Affiliates as of and for the years ended September 30, 2016 and 2015;
3. Audited Financial Statements of Wentworth-Douglass Health System and Subsidiaries as of and for the years ended December 31, 2016, 2015 and 2014;
4. Multi-Year Financial Framework of Partners Healthcare System, Inc. for the fiscal years ending 2017 through 2021 prepared as of December 8, 2016;

5. Preliminary Financial Results for Partners HealthCare System, Inc. for the fiscal year ended September 30, 2017 as of October 19, 2017;
6. Company website – [www.partners.org](http://www.partners.org);
7. Various news publications and other public information about the Company;
8. Determination of Need Application Instructions dated March 2017; and
9. Draft Determination of Need Factor 1, provided October 30, 2017.

#### V. REVIEW OF THE PROJECTIONS

This section of my report summarizes my review of the reasonableness of the assumptions used and feasibility of the Projections. The Projections are delineated between five categories of revenue and six general categories of operating expenses of Partners as well as other non-operating gains and losses for the Organization. The Projections incorporate the operating results of Wentworth-Douglass Health System into Partners for the fiscal year ending 2017; however, the operating results of Wentworth-Douglass Health System were excluded from the Projections for the fiscal years ending 2018 through 2021 – see further discussion below. The following table presents the Key Metrics, as defined below, of Partners which compares the results of the Projections for the fiscal years ending 2017 through 2021 to Partners historical results for the fiscal year ended 2016.

	Partners, as	Change in Key Metric of pro forma results compared to				
	reported	prior year				
	2016	2017	2018	2019	2020	2021
EBIDA (\$)	582,980	368,706	135,228	48,954	44,662	47,720
EBIDA Margin (%)	4.7%	2.4%	1.0%	0.0%	-0.1%	0.0%
Operating Margin (%)	-0.9%	2.0%	0.8%	0.0%	0.0%	0.0%
Total Margin (%)	-2.0%	6.8%	-1.3%	0.1%	0.0%	0.0%
Total Assets (\$)	15,912,872	1,054,900	676,726	678,272	678,574	430,025
Total Net Assets (\$)	5,474,357	714,859	499,914	578,509	581,508	588,228
Unrestricted Cash Days on Hand (days)	183.8	3.8	19.6	12.9	13.1	6.0
Unrestricted Cash to Debt (%)	119.8%	3.1%	6.6%	12.3%	13.3%	16.4%
Debt Service Coverage (ratio)	2.2	3.7	(0.9)	0.1	0.0	(2.3)
Debt to Capitalization (%)	55.4%	-2.8%	-1.7%	-2.1%	-2.0%	-2.8%

The Key Metrics fall into three primary categories: profitability, liquidity, and solvency. Profitability metrics, such as EBIDA, EBIDA Margin, Operating Margin, Total Margin, and Debt Service Coverage Ratio are used to assist in the evaluation of management performance in how efficiently resources are utilized. Liquidity metrics, such as Unrestricted Days Cash on Hand, and Unrestricted Cash-to-Debt measure the quality and adequacy of assets to meet current obligations as they come due. Solvency metrics, such as Debt to Capitalization, and Total Net Assets, measure the company's ability to service debt obligations. Additionally, certain metrics can be applicable in multiple categories.

The following table shows how each of the Key Metrics are calculated.

Key Metric	Definition
EBIDA (\$)	(Earnings before interest, depreciation and amortization expenses) - Operating gain (loss) + interest expense + depreciation expense + amortization expense
EBIDA Margin (%)	EBIDA expressed as a % of total operating revenue. EBIDA / total operating revenue
Operating Margin (%)	Income (loss) from operations / total operating revenue
Total Margin (%)	Excess (deficit) of revenue over expenses / total operating revenue
Total Assets (\$)	Total assets of the organization
Total Net Assets (\$)	Total net assets of the organization (includes unrestricted net assets, temporarily restricted net asset and permanently restricted net assets)
Unrestricted Cash Days on Hand (days)	(Cash & cash equivalents + investments + current portion investments limited as to use + investments limited as to use - externally limited funds) / ((Total operating expenses - non recurring charges - depreciation & amortization) / YTD days)
Unrestricted Cash to Debt (%)	Unrestricted Cash-to-Debt (%) - (Cash & cash equivalents + investments + current portion investments limited as to use + investments limited as to use - externally limited funds) / (Current portion of long-term obligations + long-term obligations)
Debt Service Coverage (ratio)	Debt service coverage ratio (ratio) - (Excess (deficit) of revenue over expenses + depreciation expense + amortization expense + interest expense) / (Principal payments + interest expense)
Debt to Capitalization (%)	Debt to Capitalization (%) - (Current portion of long-term obligation + long-term obligations) / (Current portion of long-term obligations + long-term obligations + unrestricted net assets)

In preparing the Key Metrics, Management noted the following:

- Wentworth-Douglass Health System (“WD”) joined Partners effective January 1, 2017. As accounting rules require the fair value of acquired net assets to be recognized as non-operating gains, Management reflected the acquisition in the pro-forma financial information for the fiscal year ending 2017. However, WD financial information was excluded from the projections for fiscal years ending 2018 through 2021 as it was not part of Partners when those projections were initially prepared and Management concluded its impact would be immaterial.
- Based on my review of the available information and discussions with Management, I noted that WD has historically operated with positive operating margins. Management expects WD’s margins to remain consistent during the projection period. With respect to the reasonableness and feasibility of the Projections, it is conservative to not include WD into the Projections.
- Partners has a balloon payment on long-term debt maturing in fiscal year ending 2021 and prepared the Projections to include the balloon payment.

