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Agency Purpose

Smart Transit to Healthcare is committed to provide an innovative solution to patients visiting a doctor’s appointment like never before by incorporating their transportation needs at the time of scheduling their appointment at the doctor’s office. It is especially tailored to meet the need of low-income group patients who do not always have a car and hence are dependent on other means to get to their medical appointment.

The Problem

Identification of the problem and evaluation of the scenario from different perspectives have been a key component of investigation in this grant cycle. We have extensively made use of design thinking methods (and tools like the building block canvas) to come up with effective communication with patients through surveys and focus groups. The surveys and discussions were conducted in person with the help of our partners at the following sites: (a) The Family Health Center (FHC) of Worcester’s waiting room area. (b) The Worcester Regional Transit Authority’s (WRTA) bus hub. (c) Communities/coalition groups in Worcester mostly serving low income populations such as the South East Coalition, neighbor to neighbor and the Worcester Community Connection Coalition.

Patients’ Perspective

We surveyed 121 patients at these different locations, all the reference to “survey results” from now on are those tabulated from these responses. A detailed survey analysis is attached in the appendix. Besides, we have also carried out meaningful discussions with other stakeholders in our solution, namely the hospital and transportation agencies. Our key “actors” in the hospital are representatives from the scheduling department, with whom we have talked to check the feasibility of our solution and get their feedback on the operations. Statement of the problem and the different scenarios presented are a culmination of the different pieces of the story put together.

Currently, the entire process of scheduling the appointment at the doctor’s office and actually making arrangements to get there consists of the following steps (summarized in the figures below):

**Step 1**: Patient seeking an appointment calls the doctor’s office. The scheduler at doctor’s office checks for availability of the desired doctor along with additional services like interpreter schedules (if required) and schedules an appointment for the patient as per his/her preference.

**Step 2**: Once patients schedule their appointment, they have to take care of their transportation needs to visit the doctor’s office. If they do not have a car, they may either ask a friend/family for a ride, look up the public transportation schedules to see what bus get them to the appointment at the desired time, decide to walk or take a taxi, according to our survey. A flowchart of the possible process they go through at this point is depicted in the second figure.
Step 1: Current process of appointment scheduling with healthcare providers

Step 2: Process that patients go through to manage transportation needs AFTER scheduling appointment

PROBLEM !!!
Interestingly, it has been observed that a majority of people with cars do not think that they have a problem to access healthcare, this was very visible in our survey as 33% of participants asked refused to take the survey on the ground of having a car and “no issues” with transportation. They did not take into account the fact of what happens if their car is unavailable for some reason. However, the hospital authorities confirmed parking issues at peak time in their parking lot. Transferring some of this load from parking lots of the hospital by diverting patients to use an alternate mode might be beneficial to all parties. It was observed that some places in the city (like the UMass Hospital on Lincoln Street, Worcester) has a valet parking facility which costs $7 (plus tip amount), which adds to their cost. Figure 3 tabulates problems faced by people when they attempt to access appointments by other modes of transportation.

**Figure 3: Reasons for transportation problems (tabulated from our survey)**

![Figure 3: Reasons for transportation problems](image)

After the trip to hospital has been made, a possible third step is applicable to people who are covered by Mass Health. Mass Health has provision for reimbursement of the travel expense for an appointment. However the statistics do not show much promise in terms of absolute benefit from patient’s perspective. In FY 2014, there were a total of 1.3 million Mass Health beneficiaries and human service transportation spending was $150,240,859. However only 3.4% of Mass Health beneficiaries used transportation benefits, out of which 2.3% used the PT-1 demand-response
transportation benefit. Only 0.2% submitted a request for reimbursement of their transit expenses and half of which were denied. Of every $1 spent on demand-response transportation, only $0.07 are spent in transit (based on average reimbursement per month). The average cost per trip in transit is 0.89% less than average cost of demand response trip. (Source: Human Service Transportation Office, Mass.gov)

**Providers’ Perspective**

Apart from patients, we also identified issues at the provider’s end, the biggest issue is that Family Health has to deal with as an outcome of lack of transportation for patients is large number of missed appointments, which hinder their operations and cost them money. For Family Healthcare of Worcester there are a total of 213,130 clinical encounters per year which constitute about 15% missed appointments (Source: Family Health Center Data). Further, they have significant parking issues owing to a lot of people coming by private vehicles rather than public, private services which don’t have to wait for the patients. A long term issue that was also identified was dealing with more patients with chronic illness because they did not come for routine checkups due to transportation issues.

Other than patients, attempts were also made to communicate with different representatives at different transportation agencies and groups like:

1. Massachusetts Mobility Management Center - provided useful information, contacts and support along the project development process
2. Regional Coordinating Council - who played an advisory role
3. Cambridge Systematics - helped identifying common features of this software with their One-Click platform.
4. Montachusett Regional Transit Authority (MART)- run various transportation services other than just fixed route buses
5. Paratransit Brokerage Services (PBSTM) in Worcester
6. RideMatch which is a transportation database, similar to 211, specialized in local transportation services in the Commonwealth.

