The Systemic Impacts of Integrated Mobile Healthcare in a State-Wide Emergency Medical Services System

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Chapter 1: Introduction

In the United States, healthcare seems to be a topic at the forefront of governmental and citizen concern. Arguments and research regarding the provision of care often take patternicity that mirrors the inconsistence in the provision of care. In other words, often research supports a course of treatment can sometimes create statistical noise from which researchers and practitioners are desperate to find patterns. Prehospital medical care often suffers from this static and even the best intentions suffer from data noise.

Through the eyes of the untrained, medicine can appear to be patterned, logical and evidentiary. Medical issues start with a symptom; what happens after the symptom presents creates a potential divergence in care. Sometimes, a patient will have a symptom that can be treated by a primary care physician. Sometimes, the patient will need a specialist. Sometimes, the patient needs emergency care offered by an emergency department or by prehospital care providers; these prehospital care practitioners are known most frequently as EMS (Emergency Medical Services) providers. EMS providers are trained to filter out the noise of clinical distractions; can the same be said of EMS researchers? This is a difficult question, especially when it comes to evaluating patterns of care. Clinical distraction stems from a large variety of issues, and patient stability seems to be at the forefront. In short, making the patient stable and safe often trumps advance clinical decision making and diagnostics in EMS, thus making research difficult.

Research restrictions happen for many reasons. EMS providers see a wide array of patients, from those who are medically stable and are requesting an evaluation at the local emergency department despite the stability of symptoms, to patients who are in extreme danger of losing life or limb. Unfortunately, many EMS systems experience a high volume of calls for non-emergency treatment. This high call volume displaces the availability of services for high acuity illnesses and injuries, redistributing the focus to calls to EMS for care and services to treat maladies that may not be life threatening. A 2009 *Denver Post* article by Karen Auge details an example of this issue:

> *Some of these calls are from people gaming the system, such as a woman well-known to Fort Worth, Texas, EMTs, who gets drunk every Friday and then calls 911 and asks to be taken to the hospital a few yards from her apartment.*
>
> *"Then there are those who are just plain impatient," said Dr. David Ross, medical director of Colorado Springs AMR, which is that city's ambulance provider. "There are a small percentage of patients who will use the ambulance systems to try and get bumped up on the be-seen list in the emergency room," Ross said. "But many non-emergency calls are made out of frustration," said Dr. Christopher Colwell, interim director of emergency medicine at Denver Health and medical director of the paramedic division.* "[These patients] *have nowhere else to go," he said. "They deal and deal and deal until it reaches a stage where they can't deal anymore, and they can't go anywhere else."*
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> *"Even if they could see a doctor, the chronically ill and the poor often have no way to get there," Colwell said. "It often boils down to, do they need treatment, or do they need a ride?"* (Auge, 2009, p. 1).

Drs. Ross and Colwell's discussions in the above quote illustrates the two-fold issue for modern EMS services, particulary in the Anglo-American system of EMS, a system that stresses bringing the patient to medical care (such as a hospital) rather than providing services directly to the patient in his or her home environment (Walz and Zigmont, 2017). EMS providers in the US often spend time and effort on patients who are not experiencing a medical emergency and often transport these patients to a clinician or clinical facility rather than providing care at the source or "scene" of the request for transport. The transport of these non-emergency patients can, in simplest terms, be divided into two divergent call types, each with its own issues: there are callers who are poor or uneducated who call 911 because they do not have other resources and there are patients

who have legitimate illnesses or injuries of a non emergency nature who are impatient or unable to access scheduled or primary care for that illness or injury. This assertion is supported by several European studies. For example, in a 2003 study in Wales, a researcher for the UK College of Paramedics investigated the correlation between the capabilities of the ambulance crew sent by a dispatcher to a patient and the actual needs of the patient upon ambulance crew's arrival. Ambulance dispatch criteria and subsequent levels of care needed in those transports were blinded and evaluated by ten emergency physicians: 22% of the patients studied did not need emergency transport (Woollard, 2003). In a 2007 issue of the European Journal of Emergency Medicine, Swedish researchers published data that evaluated a sample of 1,977 ambulance transports and determined of those transports, 42% of non-cardiac/non-trauma patients, 18% of cardiac patients, 17% of trauma patients, and 45% of interfacility (medical facility to medical facility) transfers did not require an ambulance. Further, of those patients not requiring an ambulance, 55% could have traveled by passenger vehicles (Hjälte, Herlitz, Seserud, & Karlberg, 2007).

To resolve these requests for unnecessary transports, systems need to develop a method that delivers patient care to the non-emergency cases without taxing emergency systems and perform systemic research on the methods to determine value. Given the wide scope of care and practice, could an EMS prehospital-care provider also administer preventative care for those patients who could benefit from monitored self-care, thereby addressing the uninformed and the impatient and their respective strains on the system? Could this provision of care have a positive outcome on the operational functions of the EMS system by reducing non-emergency responses and/or transports?

Integrated Mobile Healthcare (IMHC), also known as Community Paramedicine (CP) or Mobile Integrated Healthcare (MIH[C]), is a health services delivery model first introduced in the United States in the 1990s. Public health/community health related services had existed internationally, and on an

unofficial scale in the US, prior to the 1990s, but formalization in the US started at a slower pace than its international counterparts. This pace may partially be due to the European models of socialized healthcare, or it may have been hesitancy in the US EMS system. Regardless of the reason, the system in the US started on a small, locally driven scale, rather than on a state or national scale. Initially, New Mexico EMS created and piloted a model that expanded the scope of available EMS to include preventive care, in an effort to save resources, reduce transports, protect resources, and increase productivity (Pearson & Shaler, 2015). Subsequently, in many cases the model evolved allowing EMS providers to administer a range of prophylactic and follow-up care at patients' residences (Pearson & Shaler, 2015). Other local jurisdictions in other states followed suit.

It is important to note two items moving forward, if only for clarification purposes. First, for the points of this research IMHC, CP and MIHC and MIH are used interchangeably. While one can argue for or against the synergy of these four terms, in the context in which they reference the provision of non-emergency care to a patient by EMS professionals without transportation to the hospital or other skilled facility, these terms are used interchangeably. Second, it is vital to understand that Maine is the first state with a state-wide CP protocol. While many jurisdictions within states have CP protocols, and many states, such as Minnesota, New Mexico, and Texas, endorse CP on an individual service level, until 2017, only Maine had passed legislation in conjunction with a state EMS governing body (in this case, the State Office of EMS for Maine) to enact a state-wide CP protocol. In other words, no other state had both a state-wide protocol and state-wide legislation that enabled state funding and endorsement of a CP type program. In late 2017, Wisconsin legislature followed suit with the passing of a state-wide CP bill, and in 2018 the State Office of EMS for Wisconsin initiated the state-wide protocol.[1]

Further, the research into a state-wide program, or a state regulated program that carries some type of data collection, has been minimal. At the time

[1] It is also important to note there are states, such as South Carolina, that have state wide protocols for IMHC but do not have state wide legislation.

of this research, there have been few publications studying IMHC provision over a long period of time, neither are there studies evaluating how those responses impact EMS operationally.

This study strives to investigate three fundamental questions:

1. Can prehospital care personnel produce positive patient outcomes without transport to the hospital?
2. Are EMS providers qualified and appropriately trained to make patient transport determinations for those patients who suffer from chronic medical conditions that do not pose an immediate life threat?
3. Is there a positive benefit for overall healthcare provision to EMS based preventative medicine?

These questions should not be confused with expecting providers to do more with less. Rather, the intent of the research is to ascertain whether EMS clinicians, ((also known as EMS providers) trained to the current EMS curriculum standards can generate positive patient outcomes without transport in a state-wide system. Prehospital providers have the tools to deliver positive patient outcomes and to perform out of hospital tasks, such as glucose monitoring, intravenous access and maintenance, and patient assessment (National Highway Transportation Safety Administration , 2018). Are the talents and tools available to prehospital providers enough to correct non-emergency medical issues before patients access the traditional EMS system for non-emergency care and are non-emergency interventions enough to have a positive systemic impact? This study evaluated IMHC by examining an existing IMHC system in the State of Maine. To avoid patternicity, care was taken to answer these questions using a carefully developed set of research criteria that considered demographics, EMS history, and common EMS end result policies. This introduction provides the basic demographics that made Maine an appropriate candidate for IMHC research, a brief history of the EMS systems in the US as applicable to IMHC, and the Emergency Medical Treatment and Labor Act and the Affordable Care Act in regard to their impact on prehospital and emergency department care.

1.1 Demographics

To establish a point of reference for any fiscal and operational research, a brief demographic overlay of a jurisdiction is necessary. Within an EMS system, it is important to consider not only the population served but the geographical density of populations, the wealth of a population, and the access to medical care available to the population. For the evaluation of the State of Maine, Maine's population needed to be evaluated as a whole and then the capacities of Maine's overall prehospital and emergency systems needed to be evaluated.

According to the US Census Bureau, in 2018 Maine's population was estimated at 1.3 million people in just over 35,000 square miles. In 2010, Maine was the most rural state in the nation with 61% of the population living in rural areas. In rural areas, distance and accessibility of healthcare is often a factor, especially in areas that may have an impoverished or disabled population, (United States Census Bureau, 2019). IMHC is theorized to work particularly well in areas that have a need for medical care provided in these low access areas.

The population is predominately over 18 and under 65 years of age, 93.3% white-non-Hispanic and 10% of households do not have health insurance. Additionally, about 12% of the population under 65 had a disability. That equates to nearly 40,000 citizens who would be of normal adult working age and suffer from some type of disability, (United States Census Bureau, 2019). The disabled populations fall into a target demographic for IMHC services due to lack of access to, and potential lack of finances to access, primary care medical services.

In Maine, the population density is 43.1 per square mile and the bulk of the population is in the southern third of the state. Portland, Maine, in the south of the state, and the greater Portland area, house about 40% of the state population, with an estimated 67,000 people in the city of Portland itself (United States Census Bureau, 2019). This area of density not only provides an example of an urban area of Maine, but it also provides an idea of how thinly the additional population is spread across the remaining two-thirds of the state.

These demographics illustrate the need for services outside the hospital, as the bulk of the population live outside the urban setting. The lack of access to healthcare coupled with the number of individuals with disabilities make community healthcare a vital part of overall healthcare, as it provides services to those who might have reduced healthcare access. Additionally, the number of uninsured citizens enforces the need for cost effective healthcare, given much of the population would have out-of-pocket medical expenditures.

Based on Maine Public Health Indicators from 2008, the most current available from the state, Maine has a citizen to primary care physician (PCP) access rate of 978 to 1 state wide. For public health purposes, Maine is broken into eight district health profiles; District 1, York; District 2, Cumberland; District 3, Western; District 4, MidCoast; District 5, Central; District 6, Penquis; District 7, Downeast; and District 8, Aroostook. There is an additional district that combines five tribal areas into one jurisdiction that is seated in Districts 6, 7, and 8 (See appendix Map 1), (State of Maine Center for Disease Control and Prevention, 2019). Within these, only Aroostook, Cumberland, and York have less than 10% of their respective populations with no health insurance, (Maine Department of Health and Human Services, 2008). Considering the US benchmarks of 187.3 to 1 for PCP access in Massachusetts and an uninsured rate of 8.2% in Minnesota, healthcare access statistics in Maine illustrate that there needs to be a cost-effective way for patients to access healthcare.

These demographic and district breakdowns assisted in formulating and evaluating the research questions for this study. The locations of individual IMHC participating EMS services within the districts is important, as fiscal and operational impacts of IMHC could be evaluated objectively with overall data as well as subjectively within each geographic region. To formulate an appropriate research question, these demographic nuances were considered when creating an evaluation framework.

1.2 Research Question

EMS research requires acknowledgement of certain limitations within a jurisdiction prior to creating an appropriate research question. Assessing these limitations requires background research into demographic and geographic parameters in a system so that population density, access to health care, population illnesses, and public health profiles can be considered within the jurisdiction being studied. In an effort to evaluate EMS's impact on non-emergency call volumes when using an IMHC system, it was crucial to choose a system with a wide breadth covering a large jurisdiction and a varied population. The demographics of Maine provide both the large jurisdiction and the variances in population for a reliable evaluation. Additionally, given the relative lack of state-wide EMS systems, evaluation into the benefits of statewide protocols needed to be evaluated for benefit in other states. Given Maine was the first state with state-wide protocols and legislative approval, the data from Maine can be considered the first of its kind. Systems created after this investigation could be included in future studies.

In 2012 the State of Maine's legislative officials approved and endorsed the state's EMS system implemented EMS IMHC protocol stating, "*This bill authorizes the Department of Public Safety, Emergency Medical Services' Board, in accordance with current rules of the board, to establish the requirements and application and approval process for community paramedicine pilot projects for the purpose of developing and evaluating the appropriateness of a community paramedicine program. The bill establishes minimum levels of medical oversight and requires reporting by the pilot project to the board. The board is required to report annually regarding the pilot projects to the joint standing committee of the Legislature having jurisdiction over criminal justice and public safety matters*," (125th Maine Legislature, 2012, p. 1)

This bill, enacted on March 29, 2012, permitted Maine EMS providers to act in the capacity of community paramedics, to service citizens' health within practices covered by the standing scope of emergency care, and to receive state

funding to perform this service. Systems providing care were not fully onboarded and placed in service until 2015, (Nangle, 2017). It was not until five years after the initial bill that the CP legislation became permanent, (128th Maine Legislature, 2017). So, using data from the two years before full implementation (2013-2014) and the data after (2015-2016), an evaluation framework can be provided for the implementation of health-based community paramedic programs and protocols for other state-wide systems.

The purpose of this quantitative research was to investigate the fiscal and operational impacts of implementing an IMHC program on a state-wide system that is an augmentation of an existing EMS system. This question is based on the progression of the Maine legislature, and is punctuated by data in a state that services both rural and urban jurisdictions. Before IMHC evaluations could be made, however, a brief history of EMS was evaluated to frame the information regarding system structure, finance, and operations.

1.2.1 EMS History

Prior to creating a research methodology, and in addition to understanding the geographic and demographic limitations of an EMS service area, the history of EMS must be considered. Emergency Medical Services (EMS) is by definition "the treatment and transport of people in crisis health situations that may be life threatening," (EMS 1, 2011, p. 1). How EMS is provided by each ambulance service within an EMS system can vary; these variances can be found from ambulance company to ambulance company, county to county and/or state to state. These individual methods of operation can create a conundrum when developing a standardized method of care; if there is no "right" way, can there be a "wrong" way?

When discussing the provision of IMHC, the definition alone creates a problem for programs that want to provide prehospital, non-transport based medical care. The very idea of non-transport prehospital conflicts with the definition of EMS, as it is not stated as the treatment OR transport but rather

treatment AND transport. EMS in the United States, however, carries two additional connotations: the association of any healthcare services furnished by an emergency care facility, such as a hospital emergency department, and of healthcare services dispensed by personnel via ambulance before a patient's arrival at a hospital emergency department (Walz & Zigmont, 2017). This provision of "prehospital care", often associated with ambulance care, has only been available to the public since the mid-1950s, as before the turn of the 20th century, the family doctor handled emergencies or the patient was transported by horse or carriage for medical care (Walz & Zigmont, 2017). As such, EMS is still a dynamic field that has not fully grown into its terminal purpose, providing room to expand and evolve.

EMS is intended to serve as a stop-gap between the first-aid type care that can be given by the patient or patient's in-home, non-medically trained caregiver, and the definitive care that can be administered by a hospital and or physician. The most advanced US EMS providers, known as paramedics, can perform many skills historically reserved for physicians. Paramedics receive training in differential diagnoses, patient assessment, recognition of urgent life-threatening conditions, pharmaceutical therapy, anatomy & physiology, and kinesiology, in addition to learning to perform all of these skills in an uncontrolled, out-of-hospital environment that can range from mountain tops to river valleys and nearly anywhere in between (Walz & Zigmont, 2017). Given the wide and varied amount of training and treatment modalities of a paramedic, it is not a far leap to postulate that US EMS providers could perform patient assessment and care in non-urgent situations, making transport determinations with or without the input of a physician. Dispatch centers and emergency medical providers have standing protocols for emergencies; guidelines could be created by systems and their system physicians for non-emergency situations.

There is existing precedence for greater EMS provider independence. In other areas of the world, especially in Europe and the former British colonies (such as Australia, New Zealand, and Canada), providers are successfully able to work more independently (Swanson, 2011) (Al-Shaqsi, 2011). These systems

often have EMS clinicians that operate with greater clinical independence, greater breadths of knowledge, and in some cases, elevated higher-education standards than clinicians in the United States (Al-Shaqsi, 2011). Disparities in paramedic practice internationally is often a topic of discussion among EMS professionals, but just as healthcare systems differ from country to country, it stands to reason that the scope of practice and care for clinicians vary by certification, licensure, and locality.

Why then, is advanced care a hard sell in the US? Problematically, EMS has historically not been a top priority within the research community (National Highway Transportation Safety Administration, 2013). EMS as a profession has only been in existence in its current incarnation since about 1970. Prior to the creation of the National Highway Transportation Safety Administration (NHTSA), EMS providers, from a national perspective, possessed very little medical training and were not held to a specific national standard of mandated training (Walz & Zigmont, 2017). These variances in training, however, are not evaluated within this study. Since EMS providers are not required to have advanced education beyond the curriculum required by the National Registry of EMTs (NREMT), even the most advanced practitioners would only have to complete a certificate level program to become certified or licensed at their state's level. Certificate[2] level education can be problematic considering other professions that provide patient care prior to physician intervention (e.g. registered nurses) require associate degrees (American Nurses Association, 2018). Arguably, degreed providers and certified providers have different levels of education and capabilities even though the healthcare procedures each can perform may be the same. It could then be argued that a certificate provider does not possess the advanced education needed to evaluate and release a patient without intervention of a healthcare clinician with more advanced training. The International Board of Specialty Certification (IBSC) offers community paramedicine certification to accomplish this wider breadth of care needed for

[2] There are some programs in the US that allow college "certificate programs" in paramedic and the NREMT does not require a degree to take the paramedic examination.

certificate paramedics who may not have had advanced education prior to community paramedic training.[3] This certification includes advanced patient assessment and advanced diagnostic evaluation training that is not commonly taught as a part of paramedic education (International Board of Specialty Certification, 2018). In the US, baccalaureate degrees in EMS are available at fewer than 50 institutions, master's degrees are available at fewer than ten institutions, and doctoral degrees specific to EMS have only recently been undertaken by an even smaller number of universities (Bissell, 2017). While some countries, such as Australia, require college degrees to practice EMS (Queensland Government, 2017), the US has not adopted such a policy. Because of this lack of advanced education, and because research methodologies are usually employed by those with baccalaureate or more advanced degrees, researchers in EMS are *usually* physicians and/or non-research trained fire service-based EMS practitioners, who may or may not understand the individual nuances of emergency medical services within the scope of prehospital care (National Highway Transportation Safety Administration, 2013). In other words, it is not uncommon for healthcare researchers whose expertise is outside the field of EMS to perform EMS research. This lack of EMS acknowledge arguably creates a cadre of researchers who do not specialize in prehospital patient care as well as providers who are not trained to research their practice. Consequently, quantitative, EMS-provider-driven research, especially research that provides rationale for further scope of practice, is limited.

Furthermore, given that research can be expensive, both from personnel and a time perspective, research has the potential to take a back seat to the operational costs and overhead (administrative staff, reporting, vehicles and maintenance, etc.) that an EMS system experiences. This creates a deadly circle:

[3] It is important to note that at the time of this research, the United States (US) recognizes four levels of National Certification (Emergency Medical Responder (EMR), Emergency Medical Technician (EMT), Advanced EMT (AEMT) and Paramedic (NRP). but within the US, many states carry other levels of certification that provide alternate curricula (National Registry of Emergency Medical Technicians, 2018)

without research, funding outside those received in reimbursement for transports is limited; with limited funding, research is difficult.

1.2.2 Finance

Training is not the only aspect of EMS that needs to be considered when expanding scope of care and developing research pertaining to IMHC. If the clinicians are the bones of an EMS system, finance is the muscular system holding the bones in place, providing the means to purchase goods and services needed to provide healthcare to the communities a system serves. Unfortunately, the design and practice of systems finance within an emergency medical services system dedicated to prehospital care is difficult to quantify. In many countries, especially in European models, EMS is a core part of the healthcare system and is financed through taxes or government funding. Funding for EMS in the United States is an incredibly varied mixture of financial support system types. Both for-profit and non-profit systems exist but these systems have rates of reimbursement that are regionally specific based on Federal governmental healthcare reimbursement standards (Centers for Medicare and Medicaid Services, 2018). EMS administrations are often further restricted by state or local government parameters placed on EMS systems as EMS administration procedures are not standardized nationwide (Walz and Zigmont, 2017). Inconsistent system administration requirements in the US limit systems in such a way that EMS services can only exist by providing fiscally and operationally responsible care.

> A 2011 report from the National Center for Policy Analysis states *reimbursement from public and private insurers is a major source of revenue for fire and ambulance departments, but the primary source of funding is property taxes. Budget restraints, decreasing property values and restrictions on the use of municipal bonds to pay for equipment will make it difficult for many communities to increase their financial support* (Swanson, 2011, p. 1).

This decrease in funding coupled with the formula fee schedule for payment published by the CMS makes operational and fiscal responsibility in the healthcare setting a pressing issue and leaves little room for research.

Two policies, the Emergency Medical Treatment and Labor Act of 1986 (EMTALA) and the Patient Protection and Affordable Care Act of 2010 (ACA), appear to be forcing the emergency medical service systems to reevaluate their purpose, mission, and general operations in order to sustain themselves fiscally and, at the same time, ensure the most appropriate patient-centered care. EMTALA created a societally acceptable practice of using emergency resources for non-emergency care. EMTALA also shaped a compulsory system whereby patients must be treated by any hospital receiving Federal funding (such as Medicare payments) without requiring payment at the time of service (Lawner, 2016). Without an immediate payment due, unlike many primary care physicians who have full or co-payments required at time of service, EMTALA created a system of care where treatment is compulsory for the hospital to provide care without any guarantee of payment. This problem further is augmented with the convenience of a mode of transportation that also does not require payment at time of service (EMS) thus creating a two-fold problem. This is discussed further in the EMTALA section of this document.

The Affordable Care Act has impacted the cost of patient re-admission for hospitals and has further restricted Centers for Medicare and Medicaid Services (CMS) reimbursements. In this aspect, EMS now not only needs to address non-emergency patients as a result of EMTALA but also must find a broader and more patient-centric, preventative modality of care. EMS has seen some significant changes to its utility and purpose in the light of EMTALA and the ACA (Delbridge, et al., 1998). These policies have impacted emergency medical services so significantly that many medical practitioners have changed their opinions on modifications to the manner in which EMS should be performed. Committees, such as EMS Agenda 2050, are attempting to make sense of these changes (EMS Agenda 2050, 2018).

It is important to note that there have not been any significant changes—at least on a national scale—to the manner in which EMS is performed since the 1998 EMS Agenda for the Future. 1998's Agenda saw EMS systems gain 14 attributes to a good system, stressed the importance of quality improvement, and added research as a vital part of systems (Walz & Zigmont, 2017), though little research has materialized since the 1998 Agenda. Additionally, the 1998 Agenda for the Future makes no mention of EMTALA or the effect of EMTALA on EMS systems. It does address, however, that EMS providers should strive to integrate with other healthcare and community health resources and practitioners (National Highway Transportation Safety Administration, 1998). Because of this lack of data, EMTALA, for the purpose of this study, should be separately evaluated.

1.2.3 EMTALA

Given the potential disparities between EMS goals in EMS Agenda for the Future and polices established and enforced by federal law, the impact of key legislation, such as EMTALA, must be evaluated for impacts on EMS performance. The EMTALA policies' creation was centered on the idea that patients in the midst of an actual medical emergency should not be denied care regardless of their ability to pay for services rendered (Testa & Gang, 2009). In short, the policy stated that any individual experiencing a medical emergency or who were currently in active labor could not be turned away from an emergency department until they were stabilized. If patients needed to be transferred for services unavailable at the initial receiving hospital, that transfer could only be made once the patient was stabilized, or if the services needed were genuinely unavailable at the initial medical facility. EMTALA also prevented hospitals from transferring patients to other institutions based solely on their ability to pay. [4]

[4] It is important to realize that, technically, EMTALA is only applicable to those hospitals that receive federal Medicare funding. If a hospital chooses not to receive federal funding or reimbursement via Medicare, then rules under EMTALA may not apply. Considering, however, that the bulk of the reimbursement most hospitals receive comes from Medicare programs, EMTALA regulations are followed by virtually every emergency department in the country. (Centers for Medicare and Medicaid Services, 2017)

The problem with EMTALA is the same problem encountered with many of the United States' medical policies, in that the policy is intended to render a specific outcome but by consequence of administrative procedure, renders a different result. EMTALA did reduce the number of patients being turned away from hospitals due to their inability to pay and therefore, achieved its intended effect. Problematically, however, there were several unintended results that negatively impacted the emergency medical system.

First, the word "emergency" was never specifically defined, rather EMTALA lists a set of ambiguous criteria[5] causing the definition to be left to speculation and litigation (Testa & Gang, 2009). For example, many medical practitioners would argue that an emergency is a situation that has the potential, if not treated immediately, to cause the loss of life or limb. Given this definition, there is a significant difference between trouble breathing related to a stuffy nose and trouble breathing as a consequence of anaphylaxis. However, a patient cannot be expected to know the cause of their breathing trouble, and subsequently, may believe that they are in an emergency situation, while a medical practitioner with advanced training may not judge the situation to truly be an emergency. This is complicated by the divergence in protocol and procedure as approved by local system physician oversight (also known as jurisdictional medical direction) from one jurisdiction to another.

As discussed, not only are hospitals receiving an influx of patients in their emergency departments who may not be experiencing an emergency, ambulance services also receive requests for services for problems that may not qualify as an emergency but are still medical or traumatic in nature. In most jurisdictions, ambulance service providers are normally tasked with transporting all patients

[5] The term "emergency medical condition" mean "A medical condition manifesting itself by acute symptoms of sufficient severity (including severe pain, psychiatric disturbances and/or symptoms of substance abuse) such that the absence of immediate medical attention could reasonably be expected to result in placing the patient's health, and with respect to a pregnant woman, the health of the woman or her unborn child, in serious jeopardy, serious impairment to bodily functions, or serious dysfunction of any bodily organ or part." (Department of Health and Human Services, 2001, p. 14)

who call for service unless that patient refuses, even if those patients could be transported by personal vehicle or taxi. While there are many reasons a patient could refuse care once initiated, in most circumstances the patient who requests services will receive transport. These non-emergency patients, while possibly in need of some medical care, consume valuable resources such as physicians, ambulances, hospital beds, etc. (Arkun, Briggs, Patel, Datillio, & Birkhahn, 2010). Adding to this issue, the insurance coverage levels provided by both private insurance and the Patient Protection and Affordable Care Act seem to have changed for healthcare practitioners at the hospital level, creating a need to curb both unnecessary hospital treatment, and frequent readmissions (University of Pittsburgh Medical Center, 2015).