## 1. Revenues

The only revenue category on which the proposed capital projects would have an impact is net patient service revenue. Therefore, I have analyzed net patient service revenue identified by Partners in both their

historical and projected financial information. Based upon my analysis of the projected results from Fiscal Year 2017 through Fiscal Year 2021, the proposed capital projects would represent approximately 0.168% (17 one-hundredths of 1%) of Partners operating revenue beginning in FY 2019 to 0.194% (about 2 tenths of 1%) in FY 2021. The first year in which revenue is present for any of the proposed capital projects is FY 2018 when the revenue for the proposed projects represents approximately 0.010%.

It is my opinion that the revenue growth projected by Management reflects a reasonable estimation based primarily upon the organization's historical operations.

## **2. Operating Expenses**

I analyzed each of the categorized operating expenses for reasonableness and feasibility as it relates to the projected revenue items. I reviewed the actual operating results for Partners for the years ended 2015 and 2016 in order to determine the impact of the proposed capital projects at BWH on the consolidated entity and in order to determine the reasonableness of the Projections for the fiscal years 2017 through 2021. Based upon my analysis of the projected results from Fiscal Year 2017 through Fiscal Year 2021, the proposed capital projects would represent approximately 0.132% (13 one-hundredths of 1%) of Partners operating expenses beginning in FY 2019 to 0.157% (about 16 one-hundredths of 1%) in FY 2021.

It is my opinion that the growth in operating expenses projected by Management reflects a reasonable estimation based primarily upon the organization's historical operations.

## **3. Non-Operating Gains/Expenses and Other Changes in Net Assets**

The final categories of Partners Projections are various non-operating gains/expenses and other changes in net assets. The items in these categories relate to investment account activity (realized and unrealized), philanthropic and academic gifts, benefit plan funded status, fair value adjustments and other items. Because many of these items are unpredictable, nonrecurring, or dependent upon market fluctuations, I analyzed the non-operating activity in aggregate. Based upon my analysis, there were no non-operating expenses projected for the proposed capital projects at BWH. Accordingly, it is my opinion that the pro-forma non-operating gains/expenses and other changes in net assets are reasonable.

## **4. Capital Expenditures and Cash Flows**

I reviewed Partners capital expenditures and cash flows in order to determine whether Partners anticipated reinvesting sufficient funds for technological upgrades and property, plant and equipment and whether the cash flow would be able to support that reinvestment.

Based upon my discussions with Management and my review of the information provided, I considered the current and projected capital projects and loan financing obligations included within the Projections and the impact of those projected expenditures on Partners cash flow. Based upon my analysis, it is my opinion that the pro-forma capital expenditures and resulting impact on Partners cash flows are reasonable.

## **VI. FEASIBILITY**

I analyzed the projected operations for Partners and the changes in Key Metrics prepared by Management as well as the impact of the proposed capital projects at BWH upon the Projections and Key Metrics. In performing my analysis, I considered multiple sources of information including historical and projected

Mr. Brian Huggins  
Partners HealthCare System, Inc.  
November 1, 2017  
Page 6

financial information for Partners. It is important to note that the Projections do not account for any anticipated changes in accounting standards. These standards, which may have a material impact on individual future years, are not anticipated to have a material impact on the aggregate Projections.

Because the impact of the proposed capital projects at BWH represents a relatively insignificant portion of the operations and financial position of Partners, I determined that the Projections are not likely to result in insufficient funds available for capital and ongoing operating costs necessary to support the proposed projects. Based upon my review of the Projections and relevant supporting documentation, I determined the projects and continued operating surplus are reasonable and based upon feasible financial assumptions. Therefore, the proposed capital projects at BWH are financially feasible and within the financial capability of Partners.

Respectively submitted,

*Bernard L. Donohue, III, CPA*

Bernard L. Donohue, III, CPA

**Attachment/Exhibit**

**7**

# The Commonwealth of Massachusetts

OFFICE OF THE MASSACHUSETTS SECRETARY OF STATE  
MICHAEL J. CONNOLLY, Secretary  
ONE ASHBURTON PLACE, BOSTON, MASSACHUSETTS 02108

## ARTICLES OF ORGANIZATION (Under G.L. Ch. 180)

### ARTICLE I

The name of the corporation is:

MGH/BRIGHAM HEALTH CARE SYSTEM, INC.

### ARTICLE II

The purpose of the corporation is to engage in the following activities:

- (i) To organize, operate and support a comprehensive health care system, including without limitation hospital and other health care services for all persons, and education and research for the prevention, diagnosis, treatment and cure of all forms of human illness; (ii) to improve the health and welfare of all persons; (iii) to operate for the benefit of and to support The Massachusetts General Hospital, The Brigham Medical Center, Inc., their respective affiliated corporations and such other charitable, scientific or educational organizations which are or are affiliated with teaching hospitals in the Greater Boston Area; and (iv) to carry on any other activity that may lawfully be carried on by a corporation formed under Chapter 180 of the Massachusetts General Laws which is exempt under section 501(c)(3) of the Internal Revenue Code.

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Note: If the space provided under any article or item on this form is insufficient, additions shall be set forth on separate 8 1/2 x 11 sheets of paper leaving a left hand margin of at least 1 inch. Additions to more than one article may be continued on a single sheet so long as each article requiring each such addition is clearly indicated.

### ARTICLE III

If the corporation has one or more classes of members, the designation of such classes, the manner of election or appointments, the duration of membership and the qualification and rights, including voting rights, of the members of each class, may be set forth in the by-laws of the corporation or may be set forth below:

The designation of classes of members, if any, the manner of election or appointment, the term of office, and the qualifications and rights of members are set forth in the by-laws of the Corporation.