All these agencies did acknowledge this area to be an underserved one, and helped understanding different aspects of the problem and wanted to help to make this endeavor work out.

Our investigation further revealed that for Massachusetts, there are online resources which are “information” sites telling people about the options available (see appendix), however there aren’t any existing services which attempt to provide an end-to-end experience for the patients from scheduling the appointment with the healthcare agency keeping in mind their transportation needs. Paratransit systems do take care of the transportation needs for eligible patients, but that is limited to elderly or handicapped individuals, who constitute small percentage of the patients visiting a doctor’s
appointment. When the patients were probed, whether transportation is a problem to access healthcare appointments, 51% of our survey respondents identified it as a problem. Further, we saw that 50% of the respondents either have missed their appointment or did not schedule one at Family Health Center due to lack of transportation arrangements to get to the hospital. A noteworthy observation was that most of the respondents identified multiple reasons for problems associated with their current transportation for appointments rather than a single reason which affirms the fact that the current transportation framework fails to take care of their needs and therefore needs improvement. In summary, we believe we cannot completely dissociate the processes of scheduling patients’ appointments with their healthcare providers and taking care of their transportation needs. A solution that encompasses both these two aspects has huge potential for improving health outcomes long term.

**Solution**

From the aspect of customer desirability widely explored by our surveys, focus groups, meetings with healthcare providers and representatives of transportation agencies, there is a necessity and demand of a service which ties scheduling healthcare appointments of patients with their transportation needs to get to the appointment. Smart Transit to Healthcare (STH) focusses on making this connection. A *web based interface, STH*, will assist the scheduler at the hospital to schedule an appointment for a patient at a time when he/she has availability of transportation from their respective points of origin. The transportation options would range between public transportation, cabs, Uber, other private services, paratransit (if eligible) etc. The transportation options can be easily optimized based on patients’ needs, for example affordability, least walking (e.g. in case of mothers with kids, elderly or injured patients), least wait times between bus connections etc. This innovative solution for the first time would bind together services from different transportation carriers, based on their availability with the goal of providing facilities exclusively to meet healthcare needs.

When patients were surveyed, an overwhelming majority of 86% wanted their rides to be scheduled at the same time as scheduling the doctor’s appointment. 82% of the respondents were willing to use transportation options that would run from their neighborhood to the hospital even if it was on a weekly basis. This points towards high chances of successful adoption of our solution. There were 50% respondents who did not use any planning method for their trip. This affirms our expectation that, letting the schedulers plan the trip for the individual/patient would render the solution we propose more patient friendly. With our plan to implement the solution through trip schedulers we intend to accomplish two goals: (1) simplify the process of appointment for patients; and (2) optimize the appointment allocation so that the patients do not have to miss any appointments and the schedulers do not have to overbook. For transportation agencies, they get guaranteed ridership now and such a service adds value to their system as a whole. **Figure 4** summarizes our proposed solution.
Why now

We have come across various studies and sources that have identified transportation as one of the largest barrier to healthcare that seek a solution. We think our solution has potential to address some of these issues and work towards eradicating the gap between transportation and accessing healthcare.
“Our car-dependent transportation infrastructure is a barrier to health care access. To promote greater parity in health care, our transportation policy must shift a portion of transportation investments away from new highway construction and toward other transportation modes.” (The Road to Health Care Parity: Transportation Policy and Access to Health Care, The Leadership Conference Education Fund, 2011)

“Transportation is a commonly identified barrier to care but is understudied in terms of the detail needed to address more direct health and transportation policy interventions. Relatively little research has described the level and detail of actual transportation barriers experienced by patients when they need to obtain health services” (Transportation Barriers and Health Access for Patients Attending a Community Health Center, Morgan Shook, 2005)

9% low income children missed appointments due to transportation (Children’s Health Fund, 2012)

25 percent of lower-income patients have missed or rescheduled their appointments due to lack of transportation. The patients who reported issues with transportation also missed filling prescriptions more than twice as often as patients without that same problem. “These consequences may lead to poorer management of chronic illness and thus poorer health outcomes” (Journal of Community Health, 2013)

Patients who rode the bus to the doctor’s office were twice as likely to miss appointments as patients who drove cars. (Low income patients survey in NYC, 2012)

Patients with driver’s license have 2.29 times chronic care visits and 1.92 times regular visits (Association of transportation and health care utilization in rural North Carolina, 2005)

45 % of respondents who could not drive said they would miss fewer doses of their medications if transportation was not a problem. (Effect of limited transportation on medication adherence in patients with epilepsy, J Am Pharm Assoc (2003))

Hence there is enough evidence nationwide of transportation problems significantly hindering effective access to healthcare. So it seems to be a good time for the growth and development of an innovative solution like ours, with the growing need to incorporate the need of better transportation access to healthcare appointments.