1.2.4 PPACA

The Patient Protection and Affordable Care Act (ACA) was enacted in its current format in March of 2010. Initially created as a patient bill of rights and to make healthcare more affordable, the ACA was "intended to implement activities to prevent hospital readmissions through a comprehensive program for hospital discharge that includes patient-centered education and counseling, comprehensive discharge planning, and post discharge reinforcement by an appropriate healthcare professional" (Sec 2717 42 USC 300gg 17a1B). Analysts at the University of Pittsburgh, have divided the intent of the ACA into major principles:

a. Affordable quality care for all Americans
b. Enhanced public programs (Medicare and Medicaid)
c. Improved efficiency and quality of healthcare
d. Chronic disease prevention
e. Investments in the healthcare workforce
f. Transparency and integrity
g. Long-term services support
h. Revenue provisions
i. Strengthening care (University of Pittsburgh Medical Center, 2015)

Using these principles as a guideline, it appears the ACA was intended to impart quality preventative and long-term care, in addition to urgent care, in a sustainable, fiscally responsible healthcare system. Educated providers giving efficient, sustainable care and long-term support are keystones to the ACA's success. Unfortunately, the intent of the policy was not what was implemented. Medicine is complicated; paying for medical care under the ACA is even more complicated.

For example, Medicare and Medicaid (medical assistance) are two governmental entitlement healthcare programs. Medicare is age and disability based, while Medicaid is based on financial need. While both are federally funded, Medicare is implemented by the federal government and Medical Assistance is implemented by the individual state. Under the ACA, the Centers for Medicare and Medicaid Services (CMS) have specific guidelines on what services are covered for prehospital transport. According to Jason Skidmore, CEO of Hart to Heart Transportation, the monetary amounts distributed for the provision of ambulance-based care were small before the ACA, now they often do not cover the overhead expenses for the services providing that care (Skidmore, 2016). Additionally, CMS sets the standard by which private insurance companies, such as Blue Cross and Blue Shield or CIGNA, base their reimbursement rates. Consequently, it often costs more to provide an ambulance transport in the event of a non-emergency patient transfer than the company receives in reimbursement. This can be financially devastating considering non-emergency transport makes up the bulk of all interfacility transfers and "emergency "calls. This cost-benefit mismatch creates a significant problem not only for systems operating as part of a governmentally funded system, but even more so for those systems running as a commercial or for-profit organization. Without revenue to support crews, payroll, and system overhead, the number and availability of services is reduced (Skidmore, 2016).

EMTALA and the ACA have created a twofold problem. First, the healthcare system must ascertain how to offer medical treatment to non-emergency patients before those patients seek out care by using emergency

medical services. Second, the prehospital emergency medical services must evaluate the allowances, in regard to provision of patient care imposed on them by their regulating bodies and use those allowances to create a system that offers excellent prehospital care while also acting as a buffer to prevent unnecessary transport to, or treatment at, emergency departments.

By looking at the emergency medical services systems in the United States, and the methods by which they try to reduce unnecessary transports, the questions of both proactive patient care and fiscal responsibility become of paramount importance. This study represents an introductory assessment of the abilities of state-wide IMHC to carefully and consistently bridge the gaps that exist in community healthcare given the current parameters and restrictions to prehospital community healthcare.

In an effort to establish a baseline of existing research, a review of current literature is required. Given that Maine is the first state-wide state funded system, the literature does not touch specifically on the Maine system, but rather on the individual research topics of IMHC for operational, fiscal, and patient impact.

1.2.5 Precedence

Many jurisdictions, especially those with large cities where fire-based EMS is prevalent, are not using IMHC to augment their EMS systems despite the fact that these systems often struggle with a high volume of non-emergency patients. Maryland, for example, has a state-wide protocol, but no true legislative backing. As of this publication, Maryland has seven systems currently in practice and each are fire-based EMS systems providing IMHC care[6], and each of those systems operate in their own way within the protocol parameters (Maryland Institute for EMS Systems, 2017). This affects not only patient care but ambulance availability for emergency calls. For example, according to Dr. Ben Lawner, former assistant

[6] Queen Anne's County, Prince George's County, Charles County, Salisbury (a town in Wicomico County) and Baltimore City (though this is a different type of program with alternate state approval)

medical director of Baltimore City Fire Department, the City of Baltimore has a call volume that is predominantly made up of non-emergency calls for transport. Patients sometimes call because they want to be transported to the hospital for a warm bed or a meal, or for issues like bugs in their ears, or a superficial scratch (Lawner, 2016). This call volume can be expensive both in personnel time and operational dollars given that according to the Centers for Medicare and Medicaid Services (CMS), non-emergency ambulance transportation is rarely covered by insurance. In the CMS document, Section 10.2.1, *Necessity for the Service*, in the Medicare Policy Manual, Chapter 10 for Ambulance Service states:

> *Medical necessity is established when the patient's condition is such that use of any other method of transportation is contraindicated. In any case in which some means of transportation other than an ambulance could be used without endangering the individual's health, whether or not such other transportation is actually available, no payment may be made for ambulance services*. (Centers for Medicare and Medicaid Services, 2017, p. 5).

Funding and cost, therefore, are an important point in the discussion of IMHC implementation. Systems may have the best patient interest at heart, but without funding, the service area can become restricted due to budgetary challenges. Much of this stems from CMS ambulance necessity guidelines coupled with responses for services that are not reimbursable by insurance companies due to issues with medical necessity. CMS has complex formulas for calculating costs for ambulance services. These formulas include a base rate with separate urban and rural rate modifiers, modifiers for levels of service rendered and additional provisions for mileage traveled from the response location to the patient destination (Centers for Medicare and Medicaid Services, 2018).

For this study, based on data compiled from participant Maine communities both pre (2013-2015) and post (2015-2016) full implementation of IMHC, a correlation between overall use and operational expense of the EMS system was evaluated. Data was taken directly from ImageTrend, the State of Maine's patient data reporting systems, and entered into statistical software to

evaluate significance and evaluate success in the wake of two pieces of US legislation that arguably dictate the pre-vision of emergency care: EMTALA and the ACA. These administrative mandates coupled with an evaluation of EMS history allowed for a clear path for examination of Maine's IMHC services.

1.3 Conclusion

EMS care is a complex and often overlooked treatment modality for a wide and varied number of patients. The prehospital care provided by EMS systems includes the treatment of injury and illness upon request, regardless of whether or not the issue at hand is a clinical emergency. Additionally, EMS providers often see an increase in calls from patients who were recently discharged from the hospital but who are unable or unwilling to comply with the discharge orders that could keep them from relapses in illness. In order to offset these calls for non-emergency care and to help prevent hospital readmission, IMHC has been developed to act as both a preventive and a stopgap in the healthcare system.

Considering the history of the progression of EMS care and the impacts of EMTALA and the ACA, both local and international agencies have seen an increase in non-emergency calls for service. While the international services are not impacted by EMTALA or the ACA, the rate of call requests for non-emergency patient complaints is on the rise. Systems need a way to offset these requests and make EMS units available to service those patients in need of emergency care without negatively impacting a system as a whole.

Research is needed into the benefits of IMHC, specifically as to the benefit of a state-wide IMHC system that operated with the blessing of a state legislature, both in medical protocol and in financing. Maine was a suitable system for research since it has rural, suburban, and urban populations that have access to physician care (and thus medical access) and rates of insured populations well below US benchmarks. Given that several services enrolled in the pilot stage of IMHC, this provided a large sample set from which to work.

Evaluating fiscal, operational, and patient outcome data for EMS services based on provision of care, rather than levels of training or numbers of units, is an area of EMS that requires additional research. The purpose of this study was to investigate the benefits of a state-wide IMHC system, within a population with varied demographics, for fiscal and operational outcomes as well as for the impact on patient requests for EMS services. Statistical and financial outcomes were developed based on Anderson's Healthcare Model (discussed in later chapters) and analyzed for outcomes and fulfillment of state healthcare need. The rational for this study and the need for prehospital, non-emergency care both for patients and for EMS systems, is expanded upon in the next chapter, the literature review.

The literature review looks at previous peer reviewed, expert drafted and/or and government documents that address the three basic tenets of need on which the IMHC study was based: EMS operational surges, EMS financial impacts of high non-emergency call volume, and patients' frequency in activating emergency services for non-emergency and/or preventable health care needs.

Chapter 2: Literature Review

Emergency Medical Services is a multifaceted system of prehospital and emergency based medical care that is an often-overlooked avenue for the treatment of injury and illness regardless of whether or not the issue at hand is a clinical emergency. EMS providers often see an increase in calls from patients who were recently discharged from the hospital but who are unable or unwilling to comply with the discharge orders that could keep them from relapses in illness. As discussed in the introduction of this study, in order to offset these calls for non-emergency care and to help prevent hospital readmission, integrated mobile heath care (IMHC), also known as community paramedicine (CP), has been developed to act as both a preventive and a stopgap in the healthcare system. Questions have arisen in the past as to whether modifications to the performance of EMS in any form can impact three of the larger issues currently plaguing EMS systems. This literature review delves into the previous commentaries and studies available EMS research that show EMS's impact in the following 3 arenas: cost reductions, surge reduction and patient request reduction.

Cost reduction addresses not only the monetary requirements to operate an EMS system, it also addresses the loss of revenue calls that may not be reimbursable by traditional serves avenues such as Medicare, Medicaid or private insurance. When services are provided by an EMS system that are not funded by a revenue source, the overall provision of care that an EMS system can provide can be impacted. Can IMHC assist in reducing costs?

Surge reduction addresses the sudden, and sometimes overwhelming, requests for services that are experienced by EMS systems. These surges are not exclusive to times of disaster or pandemic illness, but rather, can happen any time that a system has requests for services that outnumber available resources. Ambulances may have more requests for care than they have available transport units. Emergency departments may have more patients waiting for care than they have available beds. Can IMHC assist in operational surge reduction?

Tangential to operational surge reduction, providing any services that reduce patient requests for assistance can assist in operational surge reduction and therefore it also has the potential to reduce the fiscal impacts on an EMS system. Can IMHC reduce non-emergency patient requests in an EMS system?

The three aforementioned questions are the core of this study. As with any research endeavor, evaluations of current and previous literature into a given research topic must be performed. In the case of IMHC, the three general topics needed to properly evaluate IMHC's value to the healthcare system are: IMHC's fiscal responsiveness in the realm of healthcare, the need for community based prehospital care to offset operational surges, and the capabilities of IMHC to perform as a stopgap in the abuse of the emergency prehospital system while still addressing patient need. For the review, IMHC's potential fiscal and operational impacts will be the first focus, as they carry the widest impact. While the patient should be the primary focus of any healthcare endeavor, it is not the individual patient that makes headlines regarding system impact; rather, the cost of healthcare is generally the focus.

Given the relative newness of IMHC, performing a pointed review of literature can be difficult. The application of prehospital preventative medicine by emergency medical services providers is so new that neither a unified name nor a standardized curriculum has been established. As evident in the following literature review, population sizes in evaluation have been predominantly small in nature, generally containing less than 5,000 data points.

Additionally, given the fact that there is no national standard of care, no national licensing or certification, nor even a professional agreement on what skills and services are covered by an integrated mobile healthcare provider specific literature (especially in peer-reviewed journals), is ambiguous. There are, however, several sources that can relate specifically to integrated mobile healthcare that should be evaluated to provide baselines for fiscal, operational and patient care impacts in both European (including lands formerly in British control such as Australia) and American models.

This chapter will provide evidence rationale for IMHC. Then using this information as a skeleton, evidence rationale for IMHC can be established in later chapters. A world view of pre-hospital non-emergency care will be offered and finally, the time-line of the development of IMHC will be presented.

2.1 Reduction of Fiscal Costs

Reduction of the fiscal cost of EMS is arguably the most important aspect of the advent of IMHC care. Healthcare is expensive and reductions in cost not only have an impact on populations who are receiving care and the medical systems providing that healthcare, but also on every individual who participates in paying for health care services. This includes the general citizen who pays taxes, the patient who uses government provided entitlement insurances like Medicare and Medicaid (since there is a limited amount of funds allotted for the provisions of these services) and the corporations who fund and approve or deny care and treatment modalities for medical necessity in the private auditoria of healthcare services.

Even though operational surges and patient requests for service are tantamount in importance to fiscal impacts in EMS systems, money seems to be an overbearing issue in the provision and performance of US healthcare systems. Consequently, the need for high value, fiscally responsible healthcare should be vital to IMHC's success. Several articles discuss the impact of finances on the pre-hospital services in the US.

"Vital Directions for Health and Health Care Priorities from a National Academy of Medicine Initiative" discusses several issues central to the future of health and healthcare, issues that will remain relevant despite the modification or repeal of the Affordable Care Act (Dzau, Burke, Daschle, & et.al, 2017). The authors discuss the assertion that patient care initiatives that redirect strategic and operational foci are most imperative to the improvement and long-term success of the healthcare system.

Their review of the ACA finds several significant challenges within the US healthcare system. Dzau et.al (2017) stated:

> *Healthcare costs remain high at $3.2 trillion spent annually, of which an estimated 30% is related to waste, inefficiencies, and excessive prices; health disparities are persistent and worsening, and the health and financial burdens of chronic illness and disability are straining families and communities….The action priorities—pay for value, empower people, activate communities, and connect care—recurred across the articles as direct and strategic opportunities to advance a more efficient, equitable, and patient- and community-focused health system*. (Dzau, Burke, Daschle, & et.al, 2017, p. 3)

The National Academy of Medicine is not the first organization to discuss the need for fiscally appropriate care. In a 2006 article in the American Journal of Public Health, Yaneer Bar-Yam discusses what he believes is the main issue with the healthcare system (Bar-Yam, 2006). In essence, the healthcare system is in poor shape due to a dichotomy between healthcare expenditures and the complexities in individual patient care. Bar Yam states:

> *The problem is that the healthcare system is expected to behave efficiently with respect to financial flows at the large scale, but to exhibit the high complexity of individual patient care at the fine scale. If all patients were in roughly the same condition, requiring roughly the same treatment, an efficiency approach would be adequate, as this approach works well for streamlining low-complexity procedures. However, the medical treatment of patients is an extremely high-complexity fine-scale task. One-size-fits-all does not work in this case*. (2006, p. 462)

In other words, it is difficult to manage economically responsible care, since each patient must be treated as an individual and each individual patient may or may not fit into an organizationally created category.

Identifying that healthcare foci are strongly influenced by finances, the University of Pittsburgh Medical Center (UPMC) published a breakdown of its interpretation of the 10 goals of the ACA, including affordable care for all

Americans, the role of public programs, and improving efficiency (University of Pittsburgh Medical Center, 2015, p. 1). These goals provide a strong incentive for programs like IMHC to succeed. UPMC suggests that in order for there to be quality care for all Americans (1), public programs (2) need to be available to improve quality and efficiency in healthcare (3). By preventing chronic disease's impact on healthcare (4), and creating programs of integrity (6) by increasing a primary care based work force (5) providing innovative therapies (7) with the goal of community service (8), revenue provision (9), and a strengthened healthcare system (10) (University of Pittsburgh Medical Center, 2015, pp. 1-2). [7] Arguably, IMHC can provide all of these goals; more specifically, financial goals are addressed by UPMC. As illustrated by goals 2 and 9 (and by consequence goal 10), efficiency and responsible revenue sourcing can be a large part of the role of public programs such as IMHC.

IMHC meets the UPMC criteria, as it…:

1. Is a public program available to populations?
2. Can improve efficiency in healthcare services by keeping patient in the out of hospital setting,
3. Allows for the address of individuals with chronic illness and monitoring of individual conditions,
4. Can improve a patients' access to primary care physicians and allow EMS providers to act as a form of low-level primary care,
5. Can provide therapy innovations and provision of care that was previously only available in a hospital or clinic setting,
6. Increased the out of hospital (primary workforce),
7. Is community based,
8. May not create revenue but can potentially offset cost,
9. Can strengthen a healthcare system,
10. And can hopefully be performed with the utmost integrity.

Given that the University of Pittsburgh Medical Center (University of Pittsburgh Medical Center, 2015) the American Journal of Public Health (Bar-

[7] The numbering provided correlates to the order of the goals in the document

Yam, 2006), and the National Academy of Medicine (Dzau, Burke, Daschle, & et.al, 2017) have all published information on healthcare that is high in value and low in cost, it would seem that any innovation that cuts costs while still servicing the patient as an individual would be a welcome respite within the US healthcare's fiscal flow issue. Furthermore, the move to fiscally responsible patient centered care is a plausible possibility to augment and streamline the current transportation and treatment styles of care currently offered by EMS.

Policy analysts have written on the fiscal impacts of community care as well. In a 2011 brief, the National Center for Policy Analysis advocated both for systematic changes that would reduce a patient's use of EMS systems and for CMS to evaluate reimbursements for care that do not include transport (care within the community). Peter Swanson asserts that:

> *Ambulance providers are generally not compensated for care unless an individual is actually transported. Thus, even if the ambulance is only called as a precaution, or an individual's medical needs can be met at their location, there is a financial incentive to take an individual to a hospital in order to receive reimbursement*. (2011, p. 2)

Even more potent than the assertions of high value - low cost systems as addressed by Dzau and Bar-Yam are the estimations on statewide cost saving postulated by North Carolina. The National Association of EMS Officials (NAEMSO)[8] released data compiled by the North Carolina Office of EMS and three programs in North Carolina currently utilizing IMHC. Using data provided by North Carolina Medical Assistance regarding average amounts paid per claim, dollar amounts were applied to calls for 17,763 patients in 2015 (North Carolina Office of EMS, 2017). These 17,763 patients accounted for 141,176 calls for

[8] NAEMSO's mission statement is "The National Association of State EMS Officials is the lead national organization for EMS, a respected voice for national EMS policy with comprehensive concern and commitment for the development of effective, integrated, community-based, universal and consistent EMS systems,"**Invalid source specified.**. At the time of this publication, there is no specific committee dealing with IMHC as an independent issue, though IMHC is a topic of some discussion. Additionally, while there is some input on training and certification, the National Highway Transportation Safety Administration is the lead body for EMS certification and education, (National Highway Transportation Safety Administration , 2018)

EMS service resulting in 103,221 transports, (North Carolina Office of EMS, 2017). NAEMSO estimates that the creation of a community paramedicine program has the potential to decrease call volume

> *from 32.7% to 37.1% for a total reduction of 46,164 to 51376 EMS calls state wide. The potential decrease in transports ranged from 27.9% to 38.8% for a total reduction of 28,798-40,049 transports state wide, in a single year… [and using] estimates provided NCDMA, we estimated a potential savings of between $2,126,213 and $2,956,885, statewide, in a single year.* (North Carolina Office of EMS, 2017, pp. 1-2)

These savings could be a huge driver in the adoption of IMHC programs with funding from entities who both finance healthcare and are also looking to save money.

The next subchapter looks at another way to reduce expenses: reduction of operational surges. While reducing surge may not generate revenue, IMHC can be marketed as a way to save funds by reducing the number of patients entering or re-entering the hospital system, thus reserving ambulances and emergency department space for patients who have true emergencies.

2.2 Reductions in Operational Surges

Beyond the prevention of fiscal overspending a resolution might be found in the grounding of EMS as community-based healthcare. This would come in the reduction of operational surges. According to the US Department of Health and Human Services, a successful medical surge is the ability to provide adequate medical care during when requests outnumber resources, (US Department of Health and Human Services, 2012). In EMS, surges happen in two ways: either by not having enough units to respond to all calls for service or not having enough units with the correctly trained providers to respond appropriately to patient requests. The best way to reduce surge is by basically not exceeding operational limits.

The North Carolina study previously discussed postulates that IMHC could effect a significant reduction in patient transports and patient calls for service; these reductions would allow more units to be available to take additional calls and/or to attend to patients with issues of a higher medical acuity (North Carolina Office of EMS, 2017). Similarly, in addition to advocating for fiscal responsibility, Dzau et.al further emphasize the value of community-based, patient-centered healthcare that reduces fiscal and operational waste (Dzau, Burke, Daschle, & et.al, 2017, p. 5). To create this system, Dzau, et al. assert that increased awareness and "high-value healthcare" using technological advances are imperative to successful completion of this initiative stressing the core values of integrated mobile healthcare: the use of resources in a more efficient, cost-effective manner to integrate overall community health one patient at a time.

A lynchpin article for the use of IMHC services, the ideas emphasized lend credence for the implementation of a community-based healthcare system of some sort, if not specifically integrated mobile healthcare (Dzau, Burke, Daschle, & et.al, 2017). Given the youth of US IMHC coupled with increasingly positive patient outcomes there is provision for guidance for public health-based healthcare and for pre-hospital care programs as a whole.

The goal of IMHC is to prevent the unnecessary transport of patients, thus reducing operational surge. Given that Dzau et.al and Beck, et.al assert that community-based health care is needed to reduce patient influx into the healthcare system unnecessarily, the need for EMS services to be paid for their time and efforts often overshadows a patient's true need for service. Since CMS's guidelines on ambulance-based care currently do not address treat and release services, systems that perform IMHC functions have the potential to be at a fiscal loss when providing care. Providing patient care with competent providers in a safe and beneficial manner costs money; currently, payment for these services is difficult to collect.

After looking at the literature for reducing the fiscal impact of EMS systems incurred by treating non-emergency patients and having discussed ways the need for operational surge can be avoided, the evaluation of what can be done

to prevent fiscal and operational impacts before they begin. This method of cessation before activation can best be accomplished by reducing the number of patients who activate emergency services for non-emergency issues. While the goal is never to prevent patients from accessing EMS in time of need, reduction of non-emergency requests for care by patients and/or care givers is a crucial component of many EMS issues, but especially in showing the importance of IMHC. The next subchapter looks at another way to view the research supporting the reduction in patient requests for non-emergency services, ambulances, and emergency department space. One way to combat this is to reduce the number of requests for transport.

2.3 Reduction in Patient Request for Care

While reducing the fiscal footprint of pre-hospital patients and reducing operational surges are both important, neither will be effective in the long term without reducing patient transport requests over time. As early as 2012, several systems and administrators knew that the implementation of IMHC would be paramount to solving many pressing EMS healthcare issues as well as improving general community healthcare. "Mobile Integrated Healthcare Practice: A Healthcare Delivery Strategy to Improve Access, Outcomes, and Value" evaluates several pieces of IMHC practice as a community healthcare initiative that can act as a stop-gap between the high cost of non-emergency EMS care and need for community based healthcare initiative (Beck, Craig, Beeson, & et.al, 2012).

Beck et.al, state that patient care should be patient-centered and should combine existing EMS systems with healthcare innovations to bring care directly to the patient without transport based on a specific population's needs. This care should be available 24 hours a day and use varied, multi-disciplinary teams to develop care plans. By using currently integrated communication capabilities, such as tele-medicine, maintaining broad medical control oversight and using continuous quality management and improvement measures, IMHC could successfully fill the role of a stop-gap (Beck, Craig, Beeson, & et.al, 2012).

Within the scope of the Maine system, Beck et.al's assertions provide clarity regardless of the system's implementation catalyst. IMHC programs should establish a patient-centric, cost-effective partnership between healthcare systems that deliver competent, evidence-based practice in a technologically advanced and financially stable way. Maine corrects this issue by prophylactically visiting patients in their home environment *before* they make a call for transport services (St. Germain, 2017). In preventing a request for transport, operational surges therefore reduce, and fiscal costs reduce as well. One EMS provider can visit a patient instead of a crew of two; this automatically reduces direct payroll costs. A provider does not need to use an ambulance and can use a smaller, more cost-effective transportation source to move to and from patient locations. These savings, even without saving from the prevention of hospitalization, can be enough to impact a system.

The 2016 "Mobile Integrated Health Care and Community Paramedicine: An Emerging Emergency Medical Services Concept" further expands upon Beck et.al's assertions. In a physician-driven position paper on the advent of Integrated Mobile HealthCare, Choi et.al (2016) assert that community-centered EMS models such as IMHC are models of healthcare delivery that use EMS to supplement healthcare infrastructure, stating:

> *Currently, there are few studies of the efficacy, safety, and cost-effectiveness of mobile integrated healthcare and community paramedicine programs… Additional studies are needed to support the clinical and economic benefit of mobile integrated healthcare and community paramedicine* (Choi, Blumberg, & Williams, 2016, p. 1).

In the above quotation, Beck et.al. establish that while previous postulations have been made about how medical care needs to have a stronger community base that is grounded in efficiency and fiscal responsibility, there has currently not been a large-scale state-wide system by which to evaluate the fiscal and community impacts of EMS implementation of an IMHC program. The rationale for this proposal is based on the need to evaluate a large scale IMHC program as it applies to community responsive, fiscally responsible care.

So, looking at patient call reduction, operational costs and fiscal liabilities, has there been an evaluation of how fiscal, operational, and patient transports request savings modalities interconnect? In short, there have been some evaluations, but not any with well-rounded depth. In 2013, Minnesota was the first state to integrate Medicaid partners by creating their version of IMHC in the form of an Integrated Health Partnership (IHP initiative) to prevent ED transport and deliver healthcare at a lower cost (EMS World Staff, 2014). While the program has been in operation for several years, there is no data on actual savings or enrollment figures.

Other systems, attempting to emulate collections similar to North Carolina's, aren't producing sample size evaluations that can prove overall reliability. As discussed in the *Journal of HealthCare for the Poor and Underserved*, the authors compiled their own list of CP programs in the US as of December 2014, since there is no comprehensive list available (Patterson, Coulthard, Garberson, & Wingrove, 2016, p. 153). The Southwest Texas Regional Advisory Council (STRAC) produced a conference document in 2018 based on Canyon Lake Fire/EMS MIH[9] (Southeast Texas Regional Advisory Council, 2018). This study used a sample size of 319 calls for service that *would* have been made by 55 patients involved in MIH. While STRAC used financial data to assume that the Canyon Lake Service saved $145,811.49 as a result of MIH, there is no concrete fact or *record* of these savings. Further it was noted that data relied heavily on self-reporting and were not subject to rigorous evaluation. Patterson et. al pose yet another point; data collection is not uniform or standardized- how can it be validated?

2.4 Summary of Operational and Fiscal and Patient Reductions

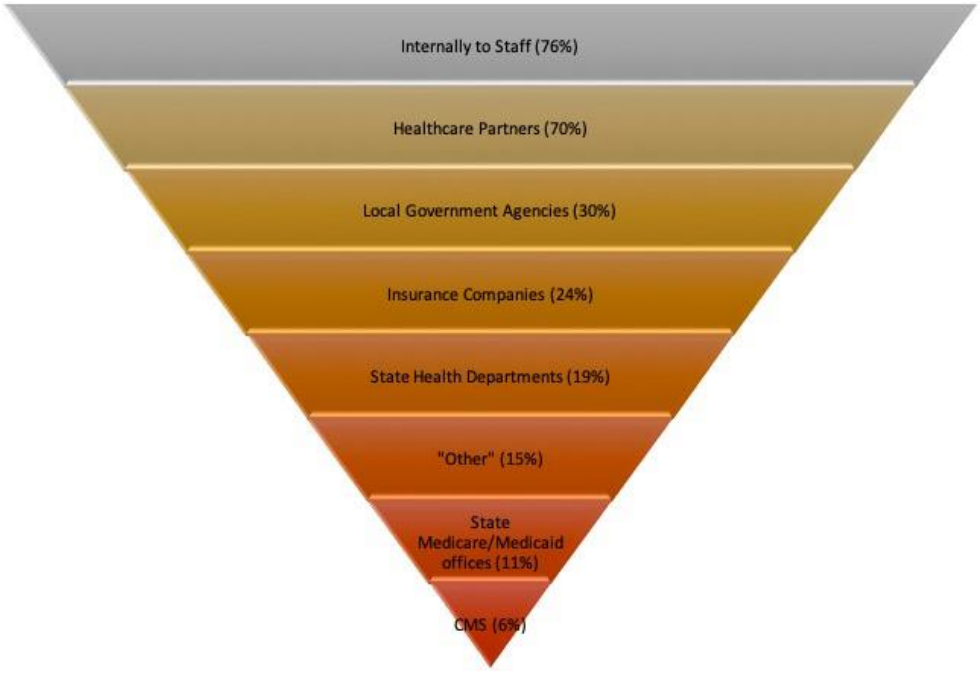
Looking at sub chapters 2.1, 2.2 and 2.3 individually, there is sufficient evidence to support further IMHC research and its potential benefit to the pre-

[9] Mobile Integrated Healthcare, abbreviated differently by this committee

hospital and emergency healthcare system. But, despite literature addressing each research idea individually, as this dissertation neared completion, The National Association of EMTs (NAEMT) published results of a survey in 2018 addressing some of these issues. This survey did not specifically address data on state-wide programs, but it did provide several points of note (National Association of EMTs, 2018).