### ARTICLE IV

\* Other lawful provisions, if any, for the conduct and regulation of the business and affairs of the corporation, for its voluntary dissolution, or for limiting, defining, or regulating the powers of the corporation, or of its directors or members, or of any class of members, are as follows:

See Continuation Sheets IV-A through IV-D attached hereto and incorporated herein by reference.

\* If there are no provisions, state "None".

Note: The preceding four (4) articles are considered to be permanent and may ONLY be changed by filing appropriate Articles of Amendment.

MGH/BRIGHAM HEALTH CARE SYSTEM, INC.

IV. Other Lawful Provisions for Conduct and Regulation of the Business and Affairs of the Corporation, for its Voluntary Dissolution, and for Limiting, Defining and Regulating the Powers of the Corporation and of its Trustees and Members.

4.1. The corporation shall have in furtherance of its corporate purposes all of the powers specified in Section 6 of Chapter 180 and in Sections 9 and 9A of Chapter 156B of the Massachusetts General Laws (except those provided in paragraph (m) of said Section 9) as now in force or as hereafter amended, and may carry on any operation or activity referred to in Article 2 to the same extent as might an individual, either alone or in a joint venture or other arrangement with others, or through a wholly or partly owned or controlled corporation; provided, however, that no such power shall be exercised in a manner inconsistent with said Chapter 180 or any other chapter of the Massachusetts General Laws or which would deprive it of exemption from federal income tax as an organization described in Section 501(c)(3) of the Internal Revenue Code.

4.2. The by-laws may authorize the trustees to make, amend or repeal the by-laws in whole or in part, except with respect to any provision thereof which by law, the articles of organization or the by-laws requires action by the members.

4.3. Meetings of the members may be held anywhere in the United States.

4.4. No trustee or officer of the corporation shall be personally liable to the corporation or its members for monetary damages for breach of fiduciary duty as such trustee or officer notwithstanding any provision of law imposing such liability, except to the extent that such exemption from liability is not permitted under Chapter 180 of the Massachusetts General Laws.

4.5.(a) The corporation shall, to the extent legally permissible, indemnify each person who serves as one of its members, trustees or officers, or who serves at its request as a member, trustee or officer of another organization or in a capacity with respect to any employee benefit plan (each such person being called in this Section 4.5 a "Person") against all liabilities and expenses, including amounts paid in satisfaction of judgments, in compromise or as fines and penalties, and

counsel fees, reasonably incurred by such Person in connection with the defense or disposition of any action, suit or other proceeding, whether civil or criminal, in which such Person may be involved or with which such Person may be threatened, while in office or thereafter, by reason of being or having been such a Person, except with respect to any matter as to which such Person shall have been adjudicated in any proceeding not to have acted in good faith in the reasonable belief that his or her action was in the best interests of the corporation or, to the extent that such matter relates to service at the request of the corporation for another organization or an employee benefit plan, in the best interests of such organization or of the participants or beneficiaries of such employee benefit plan. Such best interests shall be deemed to be the best interests of the corporation for the purposes of this Section 4.5.

(b) Notwithstanding the foregoing, as to any matter disposed of by a compromise payment by any Person, pursuant to a consent decree or otherwise, no indemnification either for said payment or for any other expenses shall be provided unless such compromise shall be approved as in the best interests of the corporation, after notice that it involves such indemnification, (a) by a disinterested majority of the trustees then in office; or (b) by a majority of the disinterested trustees then in office, provided that there has been obtained an opinion in writing of independent legal counsel to the effect that such Person appears to have acted in good faith in the reasonable belief that his or her action was in the best interests of the corporation; or (c) by a majority of the disinterested members entitled to vote, voting as a single class.

(c) Expenses, including counsel fees, reasonably incurred by any Person in connection with the defense or disposition of any such action, suit or other proceeding may be paid from time to time by the corporation in advance of the final disposition thereof upon receipt of an undertaking by such Person to repay the amounts so paid if such Person ultimately shall be adjudicated to be not entitled to indemnification under this Section 4.5. Such an undertaking may be accepted without reference to the financial ability of such Person to make repayment.

(d) The right of indemnification hereby provided shall not be exclusive. Nothing contained in this Section shall affect any other rights to indemnification to which any Person or other corporate personnel may be entitled by contract or otherwise under law.

(e) As used in this Section 4.5, the term "Person" includes such Person's respective heirs, executors and administrators, and

a "disinterested" member, trustee or officer is one against whom in such capacity the proceeding in question, or another proceeding on the same or similar grounds, is not then pending.

4.6. (a) No person shall be disqualified from holding any office by reason of any interest. In the absence of fraud, any trustee, officer or member of this corporation, or any concern in which any such trustee, officer or member has any interest, may be a party to, or may be pecuniarily or otherwise interested in, any contract, act or other transaction (collectively called a "transaction") of this corporation, and

(1) such transaction shall not be in any way invalidated or otherwise affected by that fact; and

(2) no such trustee, officer, member or concern shall be liable to account to this corporation for any profit or benefit realized through any such transaction;

provided, however, that such transaction either was fair at the time it was entered into or is authorized or ratified either (i) by a majority of the trustees who are not so interested and to whom the nature of such interest has been disclosed, or (ii) by vote of a majority of each class of members of the corporation entitled to vote for trustees, at any meeting of members the notice of which, or an accompanying statement, summarizes the nature of such transaction and such interest. No interested trustee or member of this corporation may vote or may be counted in determining the existence of a quorum at any meeting at which such transaction shall be authorized, but may participate in discussion thereof.

(b) For purposes of this Section 4.6, the term "interest" shall include personal interest and also interest as a trustee, officer, stockholder, shareholder, director, member or beneficiary of any concern; and the term "concern" shall mean any corporation, association, trust, partnership, firm, person or other entity other than this corporation.

(c) No transaction shall be avoided by reason of any provisions of this paragraph 4.6 which would be valid but for such provisions.