Our research in Worcester and neighboring areas in Boston revealed that there are a tremendous number of health care providers in MA and across the board they are not well serviced by the available public transportation It is incredibly difficult to access healthcare services outside one’s immediate region using public transportation. The cross regional connections just don’t exist. The health care providers and the transit providers don’t talk to each other or at least don’t have the opportunity or forum to figure out how to solve problems. Many regional transit authorities
understand these challenges and have started to try and tackle some of these issues most notably, there is a project out of the GATRA region where they have started to consolidate data on door to door transit providers across the state. The Massachusetts Medicaid transportation funding program is pretty good, MART runs most of the state so it is centralized and can be leveraged in our case. Uber and Lyft operate in Massachusetts/Boston whose service could also be leveraged. From the technical perspective the 1-Click open source platform developed by Cambridge Systematics has a community of users in 6 states who are investing in the platform every year to make it better. So One-Click might turn out to be a good starting point for Smart Transit software development. Our discussions with Anniko Laszlo, Mobility Manager at MassDOT has revealed that the state is interested to actively explore this underserved area of improvement of medical transportation. Massachusetts’s Community Transportation Coordination Conference being held in May 2016 is devoting a special session covering medical transportation.

**Market size and opportunity**

There are three main Customer Profiles for our project:

**Patients**: They would be the end users of the product. Upon implementation of this idea, they will get better access to healthcare appointments. Our target population is low income groups who don’t have a car and depend on other modes of transportation to get to their appointments. Based on our data at Family Health Center at Worcester, we see a significant percentage (Figure 5) of people requiring alternate modes of transportation to get to their medical appointments. Our current market penetration based on this assumption is as high as 78% at the Family Health Center at Worcester. A patient’s main mode of communication with our interface would be via phone calls to the scheduler at FHC. A direct online link to our tool on the hospital’s website would also allow patients to schedule their appointment and transportation together.

*Figure 5: How do patients get to Family Health Center in Worcester?*
**Hospitals (Healthcare Provider):** We also envision hospitals to be our customer as they have tremendous incentive to reduce the number of missed appointments and delays. Hospitals incur maximum monetary losses because of missed appointments and delays. In comparison to the annual losses incurred currently due to transportation problems, the cost of paying for their patients’ rides using our proposed solution is only around 10% (see financials).

**Transit Agencies:** Finally, various transit agencies and modes of transportation, both public and private, such as Worcester Regional Transit Authority (WRTA), MassDOT, Uber, Lyft, and local cab services among others, would be ensured guaranteed ridership under this solution, which is a huge incentive for them to provide their services as it directly links up to their profits.

Our idea is a novel solution to reduce healthcare costs simultaneously improving health outcomes. We have not found any other organization using a similar concept, as of date, despite extensive market research. There are plenty of websites providing basic information (see appendix for list). However, none of them consider the root cause which we propose to address: Currently, the transit agencies and the hospital scheduling platforms do not “talk” to each other. Once a communication medium between these two key stakeholders is established, many existing transit service options can be fruitfully leveraged for providing transportation services to patients. As mentioned earlier, services like Uber, cabs, paratransit, Rideshares are some options that can be easily accessed.

In our initial phase we want to pilot the solution in two other hospitals other than Family Health Center of Worcester. Right now, just for FHC in Worcester, 18% of patients drive alone (average of 16,840 patients); 45% take the bus (average of 42,101); 15% (average of 14,034) share a ride with a friend; 10% (average of 9,356) use a taxi or livery service; and 12% (average of 11,227) walk to the FHC per year. Once implemented, 82% of patients (maybe more) would have the option to use this service (we excluded the ones who are currently using their own car to drive for the appointments) to effectively schedule their medical appointments based on their respective transportation needs. Owing to the excellent scalability of this solution, it will reach out to huge pool of patients at other hospital sites as well, once in operation.

One key issue on which our solution is based, would be to come up with a strategy to address who pays the transportation cost for the patients. The current framework allows patients with MassHealth PT-1 service to get reimbursed for their transportation needs. However statistics show that this facility is quite underutilized. We discuss more about this barrier in our financial section and a proposed effective solution.
Service/Product

We are offering a service which does not exist right now. The patients currently deal with two worlds apart, there is no communication between the hospital and transit services to get the patients to the hospital for their medical appointments. Our solution attempts to offer that communication and then take an active role in scheduling the patient’s appointment based on the transportation needs. Key features of the product include:

a) Patients do not need to make their own arrangement to get to the hospital
b) Smart Transit uses its database to incorporate patient’s transportation needs, hospital’s available schedules and available transit options from patient location to pull out an optimum date and time for the appointment
c) Web based application reduces the chances of interfering hospital’s own interface which contain private patient information
d) Smart Transit interface being via the scheduler will provide better reliability/dependability for patients to use these options as the hospital schedules it for them
e) There is opportunity for implementation of MassHealth Smart Transit Card where on the day of the appointment a one day pass is uploaded to beneficiaries’ cards based on request for transportation using the Smart Transit application.