NAEMT reports that 129 programs responded to their survey (70% using CP and 30% using MIH as the program nomenclature) in 33 states and the District of Columbia (National Association of EMTs, 2018, p. 6). Additionally, the survey results indicate that system data is gathered as illustrated below:

Graphic Representation of the NAEMT Report



In the graphic, ‘other’ represents grant agencies or research agencies with which the agency may be working. It is even more important, however, to note that 24% of all agencies do not report results to their own staff and better than 69% of all agencies do not report data outside of their own healthcare system. (National Association of EMTs, 2018). This information is important to note, as it shows a problem not only with IMHC data sharing but illustrates an inherent

problem in EMS data as a whole - information sharing. While health care privacy is of paramount concern, blinded data and raw numbers should be shared and published to bolster or dissuade systems from pursing alternatives to care.

NAEMT asserts that "88% (of IMHC Administrators) agree that their program is data-driven, and data is collected to measure the program's performance over time" (National Registry of Emergency Medical Technicians, 2018, p. 26). It is interesting to note, however, that based on the information provided, only 7% of systems would be collecting data about surge reduction and in most cases, data is not being shared with agencies apart from those who have direct patient care partnerships with the IMHC system. This creates a cooperative quagmire; a fine line between proprietary system data and the greater public health. This also provides support for the benefits of a state wide, legislatively sanctioned IMHC/CP program administered and approved at the state level. At the state level, staff, partners, local and state government, state Medicare and Medicaid offices and CMS would have ready access to the information provided in a state governed, quality-improvement-monitored format.

The overall rationale for the practice of IMHC is fiscal operational and patient request reduction in non-emergency pre-hospital care and in prevention. The next sub-chapter will focus on the summary of the literature and provide a summative rationale for the provision of IMHC.

2.5 Evidence rationale

As the literature emphasizes a need for implementation of a well-formed, patient-centered, successful community-based pre-hospital system, and given that systems need to keep reliable data, the basis by which the Maine IMHC protocols and programs should be evaluated is firmly established. The literature shows a definite need, a well-defined path, and a shortage of study-based information on the implementation of IMHC programs, especially those rooted in state oversight. It also shows a reluctance to share the data provided, despite its potential benefits of doing so.

The literature shows a clear picture of the rising expenses of all healthcare–not simply the cost of in-hospital or prehospital services–and illustrates how reductions in spending and overall efficiency can improve patient care in addition to saving money (Choi, Blumberg, & Williams, 2016). Second, the literature reviewed in this study outlines the potential benefits of IMHC community healthcare in reducing these costs. By overlaying these assertions on a common healthcare theoretical model; a plan and schematic for an overall reduction of cost can be discussed and researched.

Maine's IMHC program was studied using actual call numbers with the intent to perform systematic evaluation of statistical significance (or lack thereof) within the system. Using real data, as opposed to estimates, and evaluating how individual systems were impacted was vital considering the breadth of population variance (rural, urban, suburban) in a state the size of Maine. If state-wide systems are to have a standard of evaluation in the future, data should be shared with other agencies both to prevent repetition and to avoid pratfalls in system set up that have already been addressed and possibly avoided. Looking at the US IMHC time line is an excellent launching point for any system, if not for the potential speed of the process, but then for the progression of legislation and implementation.

2.6 Timeline

Previous subchapters have discussed fiscal, operational and patient request reduction but further information is needed to support a finite timeline of IMHC/CP's creation and beginnings and to understand the progression of this innovative form of pre-hospital care especially given that discussion or research of IMHC can seem like an overwhelming conglomeration of acronyms and overlaps. In an effort to make both the research and the literature review more digestible, a timeline was created in an effort to facilitate clarity.

In the US, the first iteration of any sort of EMS based community care was documented in 1993. According to Kurt Krumperman, the US General

Accounting Office reported on a program in Alaska that wanted to use paramedics and community health aides (non-physician) to provide immunizations and screen those with chronic health conditions. Then, in 1996 and 1997, Orange County, North Carolina and the state of Idaho respectively, allowed for low-acuity patients to be treated and referred or transported to a primary care provider (Krumperman, 2010).

Krumperman enforces the core tenant of IMHC practice from the provider-based level; paramedics already have the skills to be considered public health workers and in times of need, paramedics have been brought forward to act as a stop-gap. If paramedics can function in this manner with their current curricular training, then why can't this same function be a part of the potential daily role of a paramedic provider? This question stagnated for several years.

Then, in 2002, when specialty care transport (SCT) was created in the Medicare fee schedule, CP/IMHC's seed began to sprout. It is important to understand that while SCT was acknowledged by CMS, CMS would not discuss "treat and release" services under this payment modality; but even in the lacking discussion, the idea emerged that IMHC information and implementation needed to be collected and improved upon by willing and innovative legislators and providers.

In 2007, two significant movements pushed IMHC forward. First, the Institute of Medicine (IOM) made recommendations to CMS to reevaluate treat and release EMS programs but CMS refused (Krumperman, 2010). At the same time, in a conversation among EMS officials in Lincoln, Nebraska the term "Community Paramedicine" was adopted to discuss the pre-hospital treat and (potentially) release model of CP (IMHC) known today (Raynovich, Nollette, Wingrove, Wilcox, & Mattera, 2018).

In 2008, the IOM recommendations from 2007 were readdressed by the National EMS Advisory Council (NEMSAC) and the Federal Interagency Committee on EMS (FICEMS) in an attempt to address funding to extend the reach for IMHC services. CMS denied this request (Krumperman, 2010). In 2010, the ACA was enacted into law and created additional health system issues in

regard to insurance regulations and service availability. Perhaps in response to the ACA or perhaps due to other intra-system issues, in 2012, both the city of Chicago (Raynovich, Nollette, Wingrove, Wilcox, & Mattera, 2018) and the State of Maine (Bradshaw, 2013) initiated their respective IMHC projects.

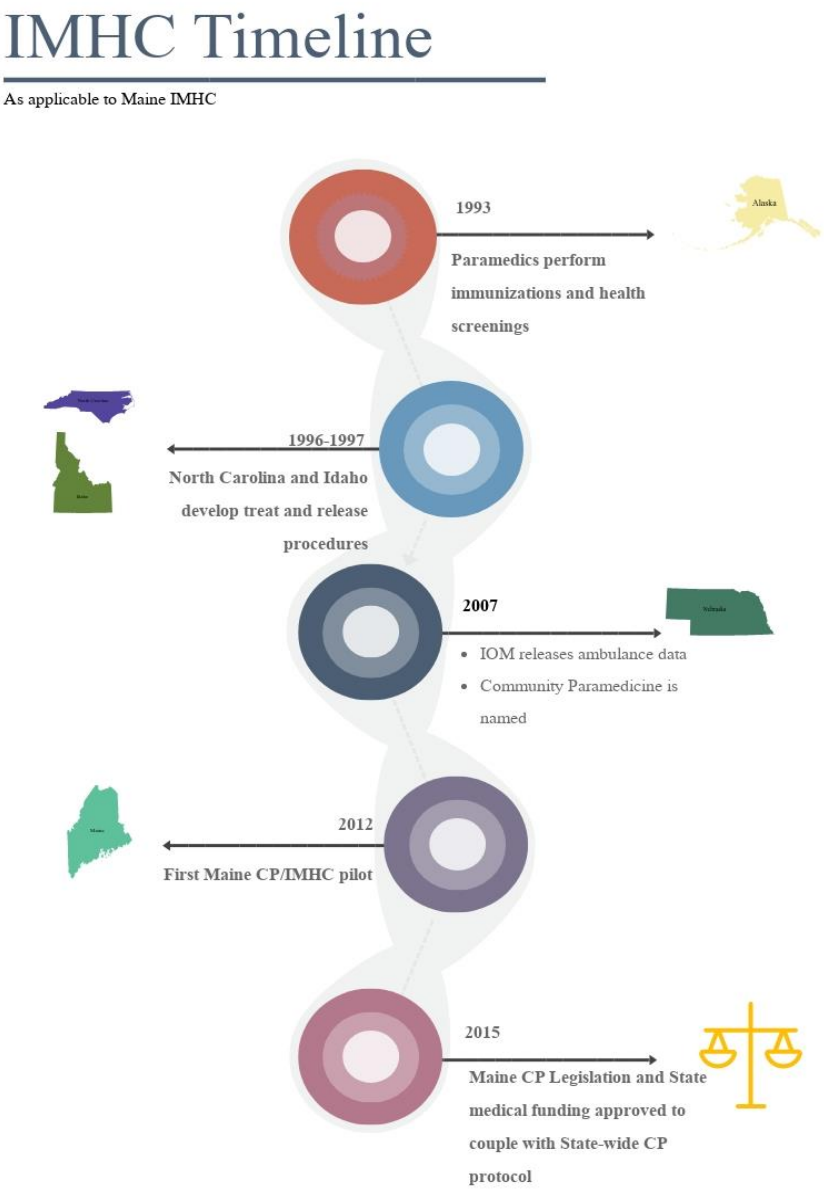
In Maine, there were initially two pilot services: Delta Ambulance and Northeast Mobile Health, with seven other ambulance services (St. George, Camden, United, Calais, Mayo, Searsport, and Crown) providing letters of interest to the state of Maine as required by the state's system -wide protocol, (Bradshaw, 2013). At this point, in 2012/2013, however, there was no state-wide legislation approving IMHC from an approved funding perspective by the State of Maine. All nine of these services would go on to on to be IMHC providers in Maine, entering at different times. Exact dates of entry into the provision of IMHC service for each participating ambulance system varied and tracking was not compulsory except in the completion of the stated patient care report (PCR) system. In fact, quality assurance (QA) and continuous quality improvement (CQI) processes were and remain primarily an internal function of a service rather than of the state (Nangle, 2017). As mentioned in subchapter 2.4, however, since this program had state initiatives and funding, the data was part of informational freedom and data could be collected and processed.

In 2014, the National Fire Protection Association, an organization creating policy for fire service systems and therefore having an interest in systems participating in fire-based EMS, convened their Technical Committee on EMS to discuss mobile integrated health and community paramedicine (MIH-CP). This push toward regulation was withdrawn, but later reinstituted in 2017 (National Fire Protection Association, 2017).

In 2015, Maine saw the official approval of all nine CP/ IMHC providers mentioned above. To add to the complexity of data collection and tabulation, in the middle of the CP pilot, Maine switched patient care report systems; the old vendor's data was archived in such a way that historic data was not readily available. Because of this, coupled with the CP program actually functioning as intended during 2015, and given that the data would be most accurate in this

period it was suggested that 2015 be considered the benchmark start of the data collection period (with 2013/14 and 2014/15 as the two years preceding and 2015/16 and 2016/17 being the two years afterward for consideration of pilot data) (Nangle, 2017).

Lastly, in 2017, two significant benchmarks in CP occurred. First, the International Association of Fire Chiefs (IAFC) published *Mobile Integrated Healthcare Handbook* as a guide to fire-based systems who need a step-by-step IMHC implementation system (International Association of Fire Chiefs, 2017). While it has been stated that fire-based systems aren't addressed in this research, the IAFC has a strong lobbying body and their opinion does influence national EMS care. At this same time, Maine became state-insurance funded, completing the Maine circle of implementation and endorsement of CP by the legislature (128th Maine Legislature, 2017). An illustrative timeline can be seen below.



List source

The timeline illustrates the 22 year move forward from EMS providers accessing public health procedures to provide immunizations through the state legislated protocols available to providers in Maine. But not Maine, nor even the United States, are the only jurisdictions that decided that IMHC might be a good way to promote public health and awareness and reduce the fiscal operational and patient requests for non-emergency prehospital services. The next sub-chapter evaluates IMHC in its world view and application.

2.7 World View

Previous sub chapters have led to the need to discuss IMHC on the world-wide level. Regardless of the set-up of a health care system, responsible application of resources, both fiscal and operational, are vital to not only the provision of care today but the continuance of care in the future. There is more to community-based medicine than just that which is practiced in the US. In discussing IMHC, it is important to look at the world view on EMS providing public healthcare, as the US models are neither the first to use the idea of community care, nor is the US model the only model in existence.

In British Columbia, Canada, IMHC providers service rural areas, providing preventive health measures and health promotion activities (Hilton, 2018). A 2018 article in Medscape states "Community paramedic programs have been associated with fewer emergency department admissions, EMS transports, and hospital admissions, as well as improved quality of life and healthcare outcomes in patients with chronic medical conditions" (Hilton, 2018, p. 2).

Further, EMS delivery systems in the United Kingdom (UK) and former UK holdings (such as Australia) have been augmented as recently as 2015 with the Emergency Care Practitioner designation. The UK determined that about 50% of patients transported to the emergency department were discharged without substantial treatments (Al-Shaqsi, 2011). Consequently, the National Health Service (NHS) created the Emergency Care Practitioner (ECP) to increase the percentage of patients treated in a community setting or at the scene of an incident and to reduce unnecessary transport (Al-Shaqsi, 2011). This outcome has been successful. Unfortunately, as of 2015, both the UK and Australia use a model of "extended-care practitioner". While this is a similar concept to CP, the main criticism is that it "focuses exclusively on emergency department avoidance" (O'Meara, 2015, p. 1). This unidirectional practice may be the result of a more robust socialized healthcare system in these countries or may be simply modeled specifically for ED patient reduction. This practice needed more research in the US model of IMHC state-wide systems.

Given that the US EMS system follows the same Anglo-American based system as the UK and much of Europe and Canada (Walz & Zigmont, 2017); the system that works in the UK, Europe and Canada would theoretically have an excellent chance at excelling if tailored to the US population. The European and Canadian models in Wales, London, Scandinavia and Nova Scotia have shown fiscal prudence, operational efficiency, and patient-centric care: the items key to the US IMHC research question and the subject of this IMHC evaluation.

Taking US policy and world systems into consideration, the methods and standards for analysis of an IMHC program needed to be carefully crafted. Before data for this study was gathered, there appeared to be success within the program in Maine, but to truly evaluate a system before and after implementation of an EMS system, theoretical models needed to be carefully selected, and methods of statistical analysis chosen to create accurate, digestible datasets. Rationale for these methods, models and analysis are found in the methodology chapter of this study.

2.8 Conclusion

As discussed in the introduction of this chapter, a review of the stopgap methods to prevent this public health issue is necessary. IMHC has been developed to act as both a preventive and a stopgap in the emergency healthcare system. This literature review evaluated previous commentaries and studies available in EMS research and showed EMS's current, potential and future impacts on cost reduction, surge reduction and patient request reduction in the emergency medical system. National and international studies were evaluated, and a timeline was created to assist in the understanding of the development of IMHC in the United States, considering both the public health uses of EMS in the recent past to the innovations in practice today. The next chapter will focus on the study rationale and theoretical model against which IMHC is evaluated in this study. Using previous literature as a guide, the models and foundations for the evaluation of a state-wide IMHC program are presented in preparation for the

results and analysis of the study in an effort to provide a linear construct of presentation.

Chapter 3: Methods and Rationale

In previous chapters, IMHC was outlined as a potential stopgap method to prevent the public health issue of non-emergency requests for ambulance transport and for the care of the recently discharged patient in an effort to prevent readmission to the hospital. The literature review evaluated previous commentaries and studies available in the limited EMS research and showed EMS's current, potential and future impacts on cost reduction, surge reduction and patient request reduction in the emergency medical system. National and international studies and a timeline was provided to assist in the understanding of the development of IMHC in the United States. This chapter will focus on the study rationale and theoretical model against which IMHC is evaluated in this study. Using previous literature as a guide, the models and foundations for the evaluation of a state-wide IMHC program are presented in preparation for the results and analysis of the study in an effort to provide a linear process.

3.2 Theoretical Model

To evaluate success, internationally or domestically, a system participating in an integrated mobile healthcare program should be evaluated within the construct of an accepted healthcare utilization model. Unfortunately, EMS research is neither as robust, nor as frequently conducted, as medical research in similar disciplines. In spite of thorough investigation, there does not seem to be a theoretical or conceptual model that could be found to specifically address EMS research. Therefore, for this study, Anderson's Health Utilization Model (AHUM) will be the basis of the evaluation.

The AHUM was published in 1974 by Ronald Anderson and John Newman and is a theoretical framework for viewing health services utilization. Anderson and Newman's work:

> *emphasizes the importance of (1) characteristics of the health services delivery system (2) changes in medical technology and social norms relating to the definition and treatment of illness, and (3) individual*

> *determinants of utilization. These three factors are specified within the context of their impact on healthcare systems*, (Anderson & Newman, 1974, p. 1)

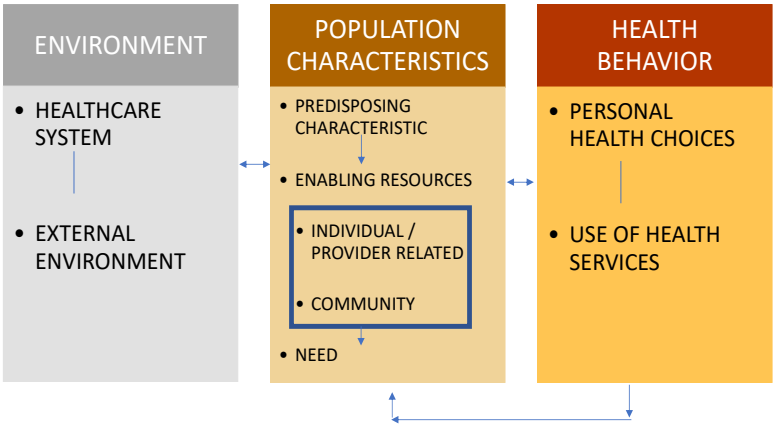
Anderson revisited his AHUM design in 2007 and asserted that AHUM evaluates a system by looking at the external environment, predisposing characteristics, enabling resources, need and or use of services, and outcomes (Anderson, 2007). Community healthcare provision by EMS certainly fits this theoretical model. The integrated mobile healthcare model is intended to reduce the utilization of both prehospital and emergency department care based on a determination of needs (by social and economic distribution) to improve outcomes and reduce costs. For this study, the AHUM is the most appropriate healthcare model by which to evaluate IMHC because it is the only model applicable to prehospital care and it appears that there have been no innovations in healthcare theoretical models since Anderson[10].

Anderson and IMHC fit well together. Anderson stresses environment and enabling factors to using healthcare; IMHC strives to decrease inappropriate/or optimize appropriate emergency health systems use by implementing policies that optimize the distribution of prehospital services via the identification of innovative methods utilizing paramedicine with the intent of reducing costs and improving patient outcomes.

[10] Considering the integrated healthcare models that would be available and applicable for health promotion where disease prevention is mostly psychologically-based, such as the trans-theoretical models of social cognitive theory and theory of reasoned action/planned behavior, Anderson provides the only tangible, concrete, empirically tested model applicable to integrated healthcare.

Figure 1

THE ANDERSON HEALTHCARE UTILIZATION MODEL



(Anderson R. M., 1995)

Figure 1 illustrates the algorithmic nature of the AHUM. Patient environment requires access to systems. Then, the patient has medical characteristics and a community that provides access to the healthcare system. Next, the patient makes choices based on available resources as to how to enter the medical system. The AHUM requires an assessment of the enabling and need factors of the patient; in the case of IMHC, patients may have limited access to primary care, limited access to funding, may be ignorant of the options available, or may merely be enticed by the ease of access to medical care initiated by dialing 911.

Using a hypothetical patient example, a walk-through of the AHUM can provide a clearer explanation. A 52-year-old patient with congestive heart failure (CHF) lives in a rural environment. His Primary Care Provider (PCP) has an office fifteen miles away that is not available by public transportation. The local hospital is twenty miles away and is also unavailable by public transportation. There are no other healthcare entities that are closer than the PCP and the hospital. The patient is on a fixed income with no local family and can only

occasionally drive when he is feeling well. This scenario illustrates the patient's ENVIRONMENT: his *healthcare system* and the parameters of his living situation.

Next, we can look at POPULATION CHARATERISTICS. CHF is a chronic condition that is often difficult to manage. Many of the pharmaceuticals given to treat CHF need constant monitoring and supervision. Failure to comply, even for a day, with the prescribed therapy(ies) can create a life-threatening issue. CHF and the complexity involved with the management of CHF, coupled with the distance to care are *predisposing characteristics*. The patient's insurance does not approve home care visits because the patient is normally able to care for himself and he can drive, creating an *enabling resource*. Without driving, though, the only way to travel for medical care is via local ambulance. His local ambulance, without IMHC, cannot treat and release and will transport the patient to the emergency department. This creates the *individual and community role*. Finally, the patient does have CHF, so he fulfills the final characteristic: *need*.

The HEALTH BEHAVIOR of the patient is difficult to empirically define. Perhaps the patient gets sick with an illness that exacerbates his CHF. Perhaps he has another injury. Perhaps he is apathetic. Perhaps he does not have the finances to see his primary care physician or pay for his medication (or feel up to driving to get his medication) and pay a co-pay but knows the hospital does not require up-front payment. In any of these cases he can activate the 911 services for transport. On the other end of the IMHC spectrum, perhaps the patient has just been discharged and has not had the opportunity to access follow up care, getting worse and requiring rehospitalization. These are examples of *healthcare choices* and *use of health services.*

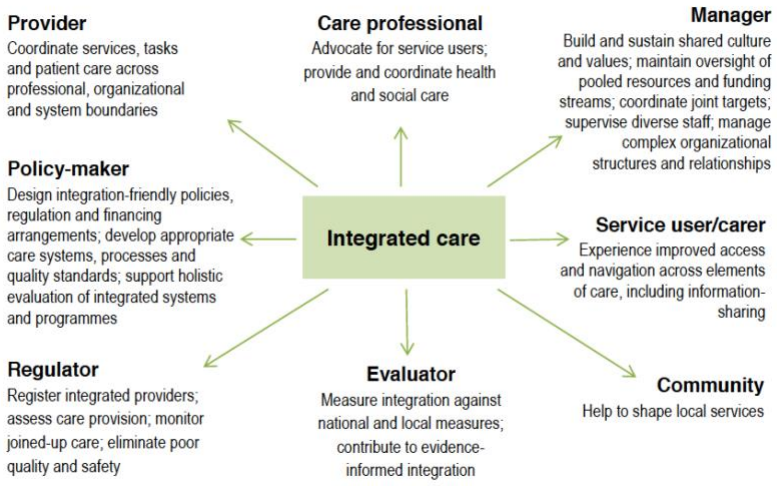
3.2 Why Anderson?

Anderson's model considers service delivery, technology and directives to the individual; but it certainly doesn't fit the needs of EMS and IMHC exactly. In this case, it is important to understand why Anderson's model was chosen.

Several other, more recent theoretical models were considered before AHUM was chosen as the final fit, including the World Health Organization's (WHO) Integrated Care Models and the Acceptability Model.

3.2.1 The WHO model

The WHO published a "working document" in 2016 titled *Integrated care models: an overview* (World Health Organization, 2016). In this document, the WHO does address the integration of care, and the different taxonomies of integration: organizational, functional, service, and clinical (World Health Organization, 2016, p. 5). Organizational brings together several entities, functional integrates electronic patient records and billing practices, service discusses organizational clinical offerings, and clinical refers to shared guidelines and protocols (World Health Organization, 2016). At first examination, this seems like an excellent operational model against which to evaluate IMHC. The problem with the WHO model, however, is that it focuses on aspects that are still missing from the IMHC provision in the US. It assumes one organization can handle all of the care a patient needs, which IMHC cannot in its current form, and it focuses on back-of-the-house functionality such as medical records in addition to simple patient care reports. EMS does not generally handle care or reports with this depth. An illustration of the WHO model is provided below:

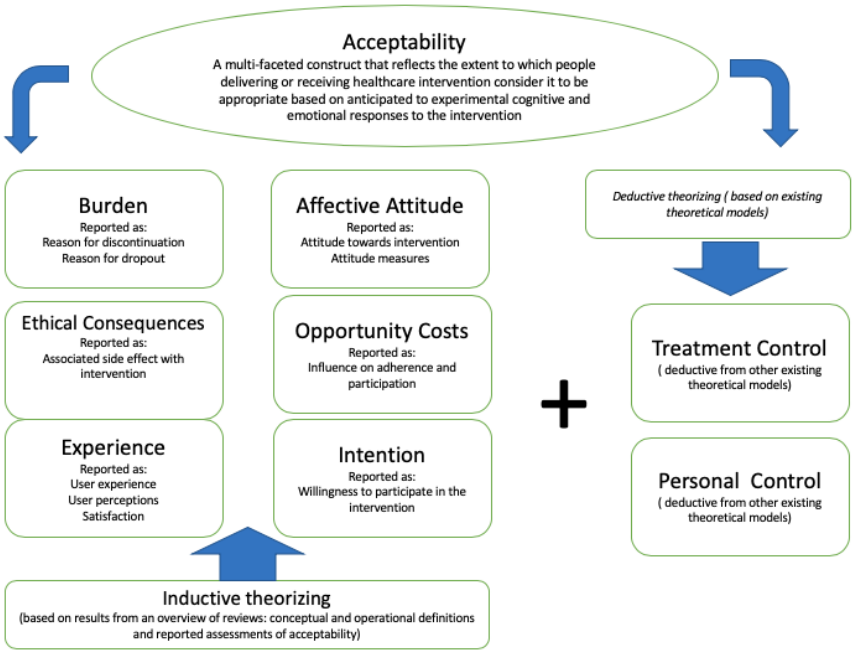


(World Health Organization, 2016, p. 3)

While the WHO model is a lofty goal, it is beyond the current scope of IMHC, and does not fit the realities of the US healthcare system's disarticulated components

3.2.2 Acceptability Model

Unlike both the AHUM and the WHO models, the Acceptability model doesn't deal with the environment of care so much as the pathways surrounding the given care. The acceptability model was an attempt by several researchers to develop a model that used inductive and deductive reasoning to look at behavior, affect, and cognition (e.g. dropouts, feelings and perception, respectively) to query clinicians giving and patients receiving care (Sekon, Cartwright, & Francis, 2017). An example of the framework is pictured below:



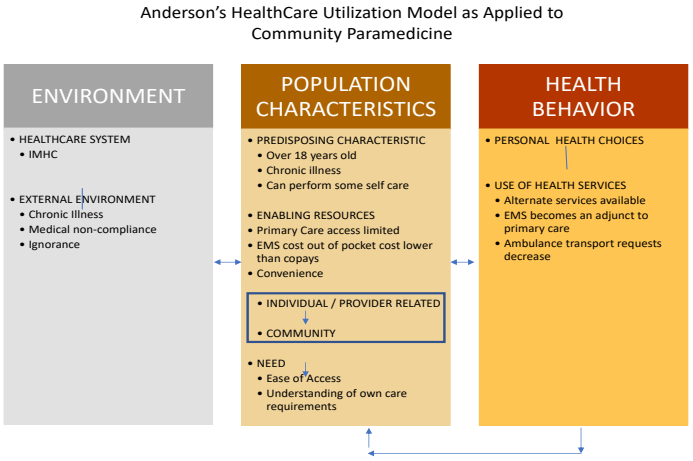
Adapted from (Sekon, Cartwright, & Francis, 2017, p. 5)

While this model carried a multifaceted approach joining both clinician and patient opinions, the lack of concrete evaluations made it a poor choice for IMHC research. Without the ability to use quantitative data, opinion based qualitative assertions (such as influence and attitude) could be valuable, but not empirical.