4.7. No part of the assets or net earnings of the corporation shall inure to the benefit of any member, officer or trustee of the corporation or any individual; no substantial part of the activities of the corporation shall be the carrying on of propaganda, or otherwise attempting, to influence legislation except to the extent permitted by Section 501(h) of the Internal Revenue Code; and the corporation shall not participate in, or

intervene in (including the publishing or distributing of statements), any political campaign on behalf of (or in opposition to) any candidate for public office. It is intended that the corporation shall be entitled to exemption from federal income tax as an organization described in Section 501(c)(3) of the Internal Revenue Code and shall not be a private foundation under Section 509(a) of the Internal Revenue Code.

4.8. If and so long as the corporation is a private foundation (as that term is defined in Section 509 of the Internal Revenue Code), then notwithstanding any other provisions of the articles of organization or the by-laws of the corporation, the following provisions shall apply:

- A) the income of the corporation for each taxable year shall be distributed at such time and in such manner as not to subject the corporation to the tax on undistributed income imposed by Section 4942 of the Internal Revenue Code, and
- B) the corporation shall not engage in any act of self dealing (as defined in Section 4941(d) of the Internal Revenue Code), nor retain any excess business holdings (as defined in Section 4943(c) of the Internal Revenue Code), nor make any investments in such manner as to subject the corporation to tax under Section 4944 of the Internal Revenue Code, nor make any taxable expenditures (as defined in Section 4945(d) of the Internal Revenue Code).

4.9. Upon the liquidation or dissolution of the corporation, after payment of all of the liabilities of the corporation or due provision therefor, all of the assets of the corporation shall be disposed of pursuant to Massachusetts General Laws, Chapter 180, Section 11A, to The Massachusetts General Hospital and The Brigham Medical Center, Inc. if exempt from taxation as organizations described in Section 501(c)(3) of the Internal Revenue Code or, if both are not, to one or more organizations with similar purposes and similar tax exemption.

4.10. All references herein: (i) to the Internal Revenue Code shall be deemed to refer to the Internal Revenue Code of 1986, as now in force or hereafter amended; (ii) to the General Laws of The Commonwealth of Massachusetts, or any chapter thereof, shall be deemed to refer to said General Laws or chapter as now in force or hereafter amended; and (iii) to particular sections of the Internal Revenue Code or said General Laws shall be deemed to refer to similar or successor provisions hereafter adopted.

MGH/BRIGHAM HEALTH CARE SYSTEM, INC.

Continuation Sheet VII(b)

	Name	Residence or Post Office Address
<u>Officers</u>		
Vice-President	J. Robert Buchanan, M.D.	25 Commonwealth Avenue Boston, MA 02116
President	H. Richard Nesson, M.D.	565 Boylston Street Brookline, MA 02146
Treasurer	Richard A. Spindler	210 Schoolmaster Lane Dedham, MA 02026
Clerk	David M. Donaldson	22 Weston Road Lincoln Center, MA 01773
<u>Trustees</u>		
	W. Gerald Austen, M.D.	163 Wellesley Street Weston, MA 02193
	Eugene Braunwald, M.D.	75 Scotch Pine Road Weston, MA 02193
	J. Robert Buchanan, M.D.	25 Commonwealth Avenue Boston, MA 02116
	Francis H. Burr	44 Prince Street Beverly, MA 01915
	Ferdinand Colloredo-Mansfeld	Winthrop Street Hamilton, MA 01982

MGH/BRIGHAM HEALTH CARE SYSTEM, INC.

Continuation Sheet VII(b)

Name	Residence or Post Office Address
John H. McArthur	Fowler 10 Soldiers Field Boston, MA 02134
H. Richard Nesson, M.D.	565 Boylston Street Brookline, MA 02146
Richard A. Spindler	210 Schoolmaster Lane Dedham, MA 02026

**ARTICLE V**

By-laws of the corporation have been duly adopted and the initial directors, president, treasurer and clerk or other presiding, financial or recording officers, whose names are set out below, have been duly elected.

**ARTICLE VI**

The effective date of organization of the corporation shall be the date of filing with the Secretary of the Commonwealth or if a later date is desired, specify date. (not more than 30 days after date of filing).

The information contained in ARTICLE VII is NOT a PERMANENT part of the Articles of Organization and may be changed ONLY by filing the appropriate form provided therefor.

**ARTICLE VII**

a. The post office address of the initial principal office of the corporation IN MASSACHUSETTS is:

c/o Ropes & Gray, One International Place, Boston, MA 02110

b. The name, residence and post office address of each of the initial directors and following officers of the corporation are as follows:

NAME	RESIDENCE	POST OFFICE ADDRESS
------	-----------	---------------------

President: See Continuation Sheet VII(b) attached hereto and incorporated herein by reference.

Treasurer:

Clerk:

Directors: (or officers having the powers of directors).

NAME	RESIDENCE	POST OFFICE ADDRESS
------	-----------	---------------------

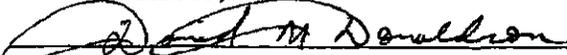
See Continuation Sheet VII(b) attached hereto and incorporated herein by reference.

c. The fiscal year of the corporation shall end on the last day of the month of: September

d. The name and BUSINESS address of the RESIDENT AGENT of the corporation, if any, is:

I/We the below-signed INCORPORATORS do hereby certify under the pains and penalties of perjury that I/We have not been convicted of any crimes relating to alcohol or gaming within the past ten years. I/We do hereby further certify that to the best of my/our knowledge the above-named principal officers have not been similarly convicted. If so convicted, explain.