We have developed a software prototype based on current requirements. We have closely worked with the IT and scheduling department at FHC to gather these requirements and crosscheck the different fields and functionalities. This prototype only incorporates public transit and walking options.

Figure 6: The Smart Transit User Interface as it would be seen by the scheduler at the hospital
Figure 7: Screenshots of step by step mapping of software functionality as developed in the STH working prototype

**Step 1**

(a) Step 1: Scheduler enters patient’s address in the “Address” field
(b) Step 2: Scheduler enters multiple days and times based on patient’s preference and providers’ availability in the “Date and Time” field.

(c) Step 3: Scheduler enters optimization criteria – least walking time, waiting time, or shortest time of travel and can look at the results for each day entered by choosing the day from the “view” field. The results are calculated according to patients’ preference.
We are working with Cambridge Systematic in our next phase of the project to develop the software solution by integrating with their already existing One-Click scheduling system. We have collaborated with them to wireframe a draft of this integrated system. This system incorporates different modes of transit including public transit, cab services, paratransit, walking, Uber. The next few screen shots depicts a visual representation of that interface.

![Smart Transit Integrated System](image)

**Fig 9**: Screen shot of User interface of Smart Transit integrated with One-Click Scheduling System
Fig. 10: Screenshot of the output screen to schedule an appointment and ride

This wireframing is a work in progress in collaboration with Cambridge Systematics and would depict a more complete and comprehensive picture before we apply for our next grant cycle.

**Business Model**

Smart Transit operations strategy will focus on two objectives: Development of the software solution, and building partnerships with interested transit bodies and hospitals. We are partnering with Cambridge Systematics, Cambridge, Massachusetts, to develop the software solution. We are also in talks about partnering with Massachusetts Department of Transportation (MassDOT) for organizational support. Other partner organizations will involve transit options like different transit authorities, cab service agencies, Uber as well as different hospitals. We have just partnered with
Family Health Center of Worcester in this phase of the project. We want to expand our learning for different transit agencies and hospitals across Massachusetts now.

We plan to launch Smart Transit software as an open source resource in partnership with Cambridge Systematics among other partners. The 1-Click open source transportation scheduling platform developed by Cambridge Systematics has a large community of users in 6 states. This will serve as a good starting point for developing the software prototype for Smart Transit. We envision the hospitals to be our “customer”: our revenue model consist of charging an annual fee for hosting and maintaining the open source platform. The initial development cost would be covered by grant amount. The network of hospitals can share the recurring maintainance and software upgrade costs. We have estimated the return on investment analysis (ROI) is presented in detail in the “Finance” section. Cambridge Systematics estimates the cost of delivering a “beta” version with the required functionalities of the web based Smart Transit software system at about $200,000. In addition to this cost, the cost of required initial research and survey for hospitals and other partners to deliver a robust value adding pilot product comes to give an estimated amount of about $350,000, which we expect to be covered by a grant source. Looking at the pricing of the service as incurred by the patients, a natural question arises who pays for it. We have thoroughly evaluated the current provisions under MassHealth which covers transportation costs and integrated that with the data obtained from Family Health and came up with a possible strategy. Please look at the next section for more details. According to this strategy, for a particular visit, a patient can choose any of the available options for transportation via the Smart transit software while scheduling their appointment, the hospital pays a fixed amount per patient and the rest of the cost is incurred by the patients themselves. This pricing can be implemented by a Smart Transit Card which would be activated only on the day of appointment for each patient for a ride to the hospital only. The hospital can directly get reimbursed by MassHealth for the respective patients.

**Finances**

Our initial plan involves piloting the product in at least two to three hospitals in the first year. In terms of pricing of the software, there will be an annual subscription of $12,000-$36000 per hospital towards support and maintenance. The approximate cost towards survey, research, and building of available transit partnerships is $20,000-$25,000 per hospital. Here is the breakdown of the initial development expense:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Software development cost</td>
<td>$200,000</td>
</tr>
<tr>
<td>Direct/Indirect cost towards three hospitals</td>
<td>$75,000</td>
</tr>
<tr>
<td>Hosting + Supporting + Maintenance cost for STH software</td>
<td>$72,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$347,000</strong></td>
</tr>
</tbody>
</table>
Hence we request a sum of $350,000 in the upcoming grant. If all the development cost is covered by the grant then the hospital only has to pay $36,000/year for support, hosting and maintenance. This is only 4.9% of the $739,200 lost in missed appointments due to transportation issues. To see an immediate ROI, they only need to recover an additional 230 trips per year that would have been missed otherwise. If the development cost needs to be invested by one hospital they may not see ROI until year 2 or 3. If there is considerable market penetration, then the development cost would be shared by a hospital network, then they could see an immediate ROI easily.