3.2.3 Anderson as a best option

Given that no one model was a good fit, even models that address care acceptability and those that address healthcare integration, the long-standing model of Anderson seems a best fit. This does not mean that the model was without need of some adjustment before it could be applied soundly. If IMHC is to be evaluated within the scope of the Anderson model, the characteristics of the IMHC system must be applied to the original Anderson Model using predisposition, resources and need as a guide to IMHC application. As illustrated in Figure 1, the AHUM application looks at external influences and the predisposition of the patients. In the area of IMHC, this translates to adult patients with at least a limited capacity for self-care, have chronic illness(es) requiring ongoing care, and may or may not be aware of the medical services available to them (Figure 2).

Figure 2



Adapted from… citation

The AHUM format also can address potential of IMHC to reduce fiscal cost. First, by taking into consideration the predisposing characteristics and enabling resources of patients, such as lack of access to a primary care physician or to those patients with uncontrolled illnesses who, despite access to a physician

may have a difficult time managing their condition, IMHC is related to the third criteria modality of the AHUM: Health Behavior. IMHC looks to address patients' personal health choices, in an effort to provide treatment in the home to patients who may not have the ability to pay for hospitalization or ambulance transport to a hospital. Given that health behaviors and choices have a fiscal impact, these behaviors directly impact the system in cost-per service. Additionally, if these patients can be treated in the home (or the residence, if the patient is a resident of assisted care or skilled nursing care[11]), the personal impact to the patient, not to mention the cost to the patients' insurance carrier, could be reduced.

Second, the AHUM addresses the question of operational surge and requests for care by a two-fold process in addressing the AHUM model of Environment and of Health Behavior. The environment is addressed by AHUM in the terms of the health system itself- the availability of services available to the patient. IMHC provides an additional mode of service for patients beyond traditional home care; IMHC adds a preventative component. Whereas home health nursing care addresses a patient's needs after the patient enters the system, IMHC seeks out frequent users of the emergency medical system and seeks to minimize their requesting or ultimately requiring EMS care, in turn preventing EMS from experiencing operational surges in terms of injuries or illnesses that can be managed in the home. Then IMHC further addresses the AHUM model's area of Health Behavior. Whereas the patient retains the freedom of choice as to whether or not to use IMHC services, IHMC seeks to widen the availability of patient choices to access health services. IMHC, therefore, has the potential to not only increase a patient's access to health care, but also provides education as to many healthcare processes. In this way, patients may be more educated as to

[11] The CMS manual Pub 100-07 transmittal 97, Item 7014.1.1 states: "The requirements for long-term care facilities require that a skilled nursing facility provide 24-hour licensed nursing services, an RN for 8 consecutive hours a day, 7 days a week (more than 40 hours a week), and that there be an RN designated as Director of Nursing on a full time basis". This means that services that require RN skills such as IV therapy etc. may not be available on weekends or evenings at a skilled facility and therefore may not be immediately available to patients regardless of the skilled care moniker**Invalid source specified.**

when to access the emergency system, and requests for care of an operational nature could be reduced, thus also reducing operational surges (an unexpected or unplanned increase in demand that tax and or overwhelm a system) in the process.

Lastly, AHUM is designed to look at the outcomes of a system; in the case of IMHC, when all of the conditions are met to adequately support an IMHC system, EMS can become an adjunct to primary care. In other words, primary, or preventative care, can be augmented with the help of EMS providers who can evaluate a greater number of patients with greater frequency, than could a small group of physicians. It is essential to understand, however, that acting as an adjunct to primary care can either have appropriate outcomes that reduce healthcare burdens and spending or detrimental outcomes that increase call volume and overall spending. In theory, when properly created and utilized, IMHC can create fiscally and operationally responsible outcomes within a given operational status. In other words, evaluations of these systems should determine if the spending and response profiles under which a service is working are the best profiles given the current circumstances.

There are essentially six policy purposes of Anderson's model (Figure 3), each of which can be applied to an IMHC system, (Anderson R. M., 1995). These can be divided into two of the research topics: operational surge and requests for care.

Figure 3- Anderson's six policy purposes

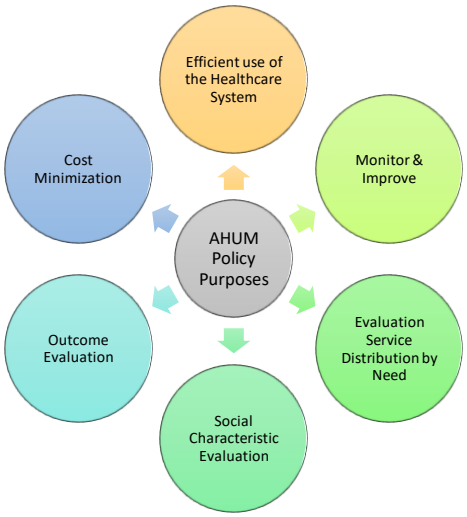


Figure 3 acts as a visual representation of the AHUM and can be applied to IMHC. IMHC strives for cost minimization- both to the patient and to the healthcare service provider. IMHC attempts to streamline the efficiency and effectiveness of a patient's access to healthcare. IMHC is monitored clinically and systemically for positive impact. IMHC is need driven. IMHC acts with the of goal changing the social characteristics of EMS activation for non-emergency or preventable medical care. Finally, IMHC is under constant evaluation.

How does IMHC meet the goal of the AHUM? First, the AHUM evaluates the increase or decrease in health services use. For the purposes of IMHC, the AHUM is intended to decrease ambulance transports without decreasing patient access to healthcare. IMHC can reduce EMS surges in this way; if properly implemented, patients may be evaluated and treated at home instead of receiving transport to the emergency department. The second purpose is to monitor and evaluate policies that influence health services' use. IMHC data can indicate how many patients are seeking out healthcare services, or which patients need advanced medical follow up. This data can then launch a proactive approach seeking out those who need healthcare but do not need the care provided

in an emergency environment, thus reducing requests for care that cause operational surges.

Third, the model can be used to ensure health services distribution is determined by need; IMHC addresses the distribution of prehospital services to accommodate non-emergency and emergency situations. Fourth, the AHUM attempts to illustrate how to reduce the influence of social characteristics and enabling resources on health services distribution. While IMHC cannot influence the social characteristics of illness, it can reduce enabling resources for calling an ambulance for non-emergency services. AHUM evaluates how a system improves the outcomes (health status, satisfaction, and quality-of-life) from health services use as its fifth goal. These goals draw back to the literature that postulate IMHC could serve as a stop gap, (Beck, Craig, Beeson, & et.al, 2012). IMHC should not serve to limit public access to EMS, rather it should assist in the reduction of patients accessing emergency services for non-emergency issues. Simply put, IMHC increases the access to in- home healthcare, thus reducing patient requests for transport to emergency care, and thus potentially reducing operational surges.

Finally, the model draws assertions as to how to minimize the cost of enhancing outcomes for health services use, a wide-reaching purpose for IMHC (Anderson & Newman, 1974). By using the modified AHUM in Figure 2 to evaluate the stop gap-capabilities (the outcome where EMS becomes an augmentation to primary care), fiscal value in the form of reduced fiscal cost and community health basis of IMHC (where cost and access are a driving force), the data contributed by Maine could support the creation of additional programs across the United States in an effort to offer an alternative to emergency EMS response for non-emergency patients.

The intent, therefore, of this quantitative study is to examine whether or not there are statistically significant impacts to EMS operations (in term of changes in call volume), within the pilot of the state-wide CP project in Maine. This evaluation aims to analyze aggregate call volume data and CMS-associated payout gains or losses by pilot-participating EMS services between the two years before and the two years after initial implementation of Maine's community

paramedicine protocol (2013-2015 and 2015-2016). [12] EMS systems evaluated will have had to participate in the IMHC pilot for at least 12 months, participate in Medicare reimbursement, charge for EMS services and charge for IMHC services. Therefore, after discussion with the Maine EMS system's data and preparedness coordinator, 2015 was determined to be the appropriate starting year.[13] Fiscal impacts will be represented by predicted service volumes and the cost and/or revenue impacts on emergency departments and EMS systems based on standard rates and are not based on validated data from individual systems or healthcare facilities, due to lack of the availability of consistent and reliable data.

By using the AHUM criteria to evaluate IMHC, the hypothesis and research design of this study were created to look at an IMHC program in a statewide, state protocol driven system. The next subchapter details the hypothesis and research design for this study.

3.3 Hypothesis and Research Design

After reviewing several research models and finding that the AHUM was the best theoretical framework with which to evaluate IMHC programs, hypotheses and research design creation was vital to the study. To evaluate the capabilities, and potential outcomes of implementing an integrated mobile healthcare program in other jurisdictions of the United States, an evaluation of a functioning statewide program was conducted. When this research project began, Maine was the only state with a state-wide protocol. Wisconsin adopted a state-wide protocol system in early 2018, and a brief description of their system can be found in the appendix for reference.

[12] As addressed in the time line, while approval began in 2012, the "ramp up" considerations of the program, coupled with the suggestions of Mr. Nagle, supplied rationale for the date ranges addressed.

[13] It is important to note that some services did not participate fully from 2013 to 2017. Data listed will be shown as aggregate and notations will be made for services who did not participate in the full cycle.

According the State of Maine's EMS Director, Shawn St. Germain, while there has been a position paper on the overall potential outcomes of the EMS pilot (Pearson and Shaler, 2015) there have not been formal, individualized, statistical analyses performed for research purposes with the aggregate data regarding operational impacts; hence, for this evaluation, quantitative factors impacting both patient requests for service and cost of service were considered (St. Germain, 2017). This research is evaluating data previously unevaluated for outcome results.

Pearson and Shaler, while providing insight into the system, focuses more on specifically rural systems, and implementation strategies in addition to looking at overall outcomes. The data is not specific to surge reduction and therefore, while similar, this study and the Muskie study have different foci (Pearson & Shaler, 2015).

Considering that patient centric care that reduces fiscal and operational surges is the main tenants of the study, the raw data from Maine provides insight into the healthcare/finance/operational correlations in participant programs in Maine.

3.3.1 Hypotheses

Given the previously mentioned ten goals of the ACA (quality for all, public programs, efficiency, prevention, increased primary provider workforce, program integration, innovation, community service, revenue provision, and strengthened healthcare) (University of Pittsburgh Medical Center, 2015), the research hypothesizes three main points regarding IMHC programs.

By implementing an IMHC program, a participating jurisdiction will:

Ha experience a reduction in patient requests for transport

Hb experience a reduction in operational surges experienced by participating services before implementation

Hc experience a reduction in fiscal loss experienced by participating services before implementation

These hypotheses are vital to IMHC evaluation for several reasons. If participating systems experience a reduction in requests for transport while experiencing an equal yet opposite rise in IMHC service requests, a conclusion can be draw that it is the IMHC requests that are reducing calls. If the volume of calls requesting transportation drops, the number of units available for calls for emergency care transport service therefore would increase.

To evaluate these hypotheses, data were exported from the reporting system (Image Trend) used by the State of Maine Emergency Medical Services department. Maine is the first state to pilot a statewide IMHC protocol and the pilot data set includes over 5000 patient encounters. These data are blinded, as per the regulations set forth by the Healthcare Information Privacy and Accountability Act (HIPAA) and additional regulations imposed by the state of Maine.

The following data were evaluated:

1. EMS Services participating in the pilot were identified
2. EMS Service data were gathered for two years before the start of the pilot and two years from the date of the pilot's inception[14]. These data include, but are not limited to:
    a. Monthly call volume
    b. Average reimbursement rates for the state of Maine by jurisdiction, for all six governmentally outlined call types

Figure 4 outlines the call types as identified by the CMS (Centers for Medicare and Medicaid Services, 2017). The call types were calculated by the CMS Ambulance Fee schedule for the rural rate that is established for the State of Maine. By using these classifications, accurate calculations regarding the fiscal impact of IMHC on a system were developed.

[14] Using the Maine suggested starting year.

Call types for Reimbursement Rate
Figure 4

Call type	Service	Emergency Life or Limb Threat?	Example
Basic Life Support (BLS)	Basic First aid services	NO	mild cold
Basic Life Support (BLS)- Emergency	Basic First aid services	YES	a broken bone decreasing circulation
Advanced Life Support (ALS) I	Advanced life support services requiring ECG monitoring and at least one advanced skill	NO	patient is dehydrated but hemodynamically stable
Advanced Life Support (ALS) I Emergency	Advanced life support services requiring ECG monitoring and at least one advanced skill	YES	patient is dehydrated but hemodynamically unstable
Advanced Life Support (ALS) II	Advanced life support services requiring ECG monitoring and at least two or more advanced skills	NO	a dehydrated diabetic who is light-headed with a cardiac history but stabilized with fluid and medication administration
Advanced Life Support (ALS) II Emergency	Advanced life support services requiring ECG monitoring and at least two or more advanced skill	YES	a dehydrated diabetic who is light-headed with a cardiac history but did not stabilize with fluid and medication administration

Source/citation needed

For research purposes, Maine Emergency Medical Services served as the system of investigation. The state of Maine was chosen for several reasons. Primarily, Maine was among the first states to recognize the importance of integrated mobile healthcare. Secondly, since their protocol is statewide, rather than based on the protocols of a single commercial entity or jurisdiction, their data should be more robust and result in rural, suburban, and urban data. These two items allowed providers in Maine, who operate(d) under the pilot to use existing training and skills coupled with any additional training required by a specific service to perform IMHC care.

Within the state of Maine, preliminary development of an integrated mobile healthcare program protocol on a state-wide basis, adopted by legislation in 2012, has garnered a mixed response. According to Shaun St. Germain, Director of Emergency Medical Services for Maine, while this pilot program of IMHC has been embraced by several entities, the evaluation of outcome data, and

therefore subsequent permanent adoption of an IMHC system, has not yet been performed and there was no methodology precedence set forth at the time of his interview (St. Germain, 2017).

3.3.2 Methods and Research Design

The state of Maine was chosen for this study because at the time of this research, Maine was the only state in the US to have a statewide integrated mobile healthcare protocol. Within emergency medical services, not all states have a singular protocol applicable to all regions. Despite the challenges presented by many medical situations, evaluating a state that carries a state-wide emergency medical services protocol allows validity to be more robustly controlled; this control is governed by the state for reporting purposes with a standardization of reporting, whereas individual services within other jurisdictions may or may not need to report data in a similar manner. Additionally, the populations served are those who would, according to Maine EMS data, use EMS as a primary source of medical care and for transport to a hospital or urgent care facility. Consequently, these populations fit the modified AHUM as illustrated in figure 2, that the population has a need, but may not have the education or access to properly seek out healthcare that is appropriate rather than merely convenient.

Independent variables

Independent variables include:

1. EMS Services providing integrated mobile healthcare within a region
2. the Medicare reimbursement rates within each region
3. the estimated cost of an ambulance transport within each region
4. the cost of integrated mobile healthcare generated by each patient receiving services

Dependent variables

Dependent variables include:

1. Call volume
2. Fiscal fluctuation

There is a specific rationale for each variable set. For the independent variables, not all agencies in Maine are required to participate in the IMHC pilot (St. Germain, 2017); however, the rate of reimbursement, the cost to run each call to the EMS and to each ambulance service in the program were averaged system wide and the geographic modifiers for the state have little variance for each program (Centers for Medicare and Medicaid Services, 2018). For the dependent variables, call volume and reimbursement, vary from service to service.

As illustrated in Figure 2, the modified AHUM requires evaluation of both these independent and dependent variables. The availability of IMHC services and the fiscal impact of ambulance transport address the need for AHUM; the independent variables address cost, while the dependent variables can address the potential savings in both transport manpower and monetary cost.

Since the hypotheses assert that patient transports will be reduced, decreasing fiscal loss and operational surges within participant EMS services, evaluation of independent variables is vital to the application of the AHUM. Since the overall goals of IMHC are to reduce the burden on EMS systems by reducing nonemergency transports while continuing to provide cost-effective patient care, both transport reduction and cost savings must be observed to consider IMHC successful. Though the AHUM logic of *environment-> predisposition-> behavior* can illustrate that EMS can act as appropriate augmentation to primary care by intervening at the point between characteristics and behavior, IMHC programs cannot be successful unless they illustrate a positive fiscal and operational impact. To evaluate the hypotheses, Maine data were evaluated using several statistical formulae as explained in the next chapter.

3.4 Statistical Analysis

To evaluate the data presented via ImageTrend reports from the Maine Office of EMS, a set plan of evaluation development is vital to investigative success. Given the aggregate data and the need to keep patient protected

information private, linear regression presented the most logical option for statistical analysis. Linear regression was chosen for this evaluation as best estimated corollaries between dependent and independent variables. Within linear regression, a difference-in-differences regression and a Fixed Effects regression were used. Using both difference-in-difference (DID) regressions and Fixed Effects regressions, the number of patients transported throughout IMHC implementation and the regional cost of services rendered based on the average reimbursement rates in Maine as published by CMS were evaluated. First, aggregate data regarding both IMHC and overall transport call volumes were collected by year. Then, using differential analysis and Fixed Effects evaluations, linear visual representations of the impact of IMHC were created.

3.5 Conclusion

This chapter discussed the AHUM theoretical model and its use in the creation of a research model, hypothesis and statistical analysis of data for this study of statewide IMHC practices. AHUM was discussed at length and discussion revealed why the AHUM was the best model for IMHC evaluation, both due to lack of other available appropriate models and because of its best fit. The WHO model for integrated healthcare and the Accountability model, both recent addition to healthcare theoretic models, were used as a comparison. Hypotheses for IMHC were discussed and the breakdown of the study was provided. The next chapter will discuss the data results based on these hypotheses and will provide analysis of the results.

Chapter 4: Results

In previous chapters, IMHC was defined as a potential stopgap for the overuse of EMS services as a substitute for primary medical care in populations where cost, access and/or availability to medical services was limited and to assist in the prevention of readmission to the hospital for chronic or difficult to manage conditions. The Anderson Healthcare Utilization Model (AHUM) was identified as the best framework by which to evaluate IMHC care and the AHUM was used to create hypotheses and develop appropriate statistical analyses for the evaluation of a statewide, state protocol driven system such as Maine. Maine was identified as the first statewide system to use IMHC and was identified as the systems for evaluation in this study. The purpose of this investigation was to consider the fiscal and operational impacts of implementing IMHC that services rural, suburban, and urban systems as an augmentation of an existing emergency medical service system. This chapter looks at the data through the lenses of regression analysis and fiscal impact within the parameters of the available data.

The state of Maine provided several key pieces of data to assist in the system of evaluation. The data from the Maine Office of Emergency Medical Services was provided in compliance with the Healthcare Information and Patient Accountability Act (HIPAA) and with the permission of the Director of the State Office of EMS, Mr. Shaun St. Germain. The data acquisition was reviewed and approved by the institutional review board (IRB) of the University of Baltimore.

The state of Maine uses ImageTrend patient care report (PCR) software to record all patient contacts, both emergency and nonemergency, performed by emergency medical services personnel in the state. Therefore, while the data was obtained directly from patient care reports, the data is subject to the limitations of human data entry errors. It is important to note, however, that the data used is the sole data available from the state of Maine and for any Maine service participating in either standard EMS services or IMHC services.

4.1 Individualized Data

4.1.1 Cohort

In 2015, Karen Pearson and George Shaler of the University of Southern Maine, Muskie School of Public Service published a report on staffing, training, funding, and sustainability of community paramedicine (CP)programs within the state of Maine, (Pearson & Shaler, 2015). The following chart from the Pearson and Shaler report outlines the CP cohort, the program's start date, and the activities performed within the provision of community paramedicine services.

Figure 5

Service	Affiliation	Start Date	Activities
Calais Fire and EMS Calais	Municipal (Fire-Rescue)	8/12/2013	In-home management of chronic diseases (CHF, COPD, hypertension); physical assessments/vital signs; medication reconciliation/compliance; home safety assessments, blood draws; 12-Lead EKG
Castine Fire Rescue Castine	Volunteer	8/1/2013	Focus on prevention; chronic disease management; monitor vital signs; home safety checks; medication reconciliation; diet/weight monitoring; wound care; other physician-directed care/treatment within the EMS scope of practice
Charles A Dean EMS Greenville	Hospital-based	10/1/2013	In-home management of chronic diseases (CHF, COPD/asthma, diabetes); medical assessments; wound care/assessment; medication reconciliation/compliance; home safety assessments, phlebotomy, blood glucose analysis; non-emergent cardiac monitoring and infusion maintenance. All within EMS scope of practice
Crown Ambulance Presque Isle	Hospital-based	5/12/2013	Chronic disease management/monitoring (diabetes, CHF, post MI conditions and other coronary syndromes; COPD/asthma); blood glucose testing; wound assessment; routine eye exams; draw labs as needed; weight monitoring;

			medication reconciliation; spirometry testing and management of O2 delivery services
Greater Kennebec (Delta/Winthrop EMS services) Augusta and Winthrop	Private EMS Service	3/18/2013	Address needs of recently discharged patients and recovering surgical patients; episodic assessment of patients with multiple comorbidities (i.e. CHF, COPD); weight/O2 saturation assessments; home safety assessments for at-risk patients; wound assessment
Lincoln County Healthcare*** Damariscotta, Boothbay Harbor and Waldoboro	Mix of hospital and healthcare system and 3 local EMS services	3/1/2014	Post-discharge services; monitoring of chronic illnesses (i.e. Diabetes, CHF); readmission preventions; wound care assessments; diagnostic testing
Mayo EMS Dover-Foxcroft	Hospital-based	10/1/2013	Address needs of cardiac (including post MI/cardiac rehab) and diabetic patients with routine screenings, ECGs, medication reconciliation; blood glucose measurements
NorthStar EMS Farmington	Hospital-based	11/1/2013	Reduce # of ER visits and hospital admissions by monitoring at- risk patients with multiple medical conditions; patient education; post-discharge surgical patients without home health services; home safety assessment; medication reconciliation; episodic assessments of weight, BP, oximetry, heart rate
North East Mobile Health Scarborough	Private EMS Service	6/1/2013	Fall risk assessment and trauma care follow-up
Searsport Searsport	Private EMS Service	12/26/2013	Develop and implement fall prevention program; facilitate immunization; track patients with chronic diseases (esp. diabetes); well-check visits and assessments as directed by physician

St. George EMS Tenants Harbor	Volunteer (some paid staff)	6/1/2013	Address identified community needs of diabetes, respiratory distress, hypertension, post-surgical/post discharge patients; blood draws; episodic assessment/care; medication reconciliation/ compliance or other services directed by the PCP
United Ambulance Lewiston	Private EMS Service	5/8/2013	Focus on non-emergent 911 callers to decrease the number of times the ambulance is utilized for these situations; work to reduce re-hospitalization rates for chronic disease patients (CHF, COPD, diabetes); well-being checks; home safety inspection (including fall risk assessment); blood glucose monitoring and patient assessment; wound care assessment and treatment as directed by PCP

Pearson and Shaler, 2015*** Excluded from the study for this study due to lack of Image trend data, as paperwork was hospital proprietary

Figure 5 provides a list of the systems participating in IMHC and a list of the clinical services each provided. It is important to note that, in Maine, coverage area does not equate with call volume. Some areas may have huge coverage requirements for a service, but due to population density, call volumes remain low. This is important for understanding subsequent figures and charts. Data from the services were used to evaluate operational surges and patient requests for care from 1 June 2013 until 31 June 2017. It is important to note that not all of these services started care in January 2013 and not all of the services continued to provide care for the entire evaluation period.

4.1.2 Service Provision

Services provided by each jurisdiction varied but included medication reconciliation, vital sign monitoring, and general patient assessment and care as seen in Figure 6.

Figure 6

Service	Dean	Calais	Castine	Crown	Greater Kennebec	Lincoln**	Mayo	North East	North Star	Searsport	St. George	United
Medication Reconciliation		x	x		x	x	x	x	x		x	x
Diabetes Care	x	x		x	x	x	x			x	x	x
Fall Risk Assessment/ Home Safety		x	x		x	x		x		x	x	x
Monitoring Vitals/ Physical Exam			x		x	x	x	x	x		x	x
Wound Care/Surgical Follow-up		x	x		x	x	x		x		x	x
Blood Draws		x			x	x	x				x	x
Vaccine Admini-stration					x	x	x		x	x		x
CHF Care	x	x		x	x		x					x
COPD Care	x	x		x	x						x	x
Asthma Management	x			x	x						x	x
Diet/Weight Monitoring			x			x	x					x
Hypertension	x	x									x	x
Edema Assessment						x						x

Pearson and Shaler, 2015 ** Note Lincoln is excluded from this study's data

4.1.3 Call type

The figure below is based on the ImageTrend data for the entire state and from the beginning of the program, gathered in July of 2017. These are the numbers of total calls and not the number of individual patient contacts– in other words, these call numbers may account for the same patient more than once. The number of calls and their respective call types for the entire IMHC program as of June 2017 are as follows:

Figure 7

Provider Impression	# of Times patient seen	% of Times patient seen
Altered Level of Consciousness / Coma	68	1.02%
Assist Only	995	14.86%
Behavioral / Psychiatric Disorder	28	0.42%
Cardiac Narrow Complex Tachycardia	2	0.03%
Cardiac Other	28	0.42%
Cardiac Symptomatic Bradycardia	1	0.01%
Dehydration	2	0.03%
Diabetic Emergency	50	0.75%
Flu Like Illness	4	0.06%
Hemorrhage Nontraumatic	1	0.01%
Hyperthermia	1	0.01%
Nausea / Vomiting (Unknown Etiology)	5	0.07%
No Apparent Illness / Injury	1740	25.99%
Not Applicable	204	3.05%
Not Reported	22	0.33%
Obvious Death	3	0.04%
Ophthalmological Emergency	2	0.03%
Other Illness / Injury	3177	47.45%
Overdose ETOH	1	0.01%
Pain Abdominal (Nontraumatic)	13	0.19%
Pain Back (Nontraumatic)	8	0.12%
Pain Chest (Noncardiac)	1	0.01%
Pain Extremity (Nontraumatic)	11	0.16%
Respiratory Distress Bronchospasm	4	0.06%
Respiratory Distress Other	30	0.45%
Respiratory Distress Pulmonary Edema	100	1.49%
Stroke / CVA / TIA	4	0.06%
Transfer Convalescent / Skilled Nursing	1	0.01%
Traumatic Injury Burn	1	0.01%
Traumatic Injury Extremity	3	0.04%
Traumatic Injury Torso	1	0.01%
Weakness / General Malaise	91	1.36%
Unknown	93	1.39%
Total	6695*	100%

ImageTrend Data, July 2017 * includes Lincoln aggregate numbers

4.1.4 Dispatch Criteria

Additionally, call types were divided by the category of calls as they were originally dispatched to patients, as not all calls resulting in IMHC services originated as IMHC calls:

Figure 8

Dispatch Reason	Number of Call Types	% of Overall Call Types
Unknown	9	0.13%
Sick Person	2	0.03%
Transfer / Interfacility / Palliative Care	71	1.06%
Community Paramedicine	5973	89.22%
Other	636	9.50%
Patient Assist / Lifting Assist	2	0.03%
Stand By (Fire, Law, etc.)	2	0.03%
Total	6695	100.00%

ImageTrend Data, July 2017

For these columns, unknown call and sick call types are listed first as they have the greatest potential for transport; sick calls can range from a simple cold to something more severe. Palliative care calls are placed into the same call category as transfers between home and other types of medical facilities (such as doctor's appointments) and with inter-facility transports (such as between hospitals). "Other" calls are grouped (good and welfare checks and home inspections for possible hazards, for example) together. Calls that have no actual patient care component (just assisting with movement or scene control) are listed last.