IN WITNESS WHEREOF and under the pains and penalties of perjury, I/WE, whose signature(s) appear below as incorporator(s) and whose names and business or residential address(es) ARE CLEARLY TYPED OR PRINTED beneath each signature do hereby associate with the intention of forming this corporation under the provisions of General Laws Chapter 180 and do hereby sign these Articles of Organization as incorporator(s) this 9<sup>th</sup> day of December, 19 93



David M. Donaldson

Ropes & Gray  
One International Place  
Boston, MA 02110

NOTE: If an already-existing corporation is acting as incorporator, type in the exact name of the corporation, the state or other jurisdiction where it was incorporated, the name of the person signing on behalf of said corporation and the title he/she holds or other authority by which such action is taken.

SECRETARY OF STATE  
RECEIVED

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CORPORATION DIVISION

449104

THE COMMONWEALTH OF MASSACHUSETTS

ARTICLES OF ORGANIZATION  
GENERAL LAWS, CHAPTER 180

I hereby certify that, upon an examination of the within-written articles of organization, duly submitted to me, it appears that the provisions of the General Laws relative to the organization of corporations have been complied with, and I hereby approve said articles; and the filing fee in the amount of \$35.00 having been paid, said articles are deemed to have been filed with me this 15<sup>TH</sup> day of December 1993.

Effective date:

*Michael Joseph Connolly*

MICHAEL J. CONNOLLY  
Secretary of State

**A PHOTOCOPY OF THESE ARTICLES OF ORGANIZATION SHALL BE RETURNED**

TO: David M. Donaldson, Esq.  
Ropes & Gray  
One International Place, Boston, MA 02110  
Telephone: (617) 951-7250



The foregoing amendment will become effective when these articles of amendment are filed in accordance with Chapter 180, Section 7 of the General Laws unless these articles specify, in accordance with the vote adopting the amendment, a later effective date not more than thirty days after such filing, in which event the amendment will become effective on such later date.

IN WITNESS WHEREOF AND UNDER THE PENALTIES OF PERJURY, we have hereto signed our names this  
18th day of March, in the year 1994

*H. Richard Nesson*

President / ~~President~~

*[Signature]*

Clerk / ~~Clerk~~

459052

781

SECRETARY OF STATE  
RECEIVED

1994 MAR 18 PM 4:10

CORPORATION DIVISION

THE COMMONWEALTH OF MASSACHUSETTS

ARTICLES OF AMENDMENT

(General Laws, Chapter 180, Section 7)

I hereby approve the within articles of amendment  
and, the filing fee in the amount of \$ 15  
having been paid, said articles are deemed to have been  
filed with me this 18<sup>th</sup>  
day of March, 1994

*Michael Joseph Connolly*

MICHAEL J. CONNOLLY

Secretary of State

TO BE FILLED IN BY CORPORATION  
PHOTO COPY OF AMENDMENT TO BE SENT

①

TO:

John E. Beard

Ropes & Gray

One International Place, Boston 02110

Telephone 617-951-7411

Copy Made



(collectively, the "Partners Affiliated Corporations") and such other charitable, scientific or educational organizations which are or are affiliated with teaching hospitals in the Greater Boston Area; and (iv) to carry on any other activity that may lawfully be carried on by a corporation formed under Chapter 180 of the Massachusetts General Laws which is exempt under Section 501(c)(3) of the Internal Revenue Code; and in furtherance of the foregoing purposes to:

(a) Serve as the controlling and coordinating organization for the Partners Affiliated Corporations in order to assure the consistency and appropriateness of their respective missions, activities, governance and administration;

(b) Solicit and receive devises of real property and grants, donations and bequests of money and other property to be used to further the foregoing purposes and those of the Partners Affiliated Corporations; and

(c) Support the Partners Affiliated Corporations by loan, lease or donation of funds or other assets, by guaranty of obligations or by other action.

2. Delete Section 4.5. of Article IV.

The foregoing amendment(s) will become effective when these Articles of Amendment are filed in accordance with General Laws, Chapter 180, Section 7 unless these articles specify, in accordance with the vote adopting the amendment, a later effective date not more than *thirty days* after such filing, in which event the amendment will become effective on such later date.

~~XXXXXXXXXX~~

SIGNED UNDER THE PENALTIES OF PERJURY, this 29<sup>TH</sup> day of May, 1998.

Paulo She, \*President ~~XXXXXXXXXX~~

Ernest M. Haddad, Secretary  
\*~~XXXXXXXXXX~~

\*Delete the inapplicable words.

THE COMMONWEALTH OF MASSACHUSETTS

ARTICLES OF AMENDMENT  
(General Laws, Chapter 180, Section 7)

619710

SECRETARY OF  
THE COMMONWEALTH

98 JUN -2 AM 9:52

I hereby approve the within Articles of Amendment and, the filing fee in the amount of \$ 1500 having been paid, said articles are deemed to have been filed with me this 2<sup>ND</sup> day of JUNE 19 98.

Effective date: \_\_\_\_\_



WILLIAM FRANCIS GALVIN  
*Secretary of the Commonwealth*

TO BE FILLED IN BY CORPORATION  
Photocopy of document to be sent to:

Ernest M. Haddad, Esq.  
Partners HealthCare System, Inc.  
800 Boylston Street, Ste. 1150  
Boston, MA 02199

Telephone: (617) 278-1065



research and other institutions and entities that are controlled, directly or indirectly, through sole corporate membership, stock ownership or otherwise, by the Corporation (collectively, the "Affiliated Organizations"); (iv) to assist and support the Affiliated Organizations in fulfilling their respective purposes, missions and objectives in a manner consistent with the purposes, missions and objectives of the Corporation and the System; and (v) to carry on any other activity that may lawfully be carried on by a corporation formed under Chapter 180 of the Massachusetts General Laws which is exempt under Section 501(c)(3) of the Internal Revenue Code; and in furtherance of the foregoing purposes to:

(a) Solicit and receive devises of real property and grants, donations and bequests of money and other property to be used to further the foregoing purposes; and

(b) Support the Affiliated Organizations by loan, lease or donation of funds or other assets; and

(c) Support the Affiliated Organizations by guaranty of the obligations of the Affiliated Organizations or by other action.