Apart from the above pricing strategy, a considerable issue that needs to be handled is the fact that who pays patients’ transit costs. In FY14 MassHealth had a total of 1.3 million beneficiaries, of which 99% had a plan that included a transportation benefit. To receive the transportation benefit, beneficiaries need to be deemed eligible based on specific criteria. For the same year, only 29,376 (2.3%) of eligible beneficiaries (consumers) used their transportation benefit for a total of 3,100,327 one-way trips, at a cost to the state of $51,952,015 for only MassHealth PT-1 demand-response transportation.¹ The Human Service Transportation Office reports that the average cost per trip in FY14 was $17.57. The average cost per trip in the Worcester Area (HST 5) was $19.39 and the total number of trips for this area was 842,079 consumer trips.²

Family Health Center (FHC) has 85,000 to 105,000 patients visits per year. Data from 2014 reveals that 57% had Medicaid, 15% Private health care, 9% Medicare, 7% was self-paid and 12% had another public health care plan. On average, Family Health Center received 62,700 patients that had a health plan (Medicaid/Medicare) that included some type of transportation benefit. If the 2.3% proportion is applied, only, on average 1,442 are eligible to use the transportation benefit (PT-1 eligible). That leaves an average of 93,558 FHC patients a year figuring out how to get to their appointments.

<table>
<thead>
<tr>
<th>Patients with transportation included in their benefits (66%)</th>
<th>Min</th>
<th>Max</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>56,100</td>
<td>69,300</td>
<td>62,700</td>
</tr>
<tr>
<td>With Medicaid</td>
<td>48,450</td>
<td>59,850</td>
<td>54,150</td>
</tr>
<tr>
<td>Private</td>
<td>12,750</td>
<td>15,750</td>
<td>14,250</td>
</tr>
<tr>
<td>Self-Paid</td>
<td>5,950</td>
<td>7,350</td>
<td>6,650</td>
</tr>
<tr>
<td>Medicare</td>
<td>7,650</td>
<td>9,450</td>
<td>8,550</td>
</tr>
<tr>
<td>Other Public</td>
<td>10,200</td>
<td>12,600</td>
<td>11,400</td>
</tr>
</tbody>
</table>

1 The HST Office reports other demand-response and program-based transportation for other agencies besides MassHealth. The combined total in FY14 was $150,240,859 of which $51,952,015 was only for MassHealth PT-1 demand-response transportation. Total number of trips was 7,240,234.
2 MART completed 2,012,503 demand-response trips in FY14 and 2,884,484 program-based trips.
A closer look at the transportation the patients used to get to their appointments at FHC reveals that 18% drive alone (average of 16,840 patients); 45% take the bus (average of 42,101); 15% (average of 14,034) share a ride with a friend; 10% (average of 9,356) use a taxi or livery service; and 12% (average of 11,227) walk to the FHC.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Min</th>
<th>Max</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive Alone</td>
<td>15,068</td>
<td>18,613</td>
<td>16,840</td>
</tr>
<tr>
<td>Take the Bus</td>
<td>37,669</td>
<td>46,533</td>
<td>42,101</td>
</tr>
<tr>
<td>Share a Ride</td>
<td>12,556</td>
<td>15,511</td>
<td>14,034</td>
</tr>
<tr>
<td>Taxi / Livery Service</td>
<td>8,371</td>
<td>10,341</td>
<td>9,356</td>
</tr>
<tr>
<td>Walk</td>
<td>10,045</td>
<td>12,409</td>
<td>11,227</td>
</tr>
<tr>
<td>Medicaid/Medicare Transportation</td>
<td>1,290</td>
<td>1,594</td>
<td>1,442</td>
</tr>
</tbody>
</table>

In terms of the frequency of these visits, data from the Smart Transit’s survey shows that 23.3% go to the FHC on a weekly basis (at least 52 times per year), 51.2% go monthly (12 times per year) and 25.6% visit it once every three months (4 times a year).

If we look at the cost associated for each transportation mode we have a clear picture of the transportation expenses for each customer segment. In this case, we assume that patients travel an average of 3 miles one-way to the FHC.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Average Patients per Mode</th>
<th>Costs per Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>By Car¹</td>
<td>16,840</td>
<td>$ 1.71</td>
</tr>
<tr>
<td>By Bus²</td>
<td>42,101</td>
<td>$ 1.50</td>
</tr>
<tr>
<td>Ride-share</td>
<td>14,034</td>
<td>$ -</td>
</tr>
<tr>
<td>Taxi³</td>
<td>9,356</td>
<td>$ 10.88</td>
</tr>
<tr>
<td>Uber⁴</td>
<td>No data</td>
<td>$ 8.07</td>
</tr>
<tr>
<td>Walk</td>
<td>11,227</td>
<td>$ -</td>
</tr>
<tr>
<td>Paratransit⁵</td>
<td>No data</td>
<td>$ 2.25</td>
</tr>
<tr>
<td>PT-1</td>
<td>1,442</td>
<td>$ 19.39</td>
</tr>
</tbody>
</table>

1) IRS Standard Mileage Rates. The standard mileage rate is based on the fixed and variable costs of operating an automobile, including depreciation, insurance, repairs, tires, maintenance, gas and oil.