It is important to note that these call types come directly from ImageTrend and that the data categories are those in place via the state of Maine reporting categories (St. Germain, 2017).

4.1.5 Cost Configuration

IMHC must be fiscally and operationally effective to prove its worth, thus call volume changes alone are not enough to discern IMHC impacts. For purposes of fiscal evaluation, the latest data regarding the average cost per patient per length of stay in Maine hospitals was compiled by Maine Data Organization in

2013 as part of their periodic evaluation process completed every three to five years (Pearson and Shaler, p 44). These data consist of the most accurate and up to date information on the cost of a patient hospitalization in the state.

Further, according to data published by the Centers for Medicare and Medicaid Services (CMS) (Centers for Medicare and Medicaid Services, 2017), the average cost for a BLS transport for 2013 was $216.19; these figures were used to correlate the cost per call for the IMHC programs. BLS rates were used because each IMHC call was considered routine and not an emergency, therefore should the patient have been transported to the hospital, the transport would have been completed at the BLS level of care. Additionally, the majority of BLS calls for ambulatory patients do not fall under the CMS criteria for medical necessity and are therefore often not eligible for reimbursement and are subject to private payment from the patient. Figures were not calculated for mileage fees, as mileage to and from the hospital should not be considered in the cost of an IMHC service call because the IMHC service itself is not subject to mileage fees ((Centers for Medicare and Medicaid Services, 2018)

Based on the operational data provided by the state of Maine and excluding the data from Lincoln[15], there were 4,519 IMHC calls during the evaluation period. Below is a chart showing the average hospital admissions cost for each participating hospital (meaning hospitals that received IMHC patients) in Maine that receives patients from EMS. It is important to note these are facility costs only. Any fees by individual physicians, outside laboratories, or other fees are not included. It is important to note that IMHC calls by nature prevent hospital admission, and while there may have been some patients in the IMHC trial who were sent to the hospital for admission after evaluation by an IMHC provider, these admissions would be tracked as a transported call and not an IMHC call.:

[15] Lincoln used a different logging, data tracking and CQI methodology, and did not provide complete data (Nangle, 2017)

Figure 9

Hospital	Number of Admissions	Average Length of Stay (days)	Total Paid by Medicare (Facility Costs Only)	Average per Day	Average Cost per Stay
AR Gould	1127	5	$5,667,178.00	$1,005.71	$5,028.55
Blue Hill	493	5	$2,746,028.00	$1,114.01	$5,570.04
CA Dean	56	21	$340,540.00	$289.57	$6,081.07
Calais	541	5	$4,186,970.00	$1,547.86	$7,739.32
Central Maine	2875	4	$9,993,169.00	$868.97	$3,475.88
Franklin	917	4	$5,586,623.00	$1,523.07	$6,092.28
Inland	527	4	$2,536,207.00	$1,203.13	$4,812.54
Maine Coast	1144	3	$4,233,844.00	$1,233.64	$3,700.91
Maine General	2956	6	$13,641,812.00	$769.16	$4,614.96
Maine Medical	6395	5	$21,070,107.00	$658.96	$3,294.78
Mayo	667	4	$3,861,999.00	$1,447.53	$5,790.10
Mercy	1855	4	$8,638,550.00	$1,164.23	$4,656.90
Miles	810	6	$2,958,711.00	$608.79	$3,652.73
Pen Bay	1720	9	$8,830,753.00	$570.46	$5,134.16
St. Andrews	221	4	$825,323.00	$933.62	$3,734.49
St Mary	1498	5	$6,090,245.00	$813.12	$4,065.58
TAMC	126	29	$591,796.00	$161.96	$4,696.79
Waldo County	624	4	$4,544,543.00	$1,820.73	$7,282.92
Median		5			
Averages			$5,908,022.11	$985.25	$4,968.00
Totals	24552				

CMS 1 - Fees based on CMS data, 2013

4.2 Analysis

Analysis of IMHC data needs to be presented in two formats. The first is the presentation of pure numeric data. While the call volumes for each service from 2013-2016 can be found in detail in the appendix, totals for the pre (2013-2014) and post (2015-2016) are presented cumulatively. Then analytical steps evaluating statistical significance of the data were run.

4.3 Numeric/Fiscal Analysis

Perhaps the most apparent results of Maine's IMHC program are in the numbers provided by the Maine Office of EMS. To gather this information, and with the assistance of Timothy Nangle, Data and Preparedness Coordinator for Maine EMS, data was gathered directly from the Maine EMS electronic patient care report (EPCR) system. This system is hosted by ImageTrend. Image Trend does offer CP based reporting as an EPCR module, but this module was not utilized by Maine during the evaluation period.

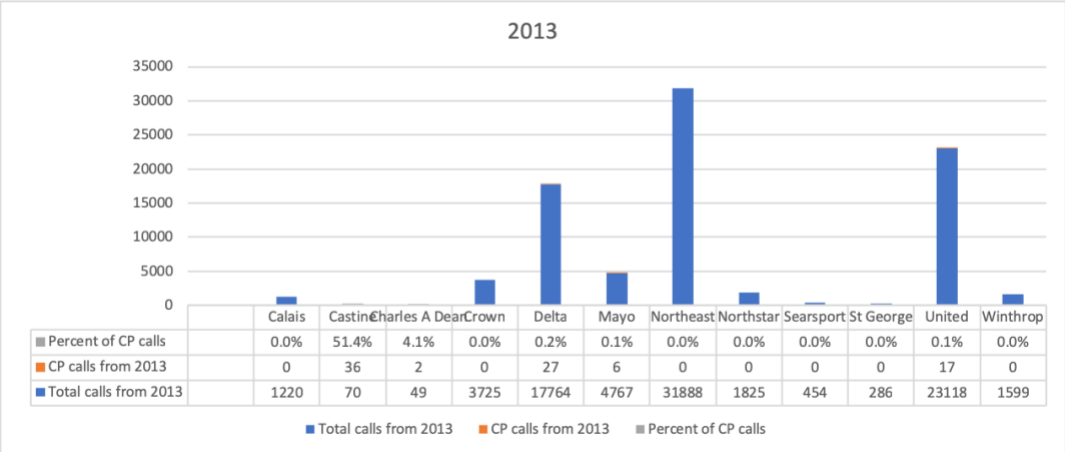
4.3.1 Pre 2015 Analysis

For this analysis, each participant system was queried from ImageTrend to gather both total call volume and CP calls from 1 January 2013 to 31 December 2015. Entries highlighted in yellow indicate that there were no IMHC calls for the collection year.

2013 full title & numbers needed

	Total calls from 2013	CP calls from 2013	Percent of CP calls
Calais	1220	0	0.0%
Castine	70	36	51.4%
Charles A Dean	49	2	4.1%
Crown	3725	0	0.0%
Delta	17764	27	0.2%
Mayo	4767	6	0.1%
Northeast	31888	0	0.0%
Northstar	1825	0	0.0%
Searsport	454	0	0.0%
St George	286	0	0.0%

United	23118	17	0.1%
Winthrop	1599	0	0.0%



	Calais	Castine	Charles A Dean	Crown	Delta	Mayo	Northeast	Northstar	Searsport	St George	United	Winthrop
Percent of CP calls	0.0%	51.4%	4.1%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
CP calls from 2013	0	36	2	0	27	6	0	0	0	0	17	0
Total calls from 2013	1220	70	49	3725	17764	4767	31888	1825	454	286	23118	1599

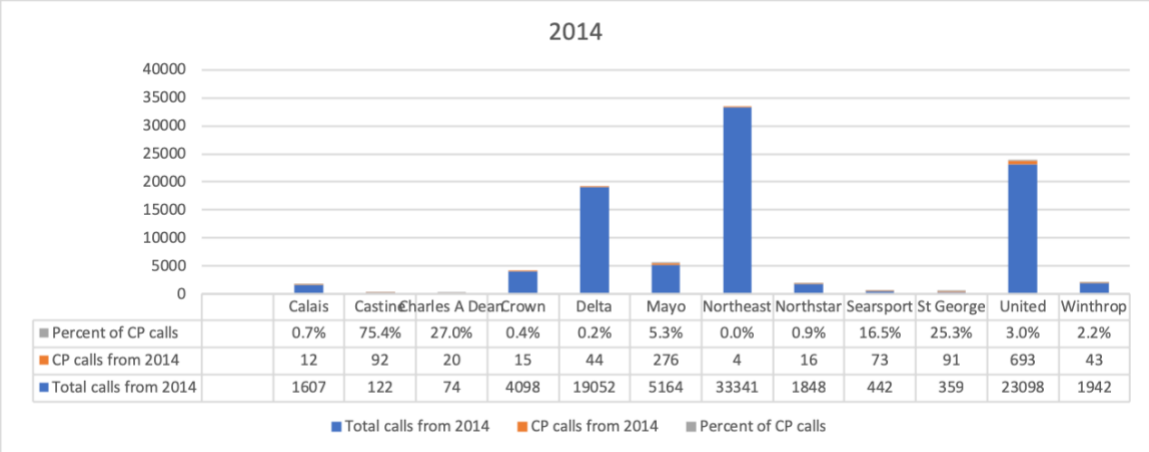
There are several items of note regarding the 2013 findings. First, several services indicated via the reporting systems that they did not perform CP services in 2013[16]. Whether this was due to call volume, patient requirement or system startup timeline could not be determined. Castine showed a large volume of IMHC calls with better than 50% of their overall volume being CP calls. This is likely due to implementation time once the legislation was passed.

2014 full title & numbers needed

	Total calls from 2014	CP calls from 2014	Percent of CP calls
Calais	1607	12	0.7%
Castine	122	92	75.4%
Charles A Dean	74	20	27.0%
Crown	4098	15	0.4%
Delta	19052	44	0.2%
Mayo	5164	276	5.3%
Northeast	33341	4	0.0%

[16] Calais, Crown, Northeast, Northstar, Searsport, St. George and Winthrop

Northstar	1848	16	0.9%
Searsport	442	73	16.5%
St George	359	91	25.3%
United	23098	693	3.0%
Winthrop	1942	43	2.2%



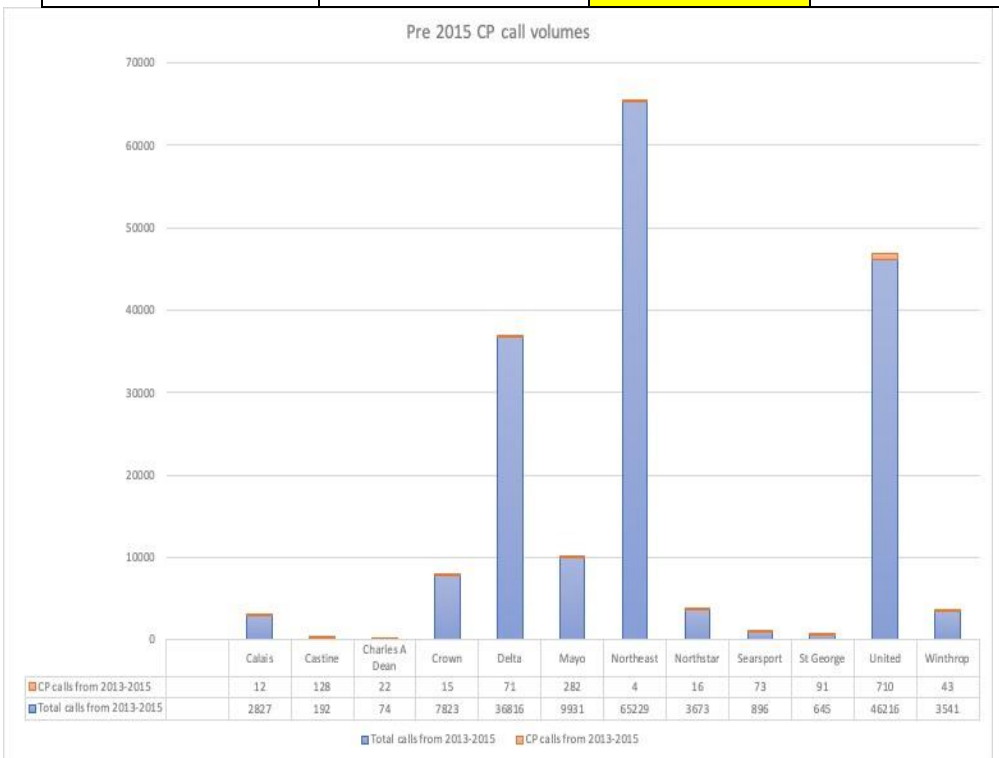
In 2014, all of the participating systems reported CP call volumes. Castine continued its growth with a nearly 75% CP volume. Though the CP calls represent a small portion of calls during this period, the progression of data indicate an increasing progression of integrating CP model into EMS operational modalities.

Pre-Implementation totals[17]

In the table below, data highlighted in yellow indicate a call volume for IMHC/ CP calls of less than 15% of the overall call volume for the EMS service. Table numbers & titles needed

[17] Only three services, Castine, Charles A Dean and St. George had greater than 10% of their call volumes (over 2 years) in CP services.

	Total calls from 2013-2015	CP calls from 2013-2015	Percent of CP calls
Calais	2827	12	0.4%
Castine	192	128	66.7%
Charles A Dean	74	22	29.7%
Crown	7823	15	0.2%
Delta	36816	71	0.2%
Mayo	9931	282	2.8%
Northeast	65229	4	0.0%
Northstar	3673	16	0.4%
Searsport	896	73	8.1%
St George	645	91	14.1%
United	46216	710	1.5%
Winthrop	3541	43	1.2%



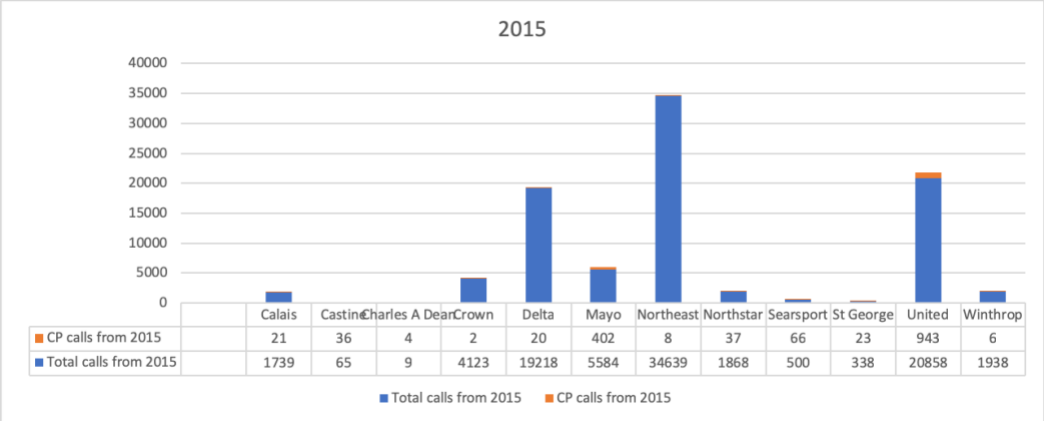
It is difficult to compare total call volumes in the first two years, given that many systems did not contribute to CP call numbers in the 2013 data set. What is important to note, is the upward trend from 2013-2014, with each service having a percentage of their calls being CP in nature by the end of 2014.

4.3.2 Post Implementation

For this analysis, each participant system was queried from ImageTrend to gather both total call volume and CP calls from 1 January 2015 to 31 December 2016.

2015 full title & number needed

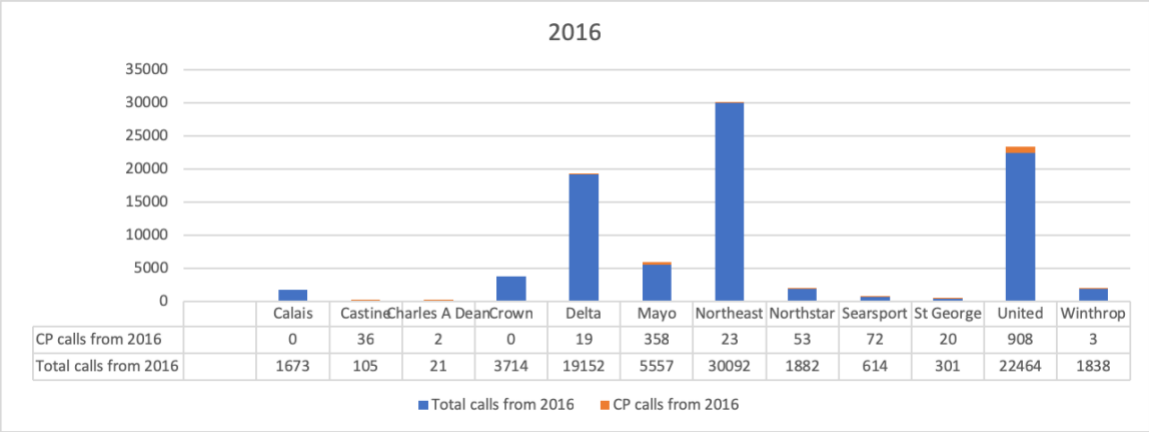
	Total calls from 2015	CP calls from 2015	Percent of CP calls
Calais	1739	21	1.208%
Castine	65	36	55.385%
Charles A Dean	9	4	44.444%
Crown	4123	2	0.049%
Delta	19218	20	0.104%
Mayo	5584	402	7.199%
Northeast	34639	8	0.023%
Northstar	1868	37	1.981%
Searsport	500	66	13.200%
St George	338	23	6.805%
United	20858	943	4.521%
Winthrop	1938	6	0.310%



Implementation of CP in Maine in 2015 was in full vigor with all systems providing IMHC Care. Percentage of call volumes of CP requests remain within 10% of the cumulative pre-implementation totals for each service.

2016 full title and number needed

	Total calls from 2016	CP calls from 2016	Percent of CP calls
Calais	1673	0	0.000%
Castine	105	36	34.286%
Charles A Dean	21	2	9.524%
Crown	3714	0	0.000%
Delta	19152	19	0.099%
Mayo	5557	358	6.442%
Northeast	30092	23	0.076%
Northstar	1882	53	2.816%
Searsport	614	72	11.726%
St George	301	20	6.645%
United	22464	908	4.042%
Winthrop	1838	3	0.163%



	Calais	Castine	Charles A Dean	Crown	Delta	Mayo	Northeast	Northstar	Searsport	St George	United	Winthrop
CP calls from 2016	0	36	2	0	19	358	23	53	72	20	908	3
Total calls from 2016	1673	105	21	3714	19152	5557	30092	1882	614	301	22464	1838

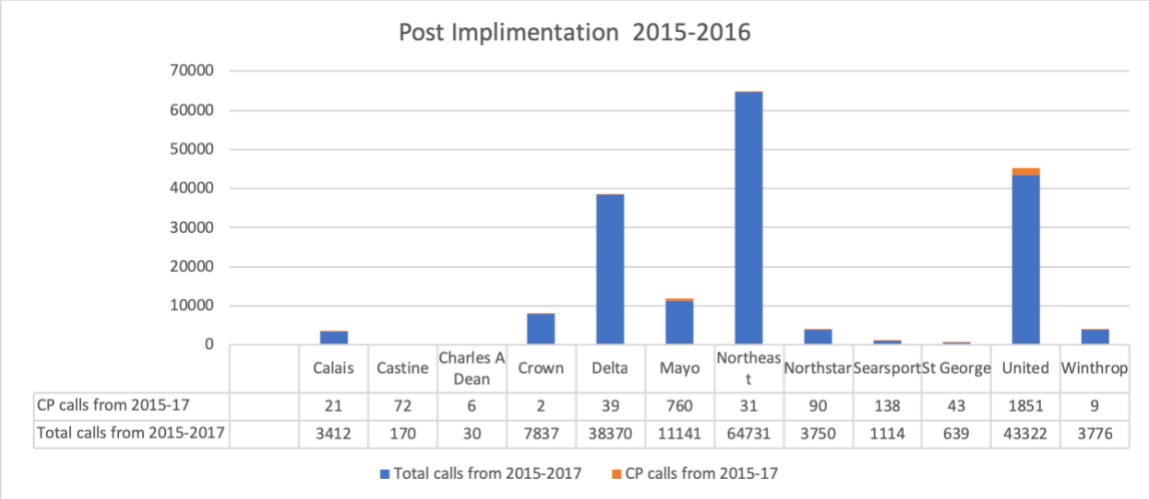
In 2016 Calais and Crown produce no CP call data. While there was no direct information within the ImageTrend as to why a system would not record any CP calls, it is important to note that systems appear to begin to disengage themselves from the program.

Total Post-Implementation totals

Titles & Numbers needed

	Total calls from 2015-2016	CP calls from 2015-16	Percent of CP calls
Calais	3412	21	0.615%
Castine	170	72	42.353%
Charles A Dean	30	6	20.000%
Crown	7837	2	0.026%
Delta	38370	39	0.102%
Mayo	11141	760	6.822%
Northeast	64731	31	0.048%
Northstar	3750	90	2.400%
Searsport	1114	138	12.388%
St George	639	43	6.729%
United	43322	1851	4.273%

Winthrop	3776	9	0.238%



	Calais	Castine	Charles A Dean	Crown	Delta	Mayo	Northeast	Northstar	Searsport	St George	United	Winthrop
CP calls from 2015-17	21	72	6	2	39	760	31	90	138	43	1851	9
Total calls from 2015-2017	3412	170	30	7837	38370	11141	64731	3750	1114	639	43322	3776

Finally, the totals for the post implementation period provide a snapshot of how many transports are avoided by each ambulance service through CP protocol. Three services (Castine, Charles A Dean and Searsport) show CP volumes accounting for 10% of their overall call volume. This data is important to discussion of overall operational surge implications. While discussed later in Chapter 5, it is of note that a 10% reduction in unnecessary transport is substantial. While the impact of a call reduction is increased or decreased based on overall system volume (i.e. a system with 10% of their total calls being CP 10,000 (1,000) calls is more significant than a system running 10% CP calls out of 100 total calls (10 calls), the impact of call reduction on a system of any size is considerable.

Call reduction in an EMS is impactful for several reasons. First, reduction in call volume benefits the provider. The National EMS Advisory Council Safety Committee advised that fatigued providers have a greater risk of committing errors when faced with unpredictable call volume and different patient acuities (Hsieh, 2016). Second, government studies have shown that cost reduction strategies in EMS include efficient deployment of equipment and standardizing billing issues that can reduce time and waste, (New York State Government, 2012). Lastly, based on CMS billing standards, since the cost of IMHC care to the patient is less than the out of pocket cost to the patient for a non-emergency

transport, the patient receives care but saves money, (Centers for Medicare and Medicaid Services, 2018).

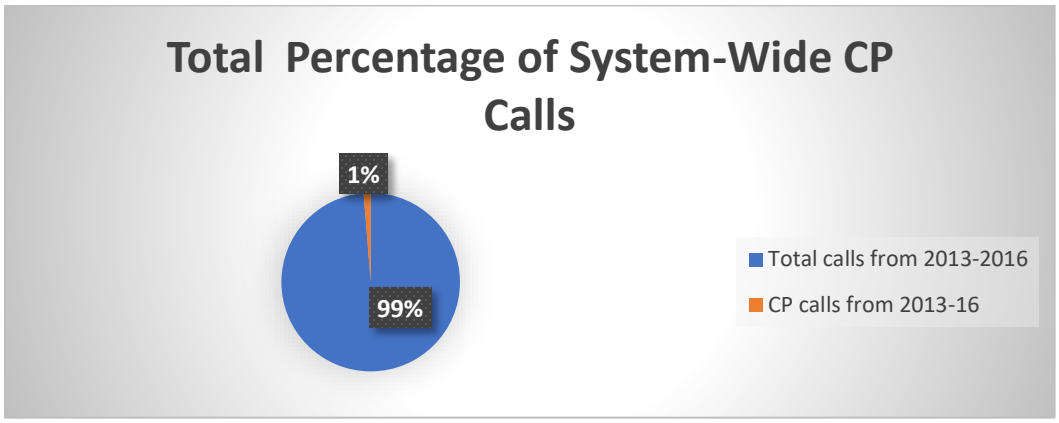
4.3.3 Overall Statistics

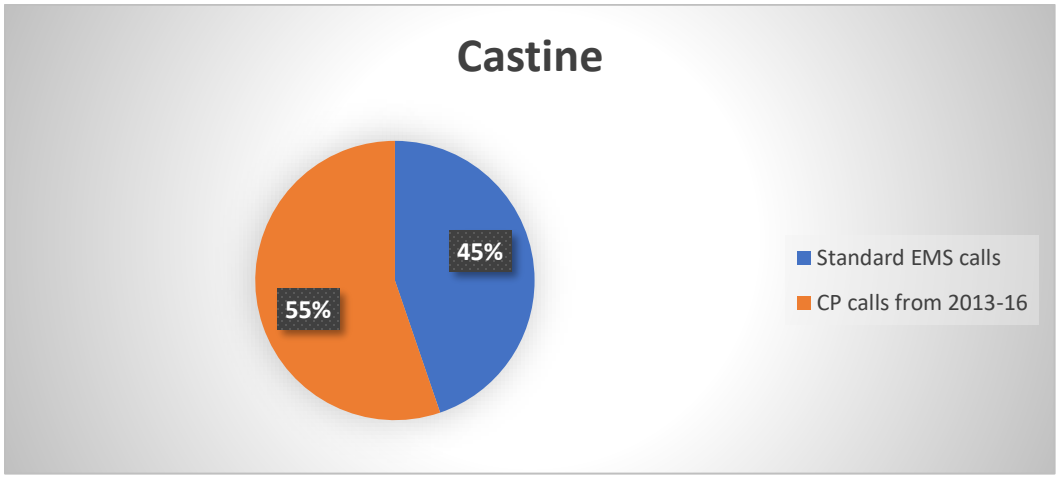
Over the entire course of the pilot, 4529 CP calls for service were made; 3062, or 69%. of these CP services were made after full implementation. Castine had the highest percentage of total calls being of CP service calls, whereas United ran the greatest number of CP calls with over 50% of the state's CP calls being performed by United.