The foregoing amendment(s) will become effective when these Articles of Amendment are filed in accordance with General Laws, Chapter 180, Section 7 unless these articles specify, in accordance with the vote adopting the amendment, a later effective date not more than *thirty days* after such filing, in which event the amendment will become effective on such later date.

~~dates of effective date:XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX~~

SIGNED UNDER THE PENALTIES OF PERJURY, this 24th day of May, 19 99,

Paul J. O'Brien

~~President or Vice President~~

James M. Haddad

Secretary  
~~or Clerk or Assistant Clerk~~

\*Delete the inapplicable words.

660922

THE COMMONWEALTH OF MASSACHUSETTS

ARTICLES OF AMENDMENT  
(General Laws, Chapter 180, Section 7)

I hereby approve the within Articles of Amendment and, the filing fee in the amount of \$ 15.00 having been paid, said articles are deemed to have been filed with me this 26<sup>th</sup> day of May 19 99.

Effective date: \_\_\_\_\_



WILLIAM FRANCIS GALVIN  
*Secretary of the Commonwealth*

99 MAY 26 AM 9:24

TO BE FILLED IN BY CORPORATION  
Photocopy of document to be sent to:

Mary LaLonde

Partners HealthCare System

Office of the General Counsel

50 Staniford St., 10th floor

Boston, MA 02114

Telephone: 617-726-5315



**The Commonwealth of Massachusetts  
William Francis Galvin**

Minimum Fee: \$15.00

Secretary of the Commonwealth, Corporations Division  
One Ashburton Place, 17th floor  
Boston, MA 02108-1512  
Telephone: (617) 727-9640

**Articles of Amendment**

(General Laws, Chapter 180, Section 7)

Identification Number: 043230035

We, BRENT L. HENRY \_\_\_ President  Vice President,

and MARY C. LALONDE \_\_\_ Clerk  Assistant Clerk,

of PARTNERS HEALTHCARE SYSTEM, INC.

located at: 800 BOYLSTON ST., SUITE 1150 BOSTON, MA 02199 USA

do hereby certify that these Articles of Amendment affecting articles numbered:

\_\_\_ Article 1                     Article 2                    \_\_\_ Article 3                    \_\_\_ Article 4

*(Select those articles 1, 2, 3, and/or 4 that are being amended)*

of the Articles of Organization were duly adopted at a meeting held on 4/19/2016, by vote of: 197 members, 0 directors, or 0 shareholders, being at least two-thirds of its members/directors legally qualified to vote in meetings of the corporation (or, in the case of a corporation having capital stock, by the holders of at least two thirds of the capital stock having the right to vote therein):

**ARTICLE I**

The exact name of the corporation, **as amended**, is:  
*(Do not state Article I if it has not been amended.)*

**ARTICLE II**

The purpose of the corporation, **as amended**, is to engage in the following business activities:  
*(Do not state Article II if it has not been amended.)*

THE PURPOSE OF THE CORPORATION IS TO ENGAGE IN THE FOLLOWING ACTIVITIES: (I) TO ORGANIZE, OPERATE, COORDINATE AND SUPPORT A COMPREHENSIVE INTEGRATED HEALTH CARE DELIVERY SYSTEM (THE "SYSTEM") THAT PROVIDES, WITHOUT LIMITATION, HOSPITAL, PHYSICIAN AND OTHER HEALTH CARE SERVICES FOR ALL PERSONS AND EDUCATION AND RESEARCH FOR THE PREVENTION, DIAGNOSIS, TREATMENT AND CURE OF ALL FORMS OF HUMAN ILLNESS; (II) TO IMPROVE THE HEALTH AND WELFARE OF ALL PERSONS AND TO CONDUCT AND SUPPORT EDUCATION, RESEARCH AND OTHER ACTIVITIES RELATING THERE TO, (III) TO SERVE AS THE CONTROLLING AND COORDINATING ORGANIZATION FOR THE SYSTEM AND ITS MEMBER INSTITUTIONS AND ENTITIES INCLUDING BRIGHAM AND WOMEN'S HEALTH CARE, INC., THE MASSACHUSETTS GENERAL HOSPITAL, NSMC HEALTHCARE, INC., NEWTON WELLESLEY HEALTH CARE SYSTEM, INC., PARTNERS COMMUNITY PHYSICIANS ORGANIZATION, INC., PARTNERS CONTINUING CARE, INC., NEIGHBORHOOD HEALTH PLAN, INC. AND SUCH OTHER HOSPITAL, PHYSICIAN, CHARITABLE, SCIENTIFIC, E