2) WRTA’s average trip length is 3.3 miles. The WRTA single fare is $1.50. One-Day Pass cost is $3.50.

3) Based on a 3-mile segment. Data taken from Taxi Fare Finder, US Taxi Cab Fare Ranking Cost, retrieved from: www.taxifarefinder.com/rates.php.
4) Based on a 3-mile segment. Data retrieved from: [www.uberestimator.com](http://www.uberestimator.com). Does not take into account the effect of surge pricing. Price is for UberX. Includes $1.00 booking fee and 20% built-in tip.

5) PBSTM Paratransit cost per mile is $8.60. A 3-mile trip will cost $25.80. Passengers only pay $2.25 one-way trip within Worcester.

Using the associated costs per mode and the frequency of the patient’s visit we have an estimate of patient’s out-of-pocket expenses by type of transportation used in addition to their healthcare expenses. Based on the assumptions related with patients’ frequency of visits and costs associated by mode, we can estimate that the average out-of-pocket yearly expenses for those patients that use transit is $1,217,562.51, ranging from a low $1,089,398.04 to a high $1,345,726.99. Average per capita expense in transit is $28.92.

<table>
<thead>
<tr>
<th>Expenses by Patients Taking the Bus by Frequency of Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Weekly</td>
</tr>
<tr>
<td>Monthly</td>
</tr>
<tr>
<td>Once every 3 months</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency</th>
<th>One Day Pass Fare X Frequency of visit</th>
<th>Min</th>
<th>Max</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly</td>
<td>$3.50 * 52 times</td>
<td>$1,597,407.09</td>
<td>$1,973,267.58</td>
<td>$1,785,337.34</td>
</tr>
<tr>
<td>Monthly</td>
<td>$3.50 * 12 times</td>
<td>$810,042.02</td>
<td>$1,000,640.15</td>
<td>$905,341.09</td>
</tr>
<tr>
<td>Once every 3 months</td>
<td>$3.50 * 4 times</td>
<td>$134,479.63</td>
<td>$166,121.90</td>
<td>$150,300.77</td>
</tr>
</tbody>
</table>

| Annual patient’s total expenses using the bus | $2,541,928.75 | $3,140,029.63 | $2,840,979.19 |

For those that use taxi, the average annual expense is $1,962,530.39. Average per capita expense in taxi is $209.75. If all taxi trips were replaced by Uber, the average will represent a 30% difference, for an annual expense of $1,455,663.62. Together, transit and taxi expenses average $3.1 million of dollars per year.

<table>
<thead>
<tr>
<th>Expenses by Patients Using Taxi/Livery Service by Frequency of Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Weekly</td>
</tr>
<tr>
<td>Monthly</td>
</tr>
<tr>
<td>Once every 3 months</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Frequency</th>
<th>One Day Pass Fare X Frequency of visit</th>
<th>Min</th>
<th>Max</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly</td>
<td>$10.88 * 52 times</td>
<td>$1,103,478.68</td>
<td>$1,363,120.72</td>
<td>$1,233,299.70</td>
</tr>
<tr>
<td>Monthly</td>
<td>$10.88 * 12 times</td>
<td>$559,571.89</td>
<td>$691,235.86</td>
<td>$625,403.87</td>
</tr>
<tr>
<td>Once every 3 months</td>
<td>$10.88 * 4 times</td>
<td>$92,897.68</td>
<td>$114,755.95</td>
<td>$103,826.82</td>
</tr>
</tbody>
</table>

| Annual patient’s total expenses using taxi/livery service | $1,755,948.24 | $2,169,112.53 | $1,962,530.39 |
The FHC cited to have an average of 800 missed encounters in a monthly basis. Currently, the standard rate per person/visit is $154. It is estimated that the FHC losses $1,478,400.00 per year solely on missed appointments. Surveys reveal 51% missed their appointments are due to transportation, that translates to $739,200 loss specifically related to transportation problems. In average, 180 patients use the WRTA fixed-route in a daily basis to go to FHC. If FHC pays $3.50 for a One-Day Pass for these patients, the daily expense will be $630. In a year (251 weekdays) the expense will reach $158,130.00. This amount is only 10.7% of FHC loss due to missed appointments. This data points out to the fact that the hospital has opportunity to save a lot of money by making this investment. As far as the patients are concerned

The previous discussion has focused on FHC only, however the largest picture for Massachusetts and nationwide shows how significant these costs really are. The Center for Health Information and Analysis (CHIA) on their annual report found that the total health care expenditures (THCE) in 2014 in MA were $54,028,247,479, or $8,010 per capita, an increase of 4.8% from 2013. Related solely to MassHealth, CHIA found that MassHealth spending increased by $2.4 billion (+19%), driven by member enrollment growth.³

At the national level, data from the Medical Expenditure Panel Survey (2012)⁴, released by the Agency for Healthcare Research and Quality (AHRQ), shows that in 2012 the mean expense per person with an expense in hospital outpatient services was $2,601; for inpatient services was $18,012; and for office-based medical provider services was only $1,390. These figures are more relevant when broken down by categories, like age, race/ethnicity or health insurance status or poverty status.