Figure number/title

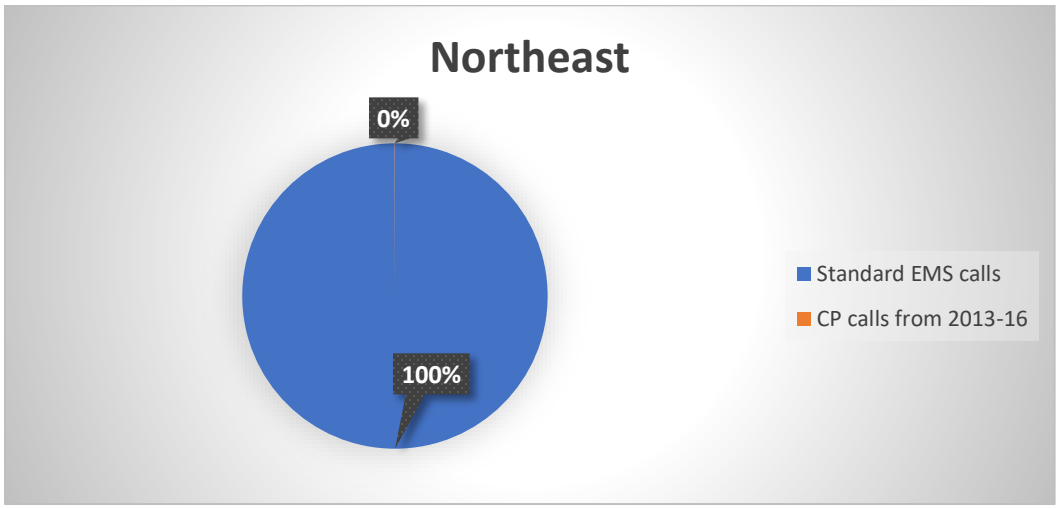
	Total calls from 2013-2016	CP calls from 2013-16	Percent of CP calls
Calais	6239	33	0.529%
Castine	362	200	55.249%
Charles A Dean	104	28	26.923%
Crown	15660	17	0.109%
Delta	75186	110	0.146%
Mayo	21072	1042	4.945%
Northeast	129960	35	0.027%
Northstar	7423	106	1.428%
Searsport	2010	211	10.498%
St George	1284	134	10.436%
United	89538	2561	2.860%
Winthrop	7317	52	0.711%
Totals	356155	4529	1.272%

Figure numbers/titles





18



[18] Highest Usage

[19]

Cost savings are shown in this data. By reducing BLS transport costs, using the average cost provided by CMS in 2013, each CP call potentially saved $216.19 in transport costs, or $920,104.64 state-wide. Arguably, the cost of providing CP care would have service specific costs (payroll, fuel, etc.), but those costs would be small compared to the cost of full BLS transport, not to mention the incalculable value of having an ambulance freed from a nonemergency patient to potentially run an emergency call for service[20]. The potential for greater savings exists if the CP calls had prevented an ALS ambulance from providing non-emergency care.

Using the daily hospitalization average of $985.25, these calls potentially saved $4,459,241.15 if the patient had been transported and was admitted for only one day. It is important to note that this cannot factor for patients who may have gone to the hospital via means other than EMS and in these cases, the savings to the hospitals and patient would be reduced but the savings to EMS services would remain constant.

Conservatively, nearly $5.5 million healthcare dollars were potentially saved over the 4 year observation period excluding emergency department cost[21]. While this information was garnered via extrapolation of CMS costs and average healthcare dollars per stay, and not actual dollars, the impact of this type of savings potential cannot be ignored.

4.4 Statistical Analysis

In order to analyze the data presented via ImageTrend reports from the Maine Office of EMS, a set plan of evaluation development is vital to

[19] Lowest Usage

[20] It is important to note that individual unit data was not available for analysis as each service runs a different deployment model. Some of these models include ambulance deployment that varies by project call volumes time of day, day of week, week of month and/or month of year over time.

[21] These costs are addressed in conclusion chapter

investigative success. Given the aggregate data and the need to keep patient protected information private, linear regression presented the most logical option for statistical analysis. Linear regression was chosen for this evaluation as it best estimates corollaries between dependent and independent variables. Within linear regression, a difference-in-differences regression and a Fixed Effects regression were used. Using both difference-in-difference (DID) regressions and Fixed Effects regressions, the number of patients transported throughout IMHC implementation and the regional cost of services rendered based on the average reimbursement rates in Maine as published by CMS were evaluated. First, aggregate data regarding both IMHC and overall transport call volumes were collected by year. Then, using differential analysis and Fixed Effects evaluations, linear visual representations of the impact of IMHC were created. Full graphic outlines for each service can be found in the Appendix.

4.4.1 Difference in Differences

The DID analysis is typically implemented in social science quantitative research by studying the differences between a treatment group versus a control group over time. DID calculates the effect of the number of IMHC calls against the total call volume by comparing the average change in overall responses over time for the group with IMHC programs to the average change over time for the response totals for the group without IMHC.

4.4.2 Parallel Trends Assumption

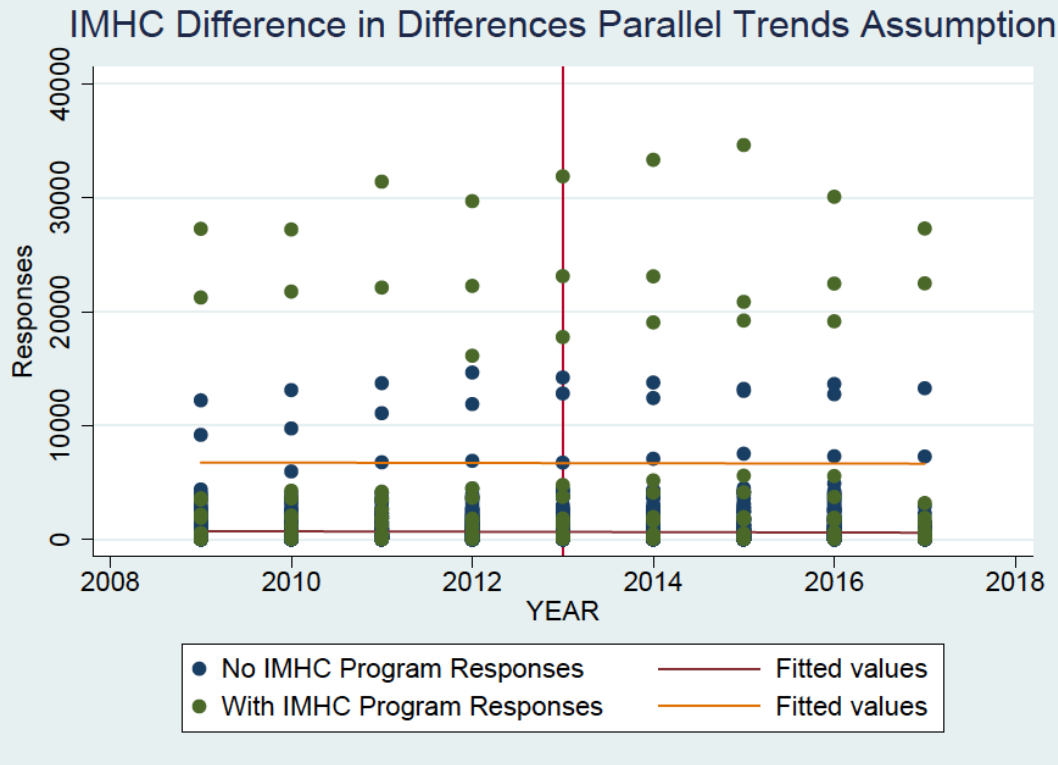
The parallel trend assumption attempts to discern the internal validity of DID models, (Columbia University, 2018). “It requires that in the absence of treatment, the difference between the ‘treatment’ and ‘control’ group is constant over time. Although there is no statistical test for this assumption, visual inspection is useful when you have observations over many time points. It has also been proposed that the smaller the time-period tested, the more likely the

assumption is to hold. Violation of [the] parallel trend assumption will lead to biased estimation of the causal effect." (Columbia University, 2018, p. 1)

4.4.3 Parallel Trends Assumption for DID

As evident in chart 1, the data remains constant over time. Given that the responses remain as a statistical constant, the ImageTrend patient care report data satisfy the parallel trends assumptions for the DID analysis. The data would be statistically probable to continue in its current path over time if all variables remain constant in the absence of IMHC programs.

Chart 1



There is no statistical test for parallel trends, so Chart 1 is the graphic representation providing visual proof of confidence in measurement validity. In other words, meeting the parallel trends assumption means that in the absence of the IMHC program in the treatment groups, the response rates in the treatment and control groups would be constant.

These data reveal several items of note. First, the larger services with over 5,000 responses or more have a lower percentage of IMHC calls performed during the trial period. Since these systems provide care to areas with larger numbers of calls for service, the number of IMHC calls seems smaller by comparison. More evaluation will be needed in the future to determine whether the reduced numbers of IMHC calls were due to patient matriculation issues (such as relocation, death or overall health improvement resulting in reduced need for service), reduction in service availability within each individual provider in the form of decreased number of available IMHC services, and/or other modifications that impacted service provision such as cessation of the IMHC program or changes in service catchment area. Larger services may also have a higher unit hour utilization rate (meaning they are busier) or a large catchment area, and thus this could mean they have less time to perform IMHC activities.

4.4.4 DID regression output

Figure number/title needed

VARIABLES	RESPONSES (ln)
IMHC Program	2.255***
(Treatment)	(0.299)
After 2013	-0.0780
(Time Dummy)	(0.0908)
IMHC_After	0.00911
(Interaction Term)	(0.364)
Constant	4.954***
	(0.0680)
Observations	2,215

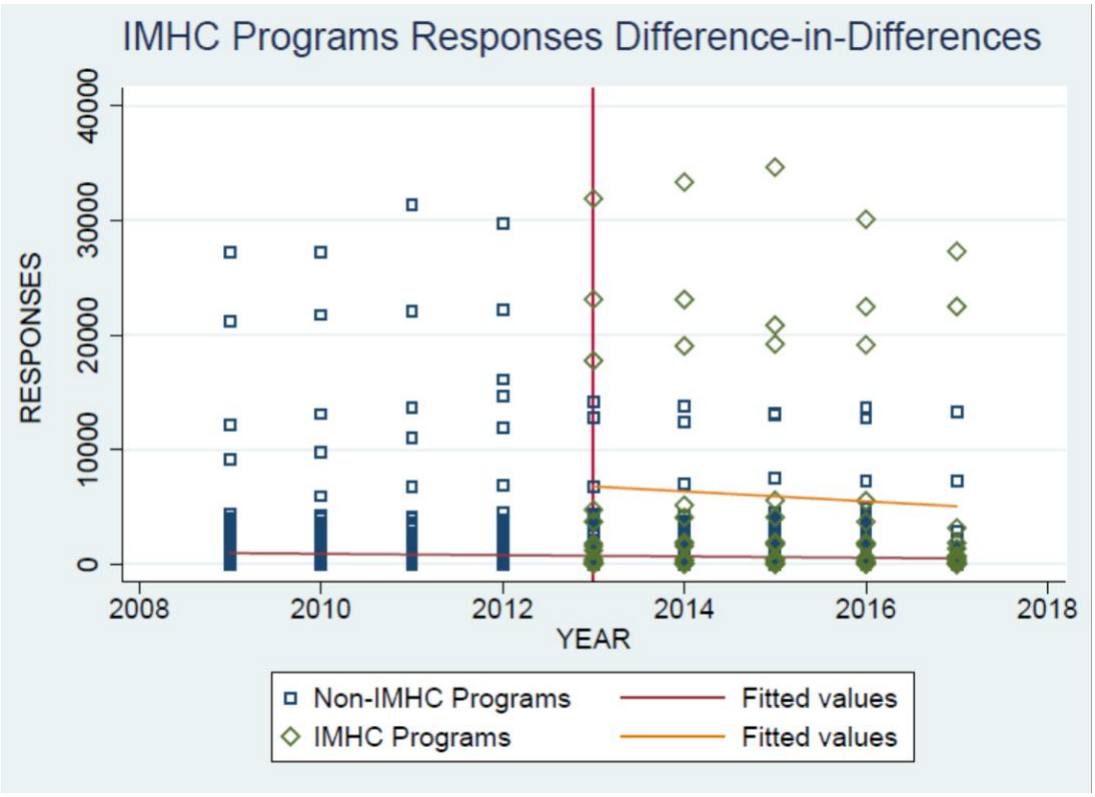
R-squared	0.050

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The expected responses in the treatment group were 2.255 units higher at each observation in the baseline period than those of the control group (P<0.01). After the intervention, that difference dropped by 0.00911 units (P>0.05 - not statistically significant).

Chart 2



4.4.5 DID overall implications

In performing a DID analysis on the ImageTrend IMHC data, there are several findings of note. First, the parallel trends analysis illustrates that the data are internally valid and should remain constant over time, given that the variables

remain constant as well. This means services will continue to reduce their individual overall transport volumes by providing IMHC services. By reducing transport volume, ambulances should available for potential calls of higher acuity[22]. Additionally, since patients will not be transported to the emergency department and or admitted to the hospital, treatment cost for the hospital services will be saved. While not all EMS systems operate in a system that benefits from hospital cost savings, hospital cost reduction would be important when looking at overall healthcare savings. Hospital admissions will continue to decrease as patients whose maladies can be treated prophylactically may not reach the point of requiring admission to the hospital for treatment.

4.4.6 Poisson Regression

The Poisson regression is used to assess counts by evaluating if explanatory variables have a statistically significant effect on the response variable. (An explanatory variable is a variable for which one cannot be certain of its independence. For the purposes of this research, given the nature of the tracking used by Maine, it cannot be certain that each variable is truly independent) Poisson was chosen as it is considered best used for rare events. The assumptions for Poisson regression are:

a. Y-values are counts
   All values for this evaluation are counts- count of over all calls and counts of IMHC calls
b. Counts must be positive integers
   Patient encounters cannot be negative, so these counts are positive when discussing each encounter
c. The mean and variance should be the same.
   Until the Poisson is properly run, means and variables must be assumed to be the same
d. Explanatory variables must be continuous, dichotomous or ordinal.

[22] It is important to note that while freeing available units, reducing call volume may also reduce the overall systems call based income. A variety of factors including reimbursement and call type would be relevant to this determination but is outside the scope of this study.

The variables are dichotomous, IMHC calls are evaluated against non-IMHC calls

e. Observations must be independent.

   Each observation is independent within the individual service provider. Since incidents with multiple patients are considered multiple patient encounters, these observations remain independent. For example, if there are three residents in a home and all receive same day services, these encounters are tracked as three observations.

For this dataset, the required assumptions of a Poisson regression were not met. The data supplied by Maine did not contain the necessary variables for a clean Poisson regression. Upon further investigation, however, a fixed-effects regression could be accurately performed with the dataset to evaluate the association between IMHC responses and overall response volumes in system that have implemented IMHC programs. The Stata14 dataset is illustrated in the Appendix.

4.4.7 Fixed Effect Regression

Statistically, in a Fixed Effects model, unit means are non-random quantities as opposed to a random effects model where all or some of the model parameters are random variables. In this case, IMHC and non IMHC calls are fixed and not random. Since the point of any regression to examine the influence of one or more independent variables on a dependent variable, and since the variables are non-random, Fixed effect seemed to be a good model for IMHC data.

The data were processed again in Stata14 and produced an r-squared value of 17%. While this is may appear low, given that the score is based on observations impacted by human behavior, a low r-squared is not unexpected. What is important to note, however, is that though the observed data only matched the expected data at 17%, a goodness-of-fit measure cannot be truly used in terms of healthcare. There is a statistically significant association (α <0.01) between IMHC calls and response rates among systems that implemented an IMHC program. While improvements in medical

services, decreases in hospital admissions, and overall impacts may not be statistically significant, any positive impact to a patient or healthcare system is normally considered an improvement. Also, in the overall applications of services, a five-year period to track changes is relatively short, but was the only window of availability in this new endeavor. Additional study at the ten year mark and onward would be helpful to illustrate outcomes.

Further, a statistically significant association ($\alpha<0.01$) was found between IMHC calls and response rates among systems that had an IMHC program such that for every "one" unit increase in IMHC calls, there was a 1.74 unit reduction in overall system responses (Figure 9). The dummy variables for the years in this model control for the unseen effects over time per the parameters of the Poisson regression, which increases the internal validity of the measures.

Additionally, a robust standard error was employed with the data to account for irregularities and heteroscedascity present in the data. These abnormalities will be further discussed in chapter 5 and provide a call for additional research.

Figure 10

Fixed Effects Analysis

VARIABLES	Responses
IMHC Response	-1.734***
	(0.542)
2013 Dummy	-257.1
	(243.6)
2014 Dummy	289.0
	(285.1)
2015 Dummy	299.5
	(426.8)
2016 Dummy (Omitted)	-
Constant	7,500***
	(224.2)

Observations	48
Number of Service Groups	12
R-squared	0.170

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

4.5 Conclusion

This chapter looked at the data through the lenses of regression analysis and fiscal impact within the parameters of the available data. The IMHC cohort, each cohort's provision of services, Service call types and dispatch criteria were all examined to create a picture of the IMHC program in the state of Maine.

The systems in Maine participating in IMHC experienced a 1% IMHC utilization overall system, with smaller systems seeing an IMHC application to call volume at the highest rate, some above 50%. The overall 1% utilization however, showed a savings of ~$920,000 state wide. While hospital savings calculations are estimates, due to data availability restrictions, a conservative savings of ~$4.5 million statewide was calculated using CMS cost data and average lengths of hospital stay. Overall, between EMS systems and hospitals, just over five-million dollars ($5,000,000) in overall healthcare savings was potentially experienced in Maine due to the implementation of IMHC.

Statistically, Difference in Differences (DID) analyses, with parallel trend assumptions, Fixed Effects analyses and a Poisson Regression were performed on the data. The DID and parallel trends showed that, while the data was valid, the impact of IMHC was not statistically significant. For this dataset, the required assumptions of a Poisson regression were not met. Upon further investigation, however, a Fixed Effects regression was performed with the dataset to evaluate the association between IMHC responses and overall response volumes in systems that have implemented IMHC programs. The Fixed Effect regression showed a statistically significant association (α <0.01) between IMHC calls and response rates among systems that implemented an IMHC program. Further a statistically significant association (α<0.01) was found between IMHC calls and response rates among systems that had an IMHC program such

that for every individual unit increase in IMHC calls, there was a 1.74 unit reduction in overall system responses.

In Chapter 5, these data and outcomes will be analyzed for growth potential, state wide system impact, and policy implications for IMHC in statewide systems and for further research.

Chapter 5: Discussion and Conclusion

Chapter 4 looked at the data through the lenses of regression analysis and fiscal impact within the parameters of the available data. The IMHC cohort, each cohort's provision of services, service call types and dispatch criteria were all examined to create a picture of the IMHC program in the state of Maine. In this chapter, these data and outcomes will be analyzed for growth potential, state wide system impact, and policy implications for IMHC in statewide systems and for further research will be discussed.

5.1 Analysis

It is important to provide a clear picture of what the research data means and what implications the data may have for further study. While the results are provided in graphical representation, a more thorough evaluation of the data's inference is needed to fully understand its impact. It is important to note, from the perspective of validity and reliability, that the data from the State of Maine and its Office of Emergency Medical Services does not clearly indicate, with statistically significant proof, that IMHC is beneficial for public health and for pre-hospital patient care in the State of Maine. Additionally, the data collection period was quite short due to the newness of the program and consideration should be made for activities and behavior patterns to be evaluated, especially in correlation with the AHUM.

Noting these issues with reliability and validity, the first goal of this analysis is to discuss IMHC in relationship to the three hypotheses: reduction in patient request for transport, reduction in operational surges, and reduction in fiscal loss. Then, shortcomings and oversights within ImageTrend and data collection can be evaluated.

5.1.1 Ha-reduction in patient requests for transport

The data from ImageTrend reports that there were 4,529 IMHC calls in the reported cohort that were completed by the 12 evaluated companies. Without knowing how patients enter the system, whether via hospital referral or by a

pattern identified by the EMS system, it is difficult to discern whether a patient's admission to an IMHC program is based on preexisting medically evaluated conditions or based on the frequency of non-emergency transport requests. From a public health perspective, the delineation between volume reduction and the cost reductions in a healthcare system is important. Without the data clarifying patient mode of entry, the benefit of an IMHC system could not truly be statistically evaluated. In the IMHC program the patients were assessed by the IMHC staff and treated without transport to an emergency department or other tertiary facility. The patients within the study had been identified as at-risk patients by the individual ambulance services or had been referred for care by a physician or social worker to enter the IMHC program.

Data from ImageTrend did not designate the method by which patients entered the system, but arguably any IMHC patient encounter could be considered a transport that has been averted. Therefore, over the four-year data period, the companies experienced a reduction in calls for transport services.

As discussed in Chapters 1 and 2, patients requesting ambulance transport for non-emergency concerns create a multifaceted problem. First, the ambulances are committed to responding and caring for a non-emergency patient and thereby are unavailable for any emergency patients that might need services during their commitment to the non-emergency patient. Unnecessary transports, such as ambulance transports for conditions that do not require emergency treatment or those patients who do not need to be transported by stretcher, can impact both hospital and EMS' abilities to provide sufficient overall care to the population. Additionally, the reimbursement rates for unnecessary transport are quite low, if there is payment made at all. By providing IMHC services, the number of patient requests for non-emergency services were reduced, thereby freeing the healthcare system for other patients whose need may have been greater.

5.1.2 Hb- reduction in operational surges

Similar to a reduction in patient requests for transport, increases in call volume from year to year in each service were evaluated via ImageTrend Data. These data per individual company can be found, alphabetically, in the appendix. Calais Fire and EMS experienced the most notable changes in their call volume over the evaluation period between 2013 and 2014. Not only did Calais experience the highest data wide operation surge between years, at 31.72% in 2014, they also experienced the sharpest decline two years later, between 2015 and 2016, at -3.80%.

In each ambulance service studied the IMHC services impacted the overall calls by reducing the transports each service needed to perform. While the impact was greater in the services completing less than 1,000 calls per year, the impact could be seen in each service.

Operational surge is an important factor for both EMS services and for hospitals. As discussed in Chapters 1 and 2, call volumes can impact individual patient-care-provider well-being and safety. High volumes can lead to provider fatigue and mistakes, (Fass, 2015). EMS systems with high volumes of non-emergency resources often need to use resources to address volume rather than acuity, (Patterson D. , 2018). Similarly, hospitals have limited resources and bed space. While both EMS systems and hospitals make every attempt to triage higher acuity patients first, in time of high volume, ambulances and hospital beds may already be in use by low acuity patients before high acuity patients call for service. Arguably, any decrease in patient volume can result in faster responses to the sickest patients (dependent on other factors such as weather, distance etc.). Lowered non-emergency patient volume, in the presence of the same amount of resources, can result in advanced care (ALS) resources being available for emergency patients. This concept was published in Fire Chief Magazine in 1983, when the National Association of Emergency Dispatchers endorsed the concept of ALS availability., (St. John & Shephard Jr., 1983).

5.1.3 Hc- reduction in fiscal loss

Reductions in operational surge acts as a starting point for justification of IMHC on the low acuity patient and the low acuity patient's request for transport. As stated earlier however, it cannot be assumed that all emergency department admissions came from transports nor can it be assumed that hospitals did not receive the low acuity patient from other transport means (e.g. personal vehicle, taxi etc.). Even so, savings from IMHC services are obvious for both the ambulance transportation services and for the receiving facilities, given that an ambulance company would lose $219.00 for each medically unnecessary transport (if that cost was not encumbered by the patient), and patients would be charged nearly $1300.00 for an emergency department visit. Each IMHC call carried a potential savings of over $1,500.00 per call. Even if this were a small percentage of calls, the impact can be noteworthy, especially in small systems with limited resources. Additionally, the ambulance service may have seen reductions on costs of fuel, maintenance or for the transport of a patient, as there was no transport performed.

5.1.4 Combined Implications

Subchapters 5.1.1, 5.1.2 and 5.1.3 evaluate the IMHC data as it pertains to each of this study's hypotheses, but together the data illuminated another key point. In order for a true impact to be seen, all three of the key hypotheses must be present in an IMHC system. While arguably any one factor (reduction in request, reduction in surge, reduction in financial loss) can create a difference in an EMS system or entire healthcare system's ability to render service to the population as a whole, the benefit can increase when the factors combine.

Consider the following scenario: a transport crew in a system providing IMHC experiences a reduction of one call for service per day due to a patient receiving IMHC. The patient is receiving IMHC care. The patient is being monitored at home. They are not being transported, reducing the risk of being injured by the ambulance crew during lifting, loading or driving. The patient is

not going to the hospital and risking nosocomial infection from contagious patients or hospital infection. The patient is receiving real time, frequent care and monitoring as a preventative tool to prevent extreme relapse or exacerbation of an illness. This prevention could save thousands of dollars in healthcare costs between ambulance and hospital services.

The ambulance crew has one less patient for which they provide in-ambulance care and one less patient they have to lift, load, and drive to the hospital. The have one less opportunity for injury, one less opportunity to be in a vehicle accident and one less trip on which to use fuel and other supplies. The crew is available for other patients who are either not in the IMHC system or who may be having a true emergency. The crew can identify IMHC candidates for additional surge reduction.

The hospital receives one less ambulance patient. It does not need to find a location for the patient to reside immediately so the ambulance can be free to leave. The hospital does not have to commit resources to a non-emergency patient, freeing staff, beds, and services for other more severe patients. The hospital does not generate charges that the patient may not be able to afford or that a health insurance company will have to fund.

Outside of the above scenario, as discussed in chapter 1, it is important to remember that IMHC is also used to prevent patient readmissions after the hospital discharges patients. IMHC is used in this type of scenario to prevent re-admission for preventable exacerbation of illness after discharge.

Arguments can be made that hospitals and ambulance services in the U.S. are more fee driven- that it is a fallacy that hospitals and ambulance services benefit from reductions in call volume since some services depend on call volume to garner revenue. This is not the case. The Hospital Readmissions Reduction Program (HRRP) is a Medicare program that reduces payments to hospitals with excess readmissions. The ACA mandated the creation of the HRRP and reduction of payments to hospitals for excess readmissions within thirty (30) days. (Centers for Medicare and Medicaid Services, 2019). Further, the Twenty-first (21st) Century Cures Act requires CMS "to assess penalties based on a hospital's

performance relative to other hospitals with a similar proportion of patients who are dually eligible for Medicare and full-benefit Medicaid beginning in FY 2019" (Centers for Medicare and Medicaid Services, 2019). These penalties concentrate on patients who have been discharged and readmitted for heart failure, heart attacks (myocardial infarction), pneumonia, coronary artery bypass, and hip and knee replacements. The penalties can be avoided by preventing readmissions by providing IMHC follow up care. In this way IMHC is not only freeing a hospital bed; it is also preventing a hospital from losing revenue via penalty.

As for Ambulance services, calls for service must meet medical necessity to be paid, (Centers for Medicare and Medicaid Services, 2018). Medical necessity is defined as "when the patient's condition is such that use of any other method of transportation is contraindicated. In any case in which some means of transportation other than an ambulance could be used without endangering the individual's health, whether or not such other transportation is actually available, no payment may be made for ambulance services", (Centers for Medicare and Medicaid Services, 2017, p. 1). So, reduction in non-emergency calls for maladies such as trips and falls, medication noncompliance, or other issues that could be assessed by IMHC providers, do create a savings; IMHC prevents transports.