DUCATIONAL, RESEARCH AND OTHER INSTITUTIONS AND ENTITIES THAT ARE CONTROLLED, DIRECTLY OR INDIRECTLY, THROUGH SOLE CORPORATE MEMBERSHIP, STOCK OWNERSHIP OR OTHERWISE, BY THE CORPORATION (COLLECTIVELY, THE "AFFILIATED ORGANIZATIONS"); (IV) TO ASSIST AND SUPPORT THE AFFILIATED ORGANIZATIONS IN FULFILLING THEIR RESPECTIVE PURPOSES, MISSIONS AND OBJECTIVES IN A MANNER CONSISTENT WITH THE PURPOSES, MISSIONS AND OBJECTIVES OF THE CORPORATION AND THE SYSTEM; AND (V) TO CARRY ON ANY OTHER ACTIVITY THAT MAY LAWFULLY BE CARRIED ON BY A CORPORATION FORMED UNDER CHAPTER 180 OF THE MASSACHUSETTS GENERAL LAWS WHICH IS EXEMPT UNDER SECTION 501(C)(3) OF THE INTERNAL REVENUE CODE; AND IN FURTHERANCE OF THE FOREGOING PURPOSES TO: (A) SOLICIT AND RECEIVE DEVISES OF REAL PROPERTY AND GRANTS, DONATIONS AND BEQUESTS OF MONEY AND OTHER PROPERTY TO BE USED TO FURTHER THE FOREGOING PURPOSES; AND (B) SUPPORT THE AFFILIATED ORGANIZATIONS BY LOAN, LEASE OR DONATION OF FUNDS OR OTHER ASSETS; AND (C) SUPPORT THE AFFILIATED ORGANIZATIONS BY GUARANTY OF THE OBLIGATIONS OF THE AFFILIATED ORGANIZATIONS OR BY OTHER ACTION.

### ARTICLE III

A corporation may have one or more classes of members. *As amended*, the designation of such classes, the manner of election or appointments, the duration of membership and the qualifications and rights, including voting rights, of the members of each class, may be set forth in the by-laws of the corporation or may be set forth below:

### ARTICLE IV

*As amended*, other lawful provisions, if any, for the conduct and regulation of the business and affairs of the corporation, for its voluntary dissolution, or for limiting, defining, or regulating the powers of the business entity, or of its directors or members, or of any class of members, are as follows:  
(If there are no provisions state "NONE")

The foregoing amendment(s) will become effective when these Articles of Amendment are filed in accordance with General Laws, Chapter 180, Section 7 unless these articles specify, in accordance with the vote adopting the amendment, a *later* effective date not more than *thirty days* after such filing, in which event the amendment will become effective on such later date.

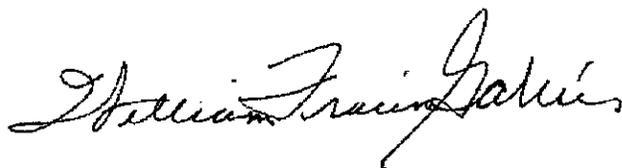
**Later Effective Date:**

**Signed under the penalties of perjury, this 20 Day of April, 2016, BRENT L. HENRY, its ,  
President / Vice President,  
MARY C. LALONDE, Clerk / Assistant Clerk.**

THE COMMONWEALTH OF MASSACHUSETTS

I hereby certify that, upon examination of this document, duly submitted to me, it appears that the provisions of the General Laws relative to corporations have been complied with, and I hereby approve said articles; and the filing fee having been paid, said articles are deemed to have been filed with me on:

April 20, 2016 04:09 PM

A handwritten signature in cursive script, reading "William Francis Galvin". The signature is written in black ink and is centered on the page.

WILLIAM FRANCIS GALVIN

*Secretary of the Commonwealth*

**Attachment/Exhibit**

**8**



**Massachusetts Department of Public Health  
Determination of Need  
Affidavit of Truthfulness and Compliance  
with Law and Disclosure Form 100.405(B)**

Version: 7-6-17

**Instructions:** Complete Information below. When complete check the box "This document is ready to print:". This will date stamp and lock the form. Print Form. Each person must sign and date the form. When all signatures have been collected, scan the document and e-mail to: [dph.don@state.ma.us](mailto:dph.don@state.ma.us) Include all attachments as requested.

Application Number:  Original Application Date:

Applicant Name:

Application Type:

Applicant's Business Type:  Corporation  Limited Partnership  Partnership  Trust  LLC  Other

Is the Applicant the sole member or sole shareholder of the Health Facility(ies) that are the subject of this Application?  Yes  No

The undersigned certifies under the pains and penalties of perjury:

1. The Applicant is the sole corporate member or sole shareholder of the Health Facility(ies) that are the subject of this Application;
2. I have read 105 CMR 100.000, the Massachusetts Determination of Need Regulation;
3. I understand and agree to the expected and appropriate conduct of the Applicant pursuant to 105 CMR 100.800;
4. I have read this application for Determination of Need including all exhibits and attachments, and certify that all of the information contained herein is accurate and true;
5. I have submitted the correct Filing Fee and understand it is nonrefundable pursuant to 105 CMR 100.405(B);
6. I have submitted the required copies of this application to the Determination of Need Program, and, as applicable, to all Parties of Record and other parties as required pursuant to 105 CMR 100.405(B);
7. I have caused, as required, notices of intent to be published and duplicate copies to be submitted to all Parties of Record, and all carriers or third-party administrators, public and commercial, for the payment of health care services with which the Applicant contracts, and with Medicare and Medicaid, as required by 105 CMR 100.405(C), et seq.;
8. I have caused proper notification and submissions to the Secretary of Environmental Affairs pursuant to 105 CMR 100.405(E) and 301 CMR 11.00; will be made if applicable
9. If subject to M.G.L. c. 6D, § 13 and 958 CMR 7.00, I have submitted such Notice of Material Change to the HPC - in accordance with 105 CMR 100.405(G);
10. Pursuant to 105 CMR 100.210(A)(3), I certify that both the Applicant and the Proposed Project are in material and substantial compliance and good standing with relevant federal, state, and local laws and regulations, as well as with all previously issued Notices of Determination of Need and the terms and conditions attached therein;
11. I have read and understand the limitations on solicitation of funding from the general public prior to receiving a Notice of Determination of Need as established in 105 CMR 100.415;
12. I understand that, if Approved, the Applicant, as Holder of the DoN, shall become obligated to all Standard Conditions pursuant to 105 CMR 100.310, as well as any applicable Other Conditions as outlined within 105 CMR 100.000 or that otherwise become a part of the Final Action pursuant to 105 CMR 100.360;
13. Pursuant to 105 CMR 100.705(A), I certify that the Applicant has Sufficient Interest in the Site or facility; and
14. Pursuant to 105 CMR 100.705(A), I certify that the Proposed Project is authorized under applicable zoning by-laws or ordinances, whether or not a special permit is required; or,
  - a. If the Proposed Project is not authorized under applicable zoning by-laws or ordinances, a variance has been received to permit such Proposed Project; or,
  - b. The Proposed Project is exempt from zoning by-laws or ordinances.