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³ http://www.chiamass.gov/total-health-care-expenditures/
⁴ Agency for Healthcare Research and Quality. Hospital Outpatient Services – Mean and Median Expenses per Person with Expense and distribution of expenses by source of payment: United States, 2012. Medical Expenditure Panel Survey Household Component Summary Data Table. Table 5, Table 7 and Table 8.
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**Hosting Agency:**  
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Phone: (508)-453-3403
Appendix

List of Services already available in MA

- **Public transit from local transit authority.** A public bus may go to the hospital or near patient’s doctor’s office.

**Resources**: Travel instruction Program

<table>
<thead>
<tr>
<th>Travel Instruction Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit orientation: explains transportation systems by sharing information about trip planning, schedules, maps, fare systems, mobility devices, and benefits and services (may be conducted in a group or one-on-one).</td>
</tr>
<tr>
<td>Familiarization: teaches people who are experienced with traveling about a new route or mode of transportation (may be conducted in a group or one-on-one).</td>
</tr>
</tbody>
</table>

- **Councils on Aging** (COAs) often provide transportation services to seniors and people with disabilities.

- **MassHealth** consumers may be eligible for transportation to their medical appointments.

  MassHealth provides nonemergency transportation services and emergency ambulance services. The general guidelines for nonemergency services are:

  - Your medical provider must authorize your need for transportation by completing a Prescription for Transportation (PT-1) form for community-based services or a Medical Necessity Form (MNF) for institutionally based services.
  - Transportation must be to and from a MassHealth provider for a MassHealth-reimbursable service.
  - Patients not able to access public transportation and/or private means of transportation

- **These transportation service options for consumers** are not exclusively for medical appointments but may help you get to your appointments.

**Resources**:

- **Find Help in Your Town**: Interactive Map: [http://maps.massgis.state.ma.us/eohhs_hst/hst.html](http://maps.massgis.state.ma.us/eohhs_hst/hst.html)
  (Though this map wants to help you find the information that local organizations have...
compiled for your community, the information don’t go beyond providing contact info for the local transit authority, council of aging contact info)

- **Local Resources**: Consists of a list of all the local transit authorities and the town halls in Massachusetts and the respective areas served by them. Navigation directly into each transit authorities is possible. Checking out schedules and other service info provided by each TA can be then accessed.

- **Regional Resources**: Lists some resources, which are initiatives taken by different regions to create a database of the services available. It also made me notice a couple of “unique” services.

**Ride Match Online Tool**: [http://www.massridematch.org/](http://www.massridematch.org/) (For SE MA and MA in general)
a regional directory of transportation options (private, public, and non-profit) for seniors, people with disabilities or anyone needing to travel in Southeastern Massachusetts and beyond.
(Good database, provides an extensive list of services)

**Power in Aging Transportation inventory**: Inventory for elders in Cape Areas
[https://docs.google.com/spreadsheets/d/1okZ3IU1BQ9MweDFPM2mKO6OWk5om1DivTxa1zUuZQ/edit?pli=1#gid=0](https://docs.google.com/spreadsheets/d/1okZ3IU1BQ9MweDFPM2mKO6OWk5om1DivTxa1zUuZQ/edit?pli=1#gid=0)
Spreadsheet containing info of private and public transportation services in cape areas


**Berkshire County services**: [http://www.berksherides.org/transportationguide.pdf](http://www.berksherides.org/transportationguide.pdf)
Have a separate page with medical transport options

**Public Transit and Alternative transit options in Western Massachusetts**: [http://www.masstraveler.com/transit/](http://www.masstraveler.com/transit/)

- **Statewide Resources**:

  - **MassRides** can help you arrange your commute to work: 1-888-4COMMUTE ([http://www.commute.com/](http://www.commute.com/))

  - **Mass211** has information about transportation and other services statewide: call 2-1-1 ([http://www.mass211.org/](http://www.mass211.org/): Information site including veterans and child care)

  - Regional **Elder Services**: call 1-800-AGE-INFO for information on regional senior services

  - **INDEX**: Call 1-800-642-0249 for information on services for **people with disabilities** in Massachusetts

- **Regional Planning Agencies** serve each region

- **Advice on finding employment transportation**

- **Other Resources**
Transportation service options for veterans can help veterans get to medical appointments in the VA system or other medical networks.

Volunteer driver programs may be able to help you find a volunteer in your community who can drive you to some of your appointments.

Long-distance medical shuttles are available in some areas for long distance transportation into medical facilities in Boston or other areas.