Maine's IMHC program illustrates the example above, but this does not mean that the study was free of issue. Subsequent subchapters in this conclusion will address the issues with the Maine study and provide commentary and suggestions for improvements in the future.

5.2 Statistical Implications

As addressed in chapter 3 and 4, several regression analyses were performed on the Maine statewide data. While the research data when processed does not show statistical significance in regard to the impact on patient transport reduction, the overall implications of patient call reduction on operational services and on overall healthcare spending are significant on a personal level to the patients and to a system level for EMS operational services and the healthcare system as a whole. The methods of data collection for the Maine IMHC data are

insufficient to provide accurate, statistically relevant results. While the program showed statistical direction for a positive impact of supportive care, the data seem to either equalize or trail off as the program continued. Programs that seemed to experience a decrease in services over time may have seen that trend due to population issues, or simply due to changes in the program's depth of participation. With millions of dollars in healthcare expenditures for medically unnecessary ambulance transport and hospitalization exchanged for the lower cost of providing a homecare visit (normally salary and vehicle costs), the implications for reallocation of healthcare dollars are potentially substantial.

With proper IMHC implementation, patients experience a reduction in debt load secondary to bills not covered by medical insurance. Ambulance services cease or reduce the number of medically unnecessary ambulance transports. Emergency departments reduce their daily census flow due to the reduction in transport into their facility allowing more bed space and staff availability to treat patients with medically necessary illnesses and injuries. Hospitals reduce admissions creating additional bed-space and staffing to address patients whose admission is medically necessary and unavoidable and cannot be treated out of the hospital. Therefore, properly implemented IMHC care can reduce medical spending, patient debt and hospital and emergency department overcrowding.

Unfortunately, answers to the three hypotheses are grounded more in inference than statistical fact. There are several concerns with the methods of data collection provided by the State of Maine. Without concrete and consistent sources of data collection, accurate tests are difficult to perform. First, the state of Maine did not use any separate or specific specialty tool in order to capture the IMHC data compiled by providers. While this may not appear to create a significant problem, it created several problems within the data set; primarily, the data was not easily harvested from the generalized data sets kept by the State Office of EMS. When pulling data from the patient care report software (ImageTrend) the only indication that a patient was a recipient of IMHC care was

indicated by provider selection[23]. If this selection was forgotten or entered incorrectly by the EMS provider either a patient was included who should not be, or a patient who should have been included was not entered. This created an instantaneous data entry/user error situation that would have little chance of being caught by quality assurance staff. Secondly, because there was no separate statewide tracking tool, nor was there an obvious set of separate state-wide quality assurance processes, the process of QA was largely up to each individual ambulance service (Nangle, 2017). IMHC calls for service did not appear to be scrutinized for correct data, correct population inclusion, or sheer numeric response outside of a record of non-transport with care rendered. (It is important to understand that for the purposes of IMHC, care rendered without transport can happen two ways in EMS: first, a patient can receive care and then refuse to be transported; second a patient can receive community paramedicine care, which by definition is care provided without transport. The delineation between these call types is crucial for research purposes).

ImageTrend does offer the ability to create systems specific modules within their software. At the time of this writing, in fact, ImageTrend has a patient care report module specifically tailored to the performance and recording of Integrated Mobile Healthcare. This option, however, was not used, (Nangle, 2017) . The lack of IMHC specific patient record augmentation created a twofold issue. First, the lack of accurate and specific data collection created a problem with an empirical data collection for this study. Performing either a cumulative or jurisdiction only specific regression, DID, parallel trending, or even accurate monetary calculations became nearly impossible.

Second, methods of compiling the data that did exist were quite difficult. Because the State of Maine was no longer supporting the version of ImageTrend where the bulk of the data was housed, the data could not be pulled cumulatively; the data instead, had to be pulled jurisdiction by jurisdiction. Because a

[23] Image trend uses button and drop-down menus that require providers to make "selections" based on the parameters of the service they have provided.

cumulative total could not be extrapolated from the system, there was no method by which a jurisdictional total and a cumulative total could be cross checked.

Last, statistical analysis is difficult for this study due to the short period of time for data collection and analysis. Coupled with the addition of other statewide state protocol driven systems (perhaps the Wisconsin system mentioned in previous chapters should be compared in the future) will provide an excellent opportunity for comparative research, but for now, a five-year period was quite small (but necessary) for evaluation. The short frame of time and the limitations of data did prove helpful in providing a window into some of the policy implications surrounding the statewide system implementation and these will be addressed in the next subchapter.

While the lack of records, the difficulty in analysis and the short period of data collection may each be factors, it is more plainly said that the Maine IMHC program was difficult to measure for several reasons, not the least of which was messy data collection.

5.3 Policy implications

Statistical analysis did not simply provide numeric test results; it made clear the importance of the data collection methodology. Revealed in the provided data and statistics, overarching concerns with the pilot data are the methods of data collection, the accuracy of data collection, without accurate data collection, it is difficult to use data to provide policy direction.

5.3.1 Methods of data collection

First, the methods of data collection for the Maine IMHC data are insufficient to provide accurate, statistically relevant results. While Maine utilized a commercially prepared, National EMS Information Systems (NEMSIS) approved data collection software suite (ImageTrend), the set up for harvesting information specifically about IMHC data is insufficient to make strong, statistically valid conclusions. ImageTrend may offer a more robust solution (such as their IMHC module for the call logging software) than is being used by

the State of Maine, but if so, it was not being utilized. IMHC calls are logged within the systems as a call type; however, this call type data is selected by the provider documenting the patient's care. This information is subject to human error in categorization, which may skew the data.

5.3.2 Accuracy of data

Because of the human error, and perhaps also due to the CQI personnel's failure to recognize the human factors, efforts need to be made to insure accuracy in collection even if that means additional evaluation on the part of the IMHC program or on the part of the State Office of EMS. ImageTrend does not have the capacity to evaluate hospital, emergency department, or insurance data nor do the hospitals or emergency departments relay information about census to the State of Maine's Office of EMS. While there is data that shows that 17% of emergency department patients are admitted to the hospital, there is no data to support that those 17% of patients were initially transported by ambulance. Insurance companies do not provide information in a publicly accessible document on the percentage of IMHC patients who are receiving benefits nor are those benefits weighed against the potential cost of an emergency department visit or hospital admission.

Considering that the Maine data only addresses the number of calls and does not evaluate hospitalization and/or patient entrance or exit dates from the IMHC system, the data simply provides counts. While these counts can be predictive, as illustrated with the parallel trend's analysis, the prediction does not possess the level of specificity needed to build and or evaluate a program; consequently, fiscal and operational savings can be postulated but not pinpointed.

5.3.3 Lack of Policy Direction

To impact further IMHC policy, more data is needed to properly predict IMHC's impact on patient care and healthcare as a whole. The hospitals need to provide data back to the EMS system in regard to emergency visits and hospital

admissions for IMHC patients. This data could be blinded to protect HIPAA covered demographics. Insurance companies need to track patient expenditures for IMHC patients against patients with similar demographically significant healthcare issues to ascertain whether IMHC is making a difference in monetary expenditures. The public health sector should have input on data collection in an effort to track and facilitate care for patients in certain categories of need and work with EMS agencies to see if care initiatives are actually creating an impact on care. By allowing this input, procedures and strategies on the creation of a streamlined, cohesive IMHC program might be created in future systems.

5.4 Suggestions

Given the issues with methodology and data availability, there are several suggestions that can be made for the Maine IMHC program. While the State of Maine believes in its IMHC program, as evidenced in the 125th and 128th Legislature's endorsement (125th Maine Legislature, 2012), (128th Maine Legislature, 2017), and while participating jurisdictions have seen both call volume and cost-per-call numbers decrease (as seen in the analysis section), traditional empirical qualitative methods are unable to show statistically significant proof that IMHC works, though Maine believes the system does work, (St. Germain, 2017).

So, if the system shows improvement but the data doesn't show statistical proof, is there a problem with the system or a problem with the data? In this case the problem in creating statistically sound results within the IMHC system is its data collection. Therefore, several suggestions can be made for the State of Maine and for systems which, in the future, should choose to undertake a State-wide IMHC program

5.4.1 Separate data collection tools

While a study could be performed to evaluate ImageTrend's patient care reporting, software other than ImageTrend could provide a single source, robust, user friendly data, collection tool. Based on findings from this study alone it is imperative that a separate tool for IMHC collection data is used. This tool should include at a minimum:

1. Designation of response location as multi resident or single resident. This will assist in determining whether a patient is a "frequent" caller or coming from a facility with multiple potential patients calling from one location for many different patients.
2. Designation of response as "frequent caller" or "discharge follow up" to delineate between patients who are receiving care before they enter the hospital system or if the patient receiving care is in the program to prevent readmission to the hospital.
3. Designation as to whether other healthcare providers have been called in for consults on the call/ incident,
4. Identification of patient referral source on all initial visits.
5. Healthcare researchers and economists should study the implications of the disparities between hospitals, EMS services and patients regarding income, expenditures and savings to discern cost verses benefit.
6. Researchers should develop patient outcome measures that focus on efficiency and effectiveness for both the healthcare systems and the patients themselves.

These six criteria are by no means a complete outline of what should be included in evaluation tools; they are, however, information that is necessary to robustly evaluate the impact IMHC visits can have on hospital systems. Differentiating nursing home responses and skilled assisted living facilities from individual residences will assist in discovering whether it is an individual patient or multiple patients at a single address that are receiving care. These data are

important as they can assist with determining whether patients at assisted or skilled living facilities are being accurately treated for illnesses for which they have already been hospitalized.

Response type clarifications should be delineated between those patients receiving care to prevent entry into the hospital system as opposed to those reentering the system after care has been rendered. This data is where the true public health value of IMHC will be supported or disproven. This data will empirically show how many patients are receiving public health prehospital services in an effort to reduce hospital transports, especially those to the emergency department, and it will illustrate how many patients who receive care after hospital discharge require readmission within a determined period of time[24]. These determinations will show whether there are truly patient and/ or fiscal benefits to community paramedics or not.

Determining whether a community paramedic could handle the patient needs or whether a more advanced individual with a higher certification is required to assist with these call types is important and should be tracked. Specific collection should be made regarding data to determine whether an advanced consultation was routine (such as a dose adjustment for medication with the physicians), or whether additional medical knowledge was needed to make a determination regarding care (such as the need for a telemedicine cardiac consult so that a cardiologist can look at an EKG printout that has confused an EMS provider).

Lastly among the minimal criteria is referral source. Determining whether the request for homecare has come from a private physician, hospital, skilled nursing facility, or some other source, could give an indication as to where community paramedicine education may be needed. Referral source is an important determination in the patient impact of IMHC. The overall issues with IMHC are two-fold. IMHC represents a vast increase in the potential workload of a system, and thereby may not be seen as a direct system benefit other than in the

[24] It is important to note that the HRRP does not distinguish the cause of the 30-day readmission, only that a readmission occurred, (Centers for Medicare and Medicaid Services, 2019)

availability for emergency ambulances to meet the needs of emergency patients. So, while IMHC might not benefit EMS services directly, it does potentially decrease societal costs of healthcare and increase ambulance availability thereby, creating an environment that could lead to better health outcomes for some or all of the covered population. The lack of an economic reward to the EMS system providers who are taking on additional work, however, is likely to be a barrier to further expansion of IMHC services.

5.4.2 Hospital data participation and submission

In addition to more data collection tools, Maine has an excellent opportunity to flex one of the greatest benefits it has in being a statewide, state protocol driven system; Maine can require hospitals to provide data on patients enrolled in the IMHC program. Since Maine supplies healthcare funding, via Medicaid, regulations could be developed and administered requiring hospitals to provide HIPAA compliant, blinded information to the Office of EMS regarding enrolled patients. Data such as admission source (ambulance, private vehicle etc.), length of stay, and discharge date would provide a large pool of information.

Gathering this type of information in a HIPAA compliant manner not only provides the opportunity to gather additional data, but also bolsters the validity of the data Maine currently collects. Furthermore, patient tracking can improve and if the tracking improves, more patients who need IMHC services might be more easily identified.

5.4.3 Qualitative studies

Additional studies need to be performed by Maine and by EMS services individually to evaluate both patient and provider satisfaction and to evaluate the benefit to hospitals/hospital systems. Arguably, statistical significance does not satisfaction make. Evaluations of improvements, or lack thereof within the flow and processing of patient care is needed to further evaluate benefit. While individual ambulance services may send out patient satisfaction surveys as part of

their internal operations, the state should develop a tool to evaluate not only the IMHC program at the patient level, but also at the hospital level. Hospital evaluations should include options on benefit of the programs to the patient, benefits to the hospital and allow for commentary from those participating in evaluation.

5.5 Lessons learned

Chapters 5.1 through 5.4 provided several pieces of information vital to the future application and research of IMHC programs. First, data collection is certainly not easy or efficient when the collection tool is inadequate and the CQI is not centralized. The biggest concern with data collection, in this case, was the accuracy of the numbers. The electronic patient care reporting software was simply not robust enough to account for potential data entry errors by providers or to capture much of the data needed to perform concreate evaluation. While the monetary extrapolations look good at first blush, they are still extrapolations. Hard data needs to be evaluated to see true benefit.

In order to get the hard data, a data collection tool or multiple tools, that allow for robust collection are needed. Partnerships with other healthcare providers who care for IMHC patients should be consulted, a committee on data collection and research formed, and a HIPAA compliant quality assurance and continuous quality improvement plan should be developed. Future systems should create this type of committee before IMHC implementation and Maine should consider implementation of such a committee immediately.

Statewide EMS systems with statewide protocols offer a unique opportunity above more localized systems for the purposes of research and collection. Since the state is supplying healthcare funding, health departments and public health entities have, or should have, access to easy to move from state office to state office. The capacity and potential for easily sharing data for the good of the patient and communities' overall healthcare can have implications for fiscal savings and overall community health.

Beyond the excellent opportunities afforded to a statewide system, there are definitely systemic threats. Urban, suburban and rural systems each have their own issues with EMS and hospital systems and when comparing different system types, there is sometimes no way for the data to match up in an "apples to apples" fashion. To offset these threats, future research into IMHC systems is needed.

5.6 Future Research

The future research in to IMHC/ CP programs can have a variety of emphases and in Maine in particular there is much that can be considered for further research. Several items are of particular interest such as:

1. Were the financial savings within each participating EMS system seen equally in urban, rural and suburban settings?
2. What was the community response to using IMHC services?
3. Were providers comfortable performing IMHC functions at their current training level and what suggestions did providers have for improvement?
4. Is oversight by the Maine office of EMS enough?
5. While monetarily, the impact of IMHC programs is visible, is a state wide, state legislated program a viable option in other areas?
6. Is there a software tools that capture data in a more robust fashion?

With the newness of CP/IMHC and overall review in each state providing IMHC is needed, complete with evaluations of services provided and overall patient outcomes. While a difficult and large proposition, objective analysis of CP is necessary not only to discern the benefits to EMS and emergency healthcare, but also to see patient value. It is an innovative and exciting time in IMHC care, and the research possibilities are endless.

5.7 Conclusion

The need for an IMHC system has been discussed by emergency medical service providers (Beck, Craig, Beeson, & et.al, 2012), physicians (Delbridge, et al., 1998), US government entities (National Highway Transportation Safety Administration, 2013) international government entities (Queensland Government, 2017) and non-medical constituents (Fay, 2018). No matter the specific definition, all of these entities understand that the pre-hospital emergency system of transporting all patients to emergency departments, coupled with the repeated readmission of frequently discharged patients is taxing the healthcare system. It is incumbent upon those individuals who operate in the prehospital arena (public health workers and pre-hospital medical care providers) in partnership with other healthcare providers, administrators, and insurers to take a strong stance and to be part of the team to assist in developing solutions for this problem in modern healthcare. Integrated mobile healthcare could be the partnership needed but more empirical statistically significant data is necessary to determine whether IMHC is an answer or a stopgap. This determination will be predicated on systems creating IMHC programs' ability to collect appropriate data.

The study was developed to evaluate a state-wide IMHC protocol that was endorsed by state legislature to evaluate whether a program might be a beneficial option in other states. Maine was selected as it was a "first of its kind" system. Literature supporting the need for an IMHC system was evaluated and the AHUM model was used to evaluate the needs for reductions in fiscal and operational costs as well as potential patient benefit. Data was collected with the permission and approval of the Office of EMS for Maine and several Maine officials assisted with the project. Statistical analysis was performed, and conclusions were drawn.

Overall, Maine had quite an opportunity and quite a difficult task when it became the first state to develop a state-wide community paramedicine protocol backed by state legislation and subsequently state funding. As is evident from the study data it is not the quantity of data collected; but rather the quality of the data

collected, that renders the over-all data lacking in statistical confidence in this study.

In order to empirically prove a program's success, strong data, firmly rooted in accepted collection metrics and with criteria specific to data being evaluated, is imperative to produce statistically sound, if not statistically significant, end results. In the case of Maine, collecting the appropriate data for supporting state-wide IMHC programs is not currently in place. While the system flourishes, and while positive changes are seen, until the positive outcomes have supporting data, the fiscal and operational outcomes of a state-wide EMS system remain to be seen. Maine has the opportunity and means to improve their system and continue to innovate as a benchmark program, but greater effort in data collection is necessary to fulfill this opportunity. With some modification and data collection discipline, the excellent system that Maine orchestrates could have the statistical markers to provide empirical proof of excellence that healthcare researchers demand and create standards on which all future statewide systems might benchmark.

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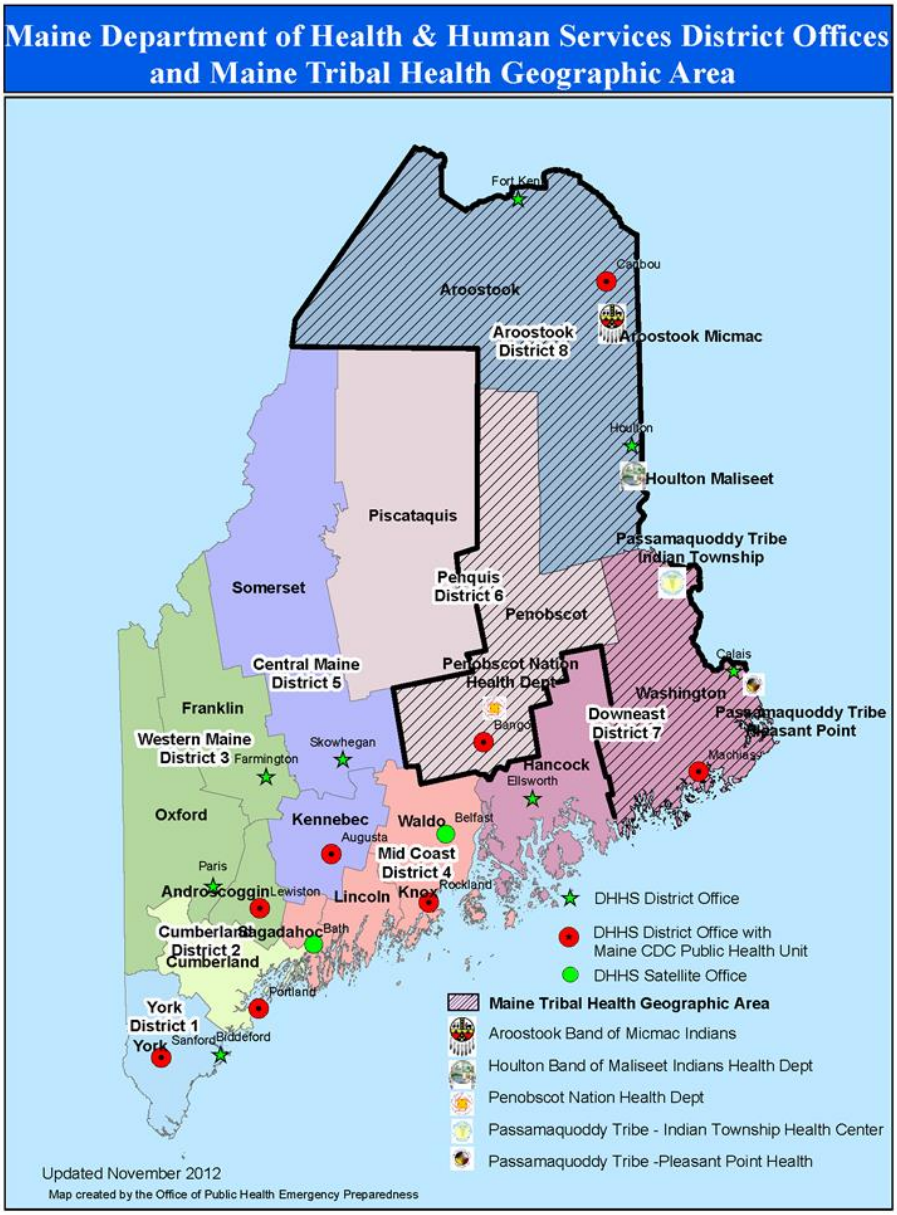
Appendix

Map 1



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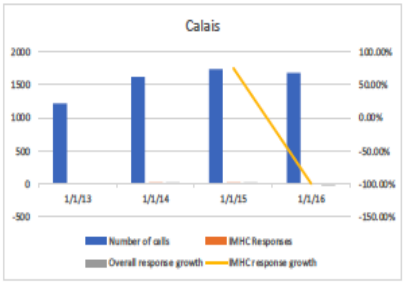
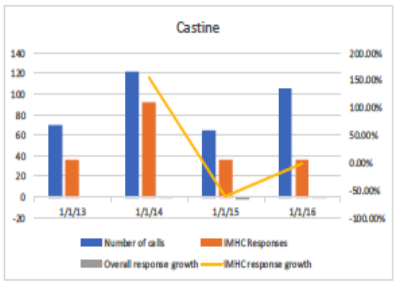
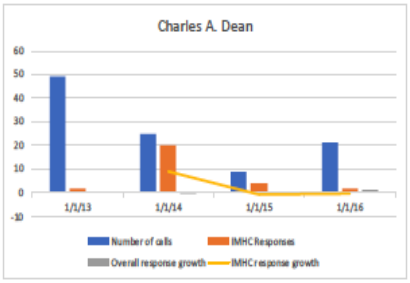
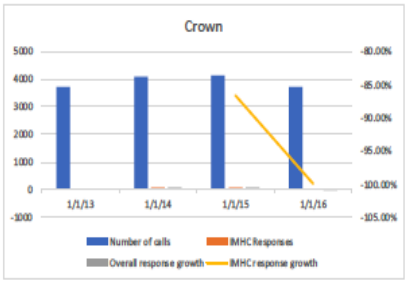
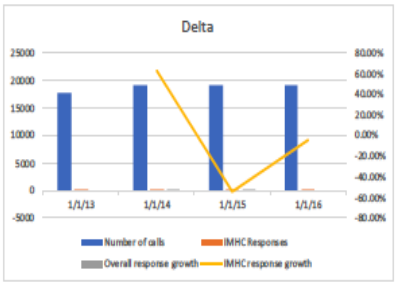
Individual overall results