**Corporation:**

Attach a copy of Articles of Organization/Incorporation, as amended

David F. Torchiana, M.D.

*David Torchiana*  
Signature:

10/14/17  
Date

CEO for Corporation Name:

Edward P. Lawrence, Esq.

Signature:

Date

Board Chair for Corporation Name:

\*been informed of the contents of  
\*\*have been informed that

\*\*\*issued in compliance with 105 CMR 100.00, the Massachusetts Determination of Need Regulation effective January 27, 2017



**Massachusetts Department of Public Health  
Determination of Need  
Affidavit of Truthfulness and Compliance  
with Law and Disclosure Form 100.405(B)**

Version: 7-6-17

**Instructions:** Complete information below. When complete check the box "This document is ready to print:". This will date stamp and lock the form. Print Form. Each person must sign and date the form. When all signatures have been collected, scan the document and e-mail to: [dph.don@state.ma.us](mailto:dph.don@state.ma.us) Include all attachments as requested.

Application Number:  Original Application Date:

Applicant Name:

Application Type:

Applicant's Business Type:  Corporation  Limited Partnership  Partnership  Trust  LLC  Other

Is the Applicant the sole member or sole shareholder of the Health Facility(ies) that are the subject of this Application?  Yes  No

- The undersigned certifies under the pains and penalties of perjury:
1. The Applicant is the sole corporate member or sole shareholder of the Health Facility(ies) that are the subject of this Application;
  2. I have read 105 CMR 100.000, the Massachusetts Determination of Need Regulation;
  3. I understand and agree to the expected and appropriate conduct of the Applicant pursuant to 105 CMR 100.800;
  4. I have read this application for Determination of Need including all exhibits and attachments, and certify that all of the information contained herein is accurate and true;
  5. I have submitted the correct Filing Fee and understand it is nonrefundable pursuant to 105 CMR 100.405(B);
  6. I have submitted the required copies of this application to the Determination of Need Program, and, as applicable, to all Parties of Record and other parties as required pursuant to 105 CMR 100.405(B);
  7. I have caused, as required, notices of intent to be published and duplicate copies to be submitted to all Parties of Record, and all carriers or third-party administrators, public and commercial, for the payment of health care services with which the Applicant contracts, and with Medicare and Medicaid, as required by 105 CMR 100.405(C), et seq.;
  8. I have caused proper notification and submissions to the Secretary of Environmental Affairs pursuant to 105 CMR 100.405(E) and 301 CMR 11.00; will be made if applicable
  9. If subject to M.G.L. c. 6D, § 13 and 958 CMR 7.00, I have submitted such Notice of Material Change to the HPC - in accordance with 105 CMR 100.405(G);
  10. Pursuant to 105 CMR 100.210(A)(3), I certify that both the Applicant and the Proposed Project are in material and substantial compliance and good standing with relevant federal, state, and local laws and regulations, as well as with all previously issued Notices of Determination of Need and the terms and conditions attached therein;
  11. I have read and understand the limitations on solicitation of funding from the general public prior to receiving a Notice of Determination of Need as established in 105 CMR 100.415;
  12. I understand that, if Approved, the Applicant, as Holder of the DoN, shall become obligated to all Standard Conditions pursuant to 105 CMR 100.310, as well as any applicable Other Conditions as outlined within 105 CMR 100.000 or that otherwise become a part of the Final Action pursuant to 105 CMR 100.360;
  13. Pursuant to 105 CMR 100.705(A), I certify that the Applicant has Sufficient Interest in the Site or facility; and
  14. Pursuant to 105 CMR 100.705(A), I certify that the Proposed Project is authorized under applicable zoning by-laws or ordinances, whether or not a special permit is required; or,
    - a. If the Proposed Project is not authorized under applicable zoning by-laws or ordinances, a variance has been received to permit such Proposed Project; or,
    - b. The Proposed Project is exempt from zoning by-laws or ordinances.

**Corporation:**  
Attach a copy of Articles of Organization/Incorporation, as amended

David F. Torchiana, M.D.  
 CEO for Corporation Name: \_\_\_\_\_ Signature: Edward P. Lawrence Date: 11/13/17  
 Edward P. Lawrence, Esq.  
 Board Chair for Corporation Name: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**Attachment/Exhibit**

**9**

To Remove Document Fold and Tear Along This Perforation

VERIFY THE AUTHENTICITY OF THIS MULTI-TONE SECURITY DOCUMENT.

CHECK BACKGROUND AREA CHANGES COLOR GRADUALLY FROM TOP TO BOTTOM.



Bank of America, N.A.  
South Portland, ME

52-153  
112 ME

DATE  
10/20/2017

0005757351

AMOUNT

PAY One Hundred Forty-Six Thousand Three Hundred Seventy-Three and 49/100 Dollars

\$146,373.49

TO THE  
ORDER OF

COMMONWEALTH OF MASSACHUSETTS  
DETERMINATION OF NEED PROGRAM  
DEPT OF PUBLIC HLTH - 99 CHAUNCY ST-2ND FL  
BOSTON MA

AUTHORIZED SIGNATURE  
VOID IF NOT CASHED WITHIN 90 DAYS