**Smart Transit: Data Analysis of the Survey Responses**

The survey was conducted over a couple of week starting from September, 18th 2015. One hundred twenty one individuals took the survey while 67% (81) of them agreed to provide responses while 33% persons (40) declined (They either declined because they had a car and hence thought had no transportation problems, or were not interested). The following analysis is based on the survey responses obtained from these 81 individuals. The initial round of the survey was carried out in the paper format while in the subsequent rounds respondents could submit their answers online. The fielded survey was designed in two languages: English and Spanish. The respondents were asked for their language preference. This analysis is conducted in this document combines responses digitally submitted, recorded on paper, answered in Spanish and in English. For the sake of analysis I have converted the counts to percentages and in certain instances the totals do not add up to 81 since a respondent could select multiple answers (for example, primary mode and secondary mode of transport).

Out of the survey respondents a clear proportion (48%) already takes the WRTA bus for their transportation needs. This number is beyond our expectation. We essentially expected a clear majority to be either driving (either by themselves or with the help of a friend). But both these options combined they only add up to a little over half (25%) of the proportion that is already taking the bus as shown in Figure 1. Therefore in future analysis one must keep in mind that respondents are already familiar with the bus system and their preferences (for example, willingness to pay for a ride) is shaped by these experiences.
In addition to general means of transport shown above, we also asked them about the method in which they reach the Family Health Center (or their primary care provider). Here again, a clear majority choses the WRTA bus. But it is noteworthy that the combined proportion of individuals driving, either by themselves or with a help of a friend, has now increased to 30% as shown in Figure 2. When combined with all other non-WRTA bus modes this number increases to 55%. This would be the market share that the current project would potentially be able to penetrate.

Furthermore, when asked whether transportation is a problem 51% have identified that it is in fact a problem for them. As solution provider, it is imperative to us that the target population identifies
transportation as a problem as well. Otherwise, even though our solution may be efficient, it is less likely to be effective. This is further clarified in the following question where the respondent was asked to point out the reasons for the problems in transport; the majority of the replies can be broken down to problem related to walking and busses. With respect to walking, the distance and the difficult in wintertime appear to be the main factors making transportation a challenge for 39% of the sample. Added to this is 31% of the respondents who face difficulties related to the bus as the services are running late, do not show at all, costly, and not user friendly. 23% of our sample indicated that they are in financial difficulty, be it paying for bus or the taxi. Since the taxis usually cost much more than the bus, in the absence of a reliable bus service, we would conclude that individuals are forced to either miss the appointments altogether or walk in adverse weather. We have calculated the proportion of individuals who have personal mobility issues (i.e. need someone else’s help) to be 12% (Figure 3). We would expect these groups of individuals to reap the benefits of our transportation solution. Another noteworthy observation is that there are 102 responses for this question even though there were only 81 individuals filling the survey. This shows that the respondents listed multiple problems and that the issues they face are not limited to one. This is one of the instances of overwhelming response rate which affirms our hypothesis that the current transport framework needs improvement.

Figure 3: Reasons for Transport Problems
Further evidence shows that about 50% of the respondents either miss their appointment or do not schedule them at all at Family Health Center. This information was extracted through the question number 7 in our survey. We then moved on to check their current technology awareness and trip planning ability. There are 50% of the respondents who do not use any planning method for their trip. This affirms our expectation that, letting the schedulers plan the trip for the individual/patient would render the solution we propose more patient friendly. Currently 32% of the respondents use the WRTA bus tracking option which is a positive sign indicating that the individuals are up-to-date with the current methods. Our software solution is essentially based on Google Maps and the statistics reveal that it is currently not reaching its full potential as shown in Figure 4. Part of the reason could be that it requires access to a smart phone and some technical knowledge. With our plan to implement the solution through trip schedulers we intend to accomplish two goals: (1) simplify the process of appointment; and (2) optimize the appointment allocation so that the patients do not have to miss any and the schedulers do not have to overbook.

![Figure 4: Trip Planning Tools Used](image)

Our final set of questions is devoted to capturing how popular our solutions would be among the target population. An overwhelming majority (82%) stated that they are willing to use the weekly bus option if such services are made available to them (the proportion increases to 96% when both “yes” groups are combined). The response rate coupled with their general interest increases the likelihood of successful adoption of our transportation solution. Furthermore we extend the analysis to
Incorporate the respondent’s interest in simultaneous scheduling. To be precise, whether they would be interested in scheduling a ride to the Family Health Center at the same time they are scheduling their doctor’s appointment. Here again there is a common consensus of positive attitude (86% said “yes”) towards this novel measure as indicated in Figure 6.

The transportation solution that we propose, though cost effective and efficient in the long-run, needs to assure its survival in the short-term. Part of this analysis is therefore conducted to understand how much an individual is willing to and able to pay for using the proposed ride from their homes to the health care provider. The survey asked the respondent’s willingness to pay in its
last question. From the responses to this question the median is $3, that is 50% of the respondents are willing to pay 3 or less dollars for a bus ride. The answers ranged from $0 (free) to $10 (the taxi fare). A majority of the respondents claimed they are willing to pay as long as it costs less than a taxi. Some cited financial difficulty as their inability to pay. Nonetheless, the common consensus was on par with the current bus fares ranging from $1.50 to $3.50.