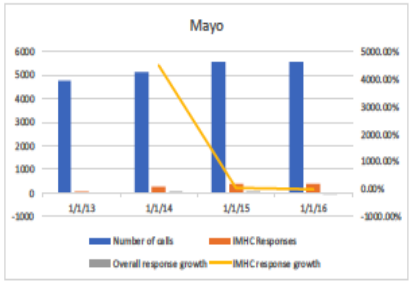


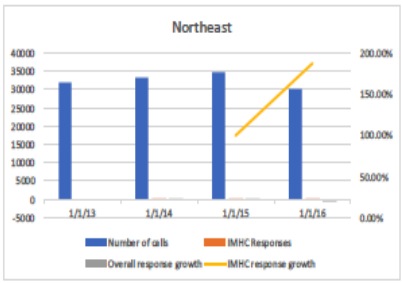


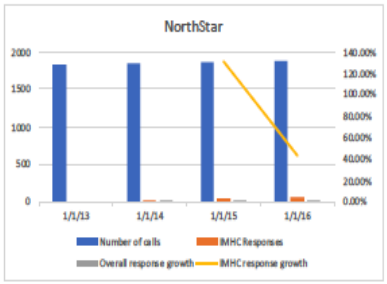


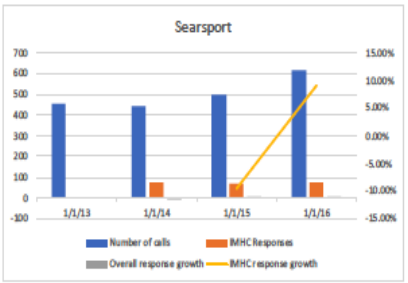


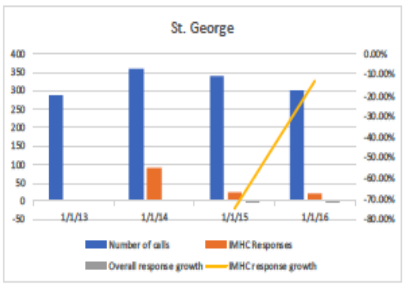


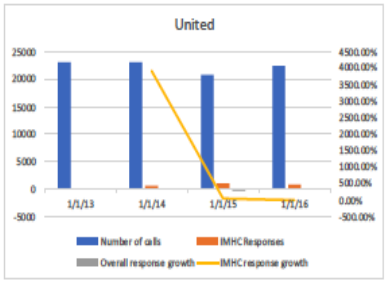


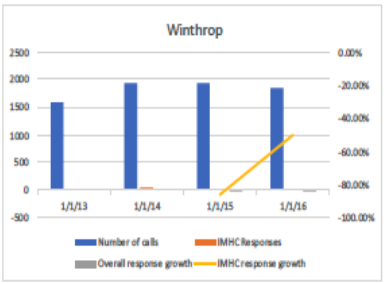






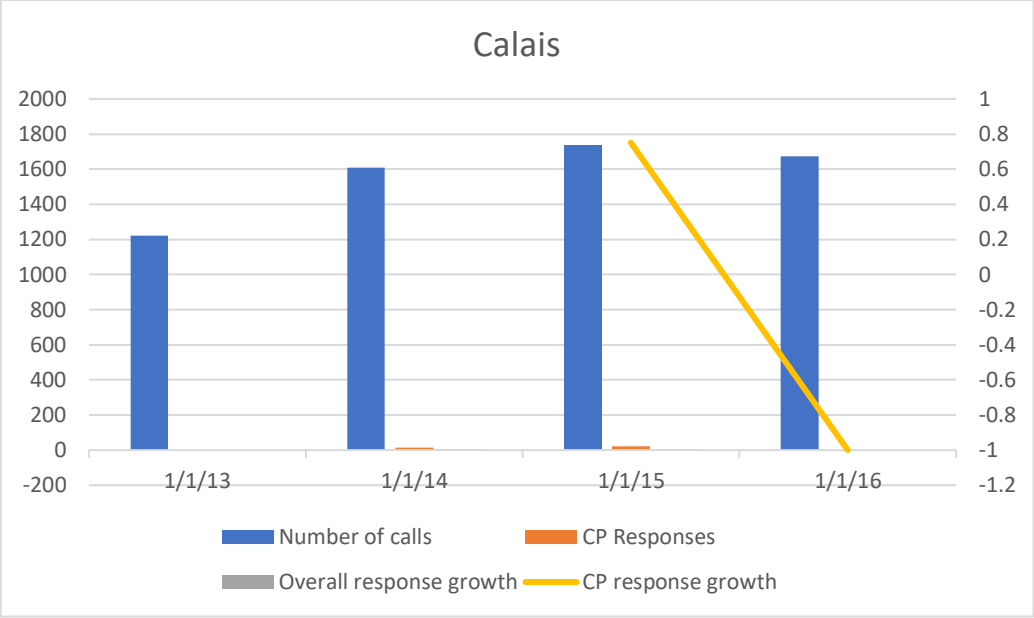


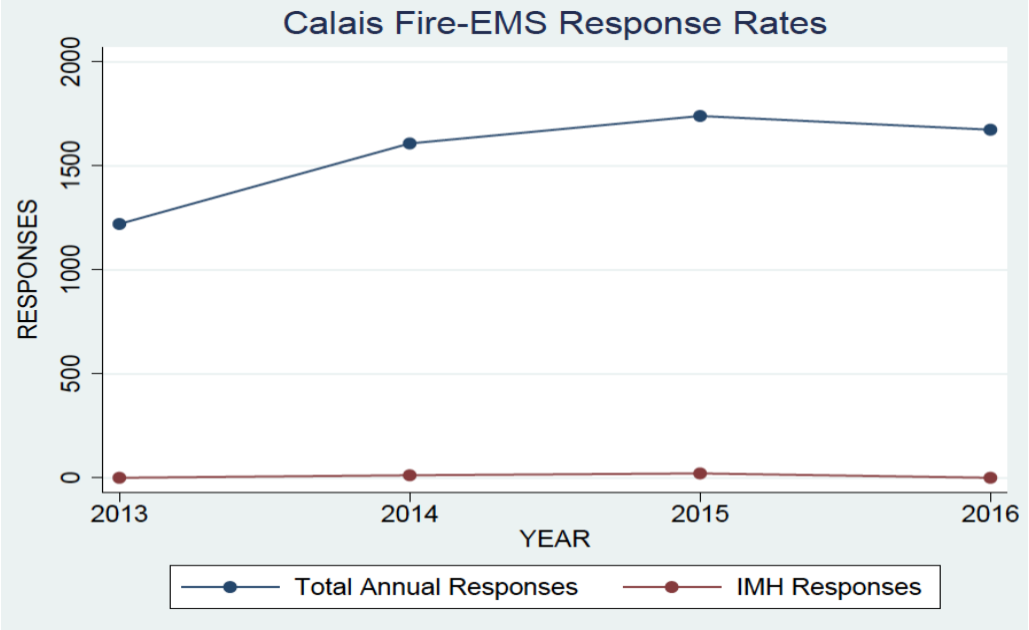




Calais Fire and EMS

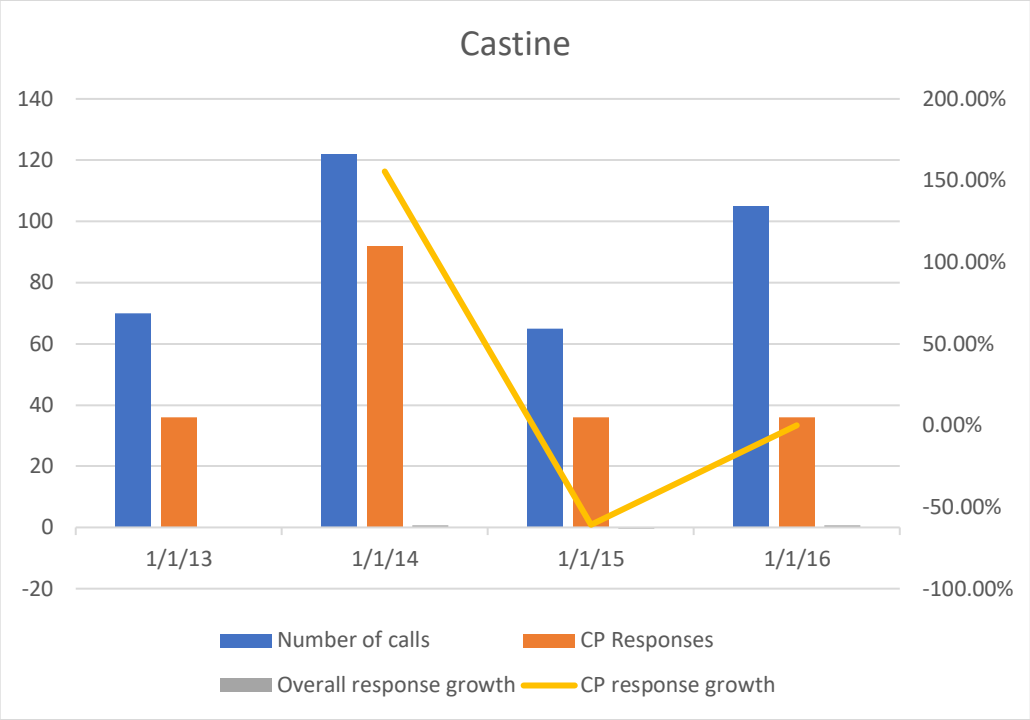
Service	Year of Observation	Number of calls	CP Responses	Overall response growth	CP response growth
CALAIS FIRE-EMS	1/1/13	1220	0		
CALAIS FIRE-EMS	1/1/14	1607	12	31.72%	
CALAIS FIRE-EMS	1/1/15	1739	21	8.21%	75.00%
CALAIS FIRE-EMS	1/1/16	1673	0	-3.80%	-100.00%

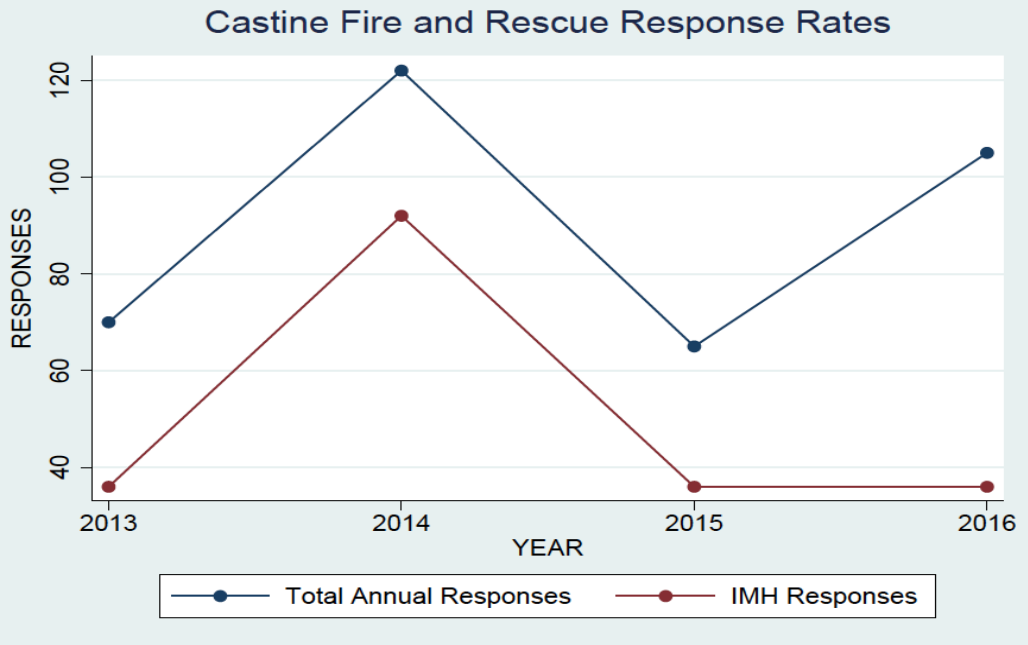




Castine Fire & Rescue

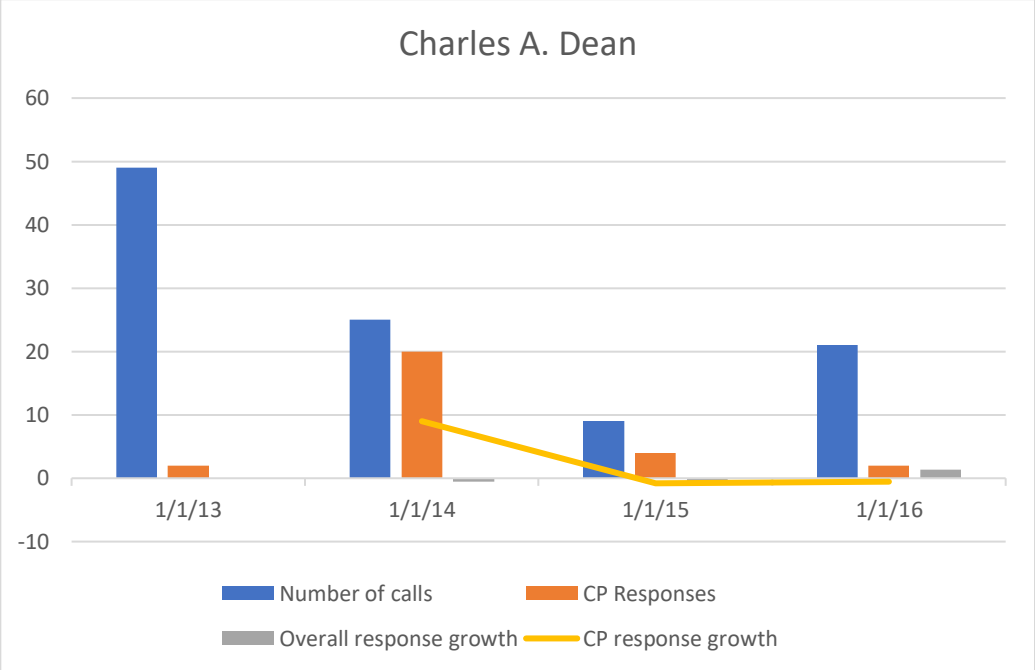
Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
CASTINE FIRE AND RESCUE	1/1/13	70	36		
CASTINE FIRE AND RESCUE	1/1/14	122	92	74.29%	155.56%
CASTINE FIRE AND RESCUE	1/1/15	65	36	-46.72%	-60.87%
CASTINE FIRE AND RESCUE	1/1/16	105	36	61.54%	0.00%

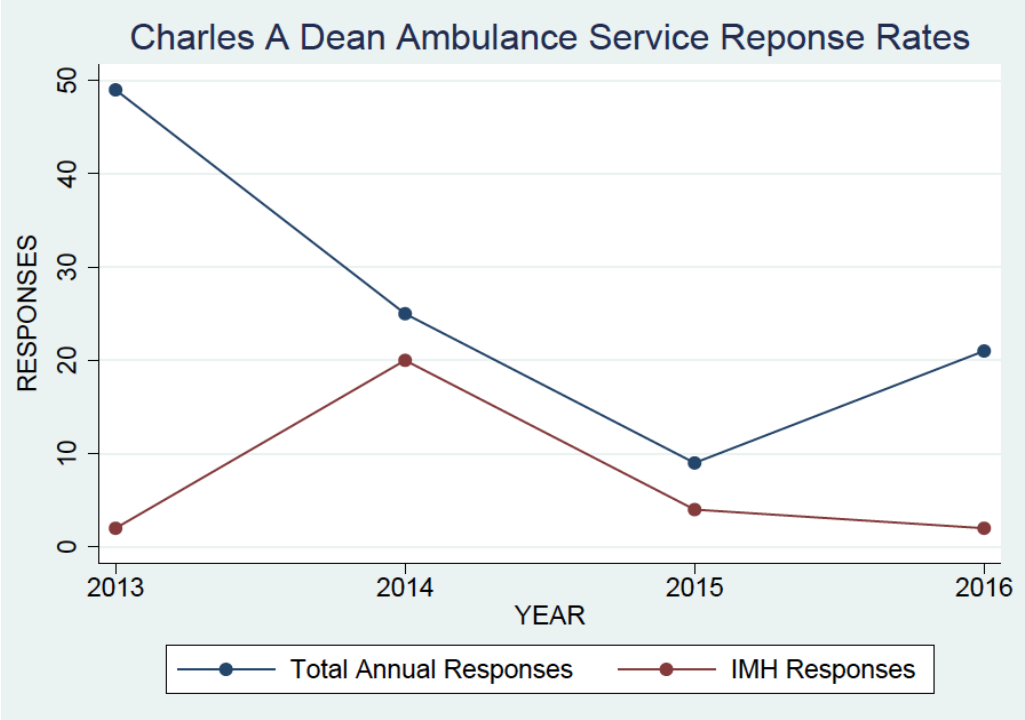

Castine
140
120
100
80
60
40
20
0
-20
200.00%
150.00%
100.00%
50.00%
0.00%
-50.00%
-100.00%
1/1/13
1/1/14
1/1/15
1/1/16
Number of calls
CP Responses
Overall response growth
CP response growth


Castine Fire and Rescue Response Rates
RESPONSES
40
60
80
100
120
2013
2014
2015
2016
YEAR
Total Annual Responses
IMH Responses

Charles A Dean Ambulance

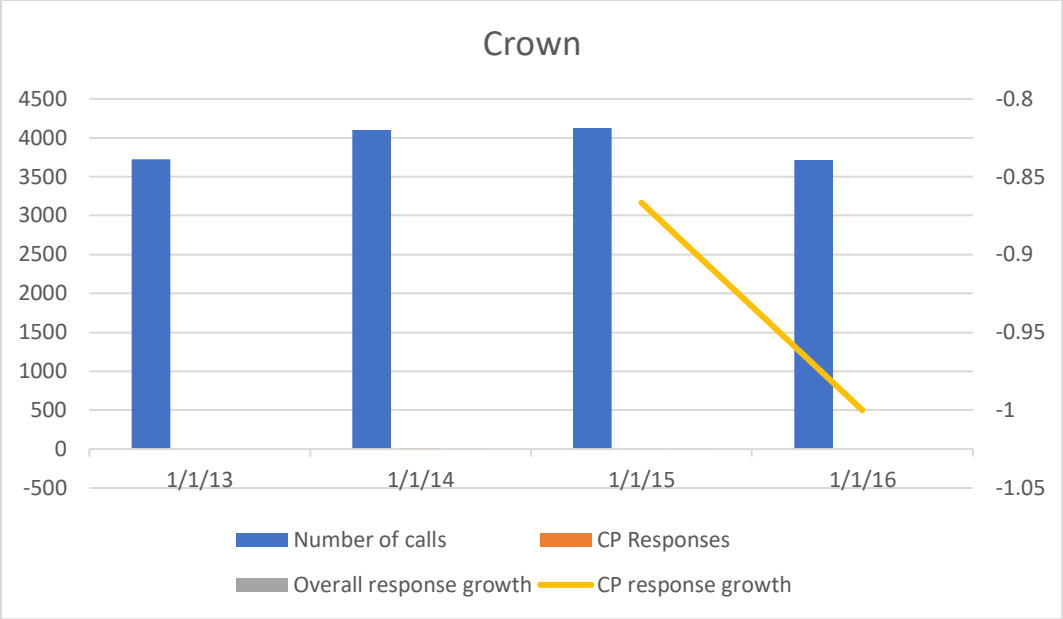
Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
CHARLES A DEAN AMBULANCE SERVICE	1/1/13	49	2		
CHARLES A DEAN AMBULANCE SERVICE	1/1/14	25	20	-48.98%	900.00%
CHARLES A DEAN AMBULANCE SERVICE	1/1/15	9	4	-64.00%	-80.00%
CHARLES A DEAN AMBULANCE SERVICE	1/1/16	21	2	133.33%	-50.00%

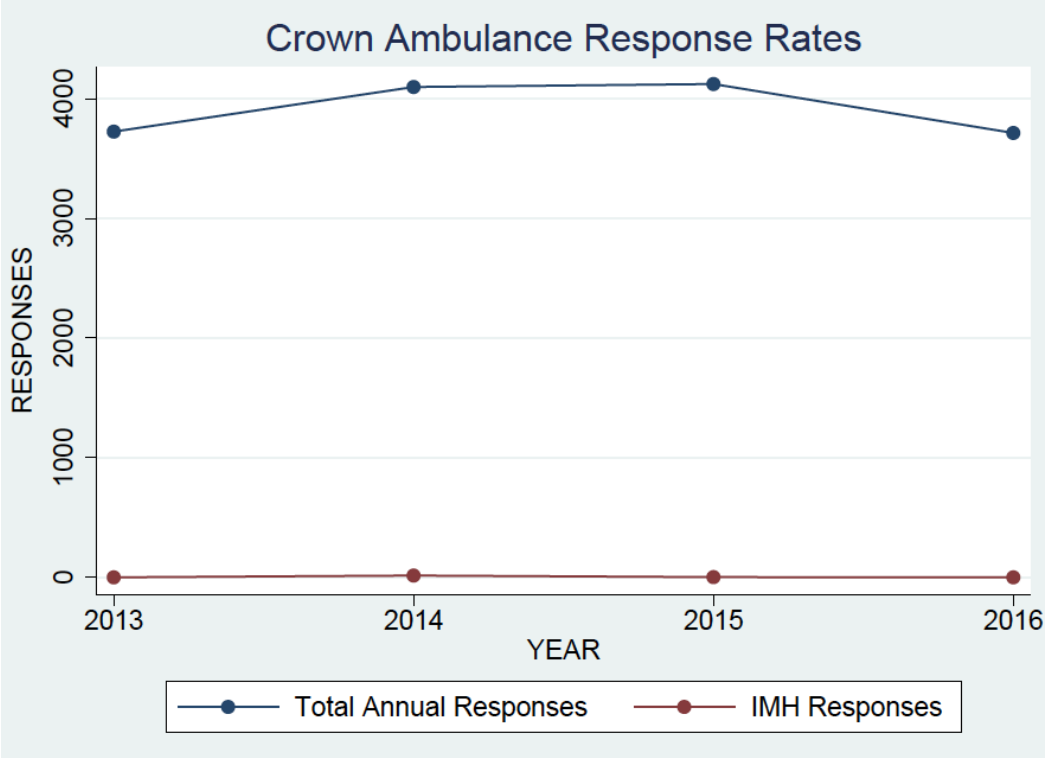




Crown Ambulance

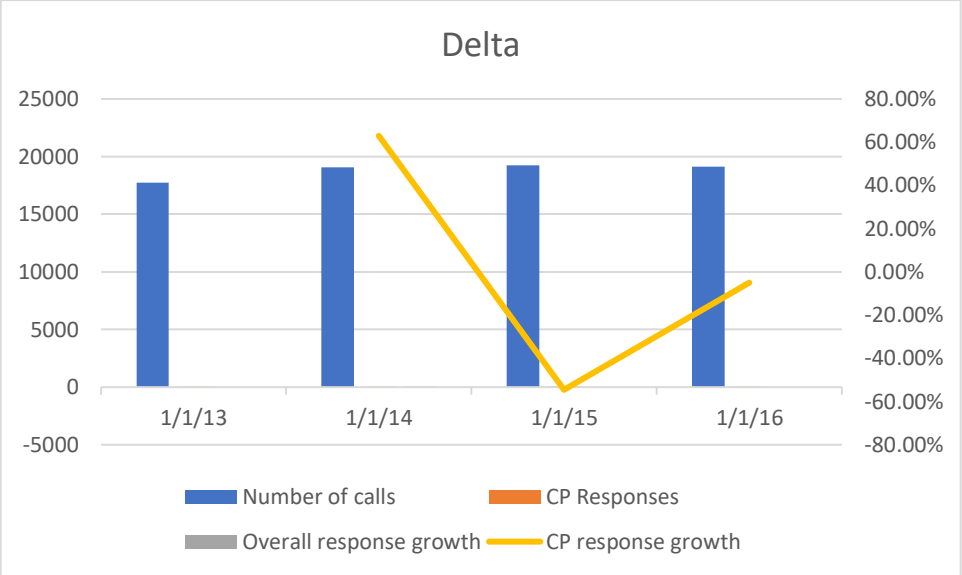
Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
CROWN AMBULANCE	1/1/13	3725	0		
CROWN AMBULANCE	1/1/14	4098	15	10.01%	
CROWN AMBULANCE	1/1/15	4123	2	0.61%	-86.67%
CROWN AMBULANCE	1/1/16	3714	0	-9.92%	-100.00%

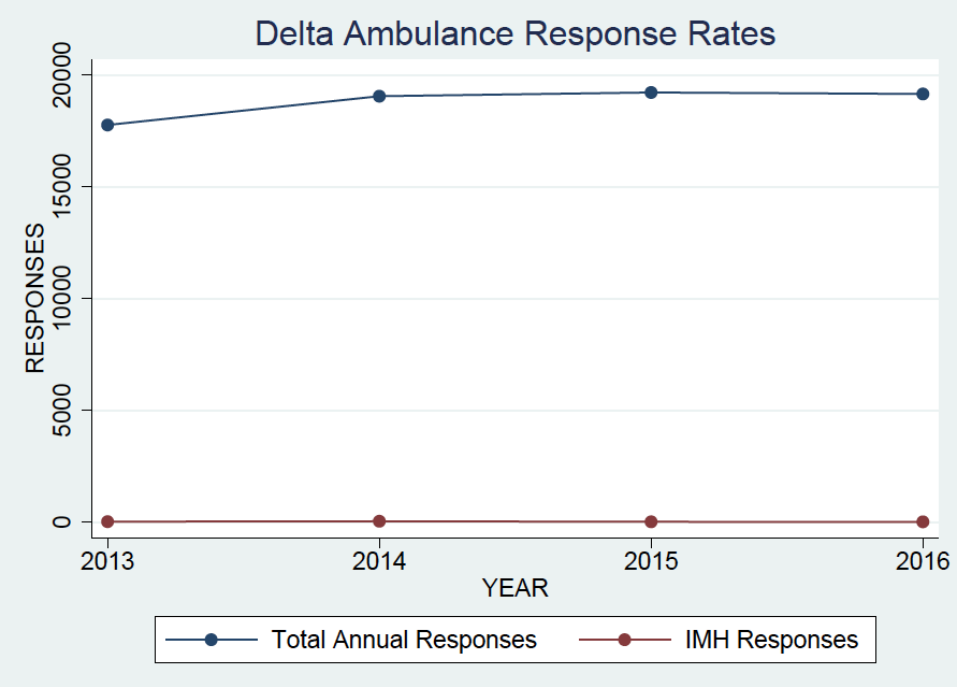

Crown
4500
4000
3500
3000
2500
2000
1500
1000
500
0
-500
-0.8
-0.85
-0.9
-0.95
-1
-1.05
1/1/13
1/1/14
1/1/15
1/1/16
Number of calls
CP Responses
Overall response growth
CP response growth


Crown Ambulance Response Rates
RESPONSES
0
1000
2000
3000
4000
2013
2014
2015
2016
YEAR
Total Annual Responses
IMH Responses

Delta Ambulance

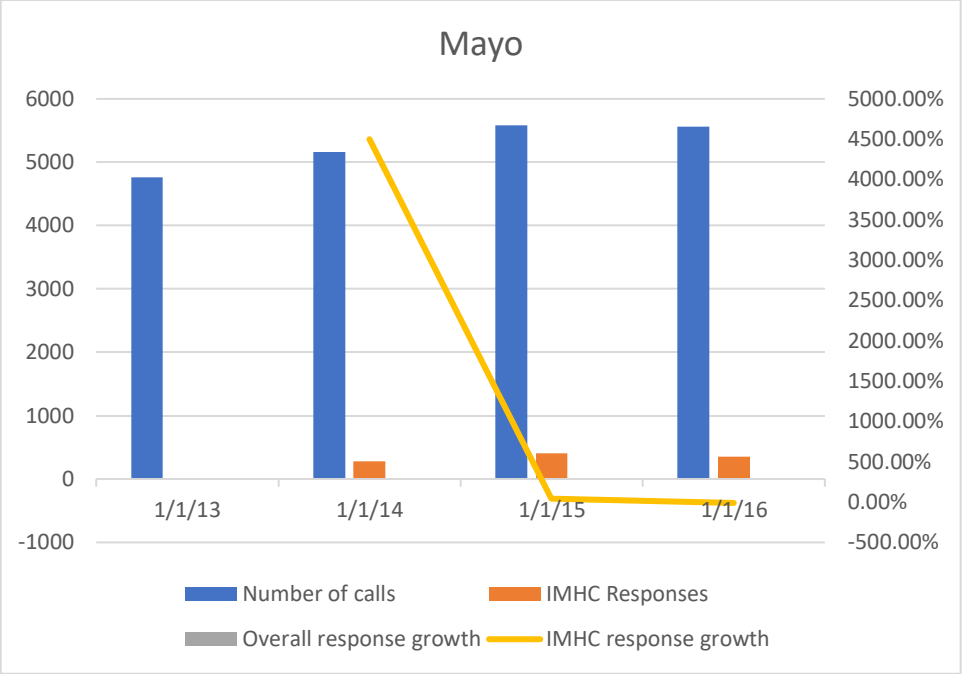
Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
DELTA AMBULANCE	1/1/13	17764	27		
DELTA AMBULANCE	1/1/14	19052	44	7.25%	62.96%
DELTA AMBULANCE	1/1/15	19218	20	0.87%	-54.55%
DELTA AMBULANCE	1/1/16	19152	19	-0.34%	-5.00%

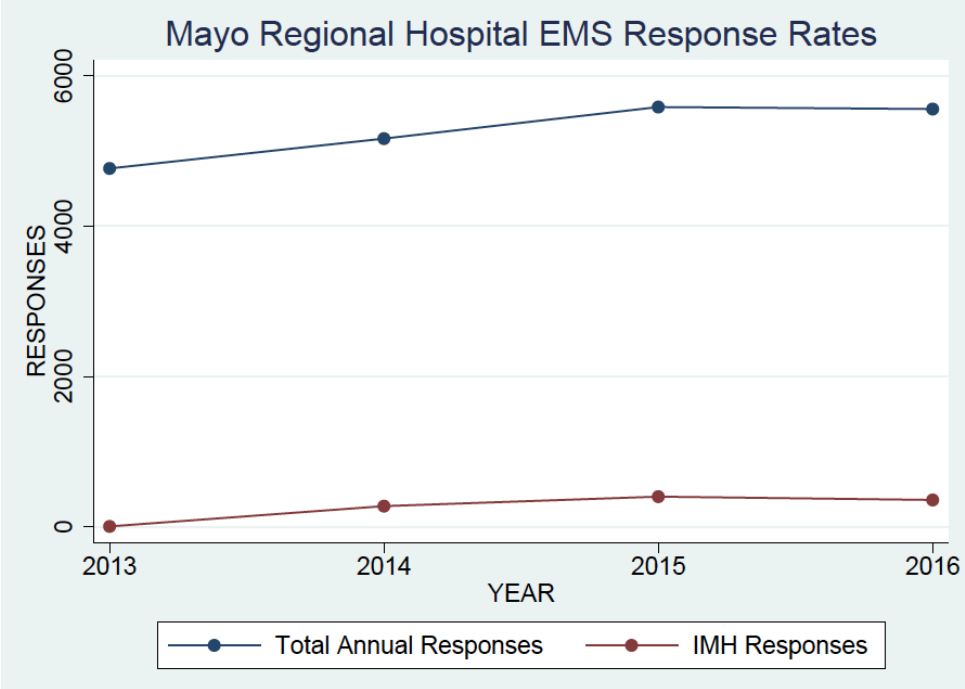




Mayo Regional EMS

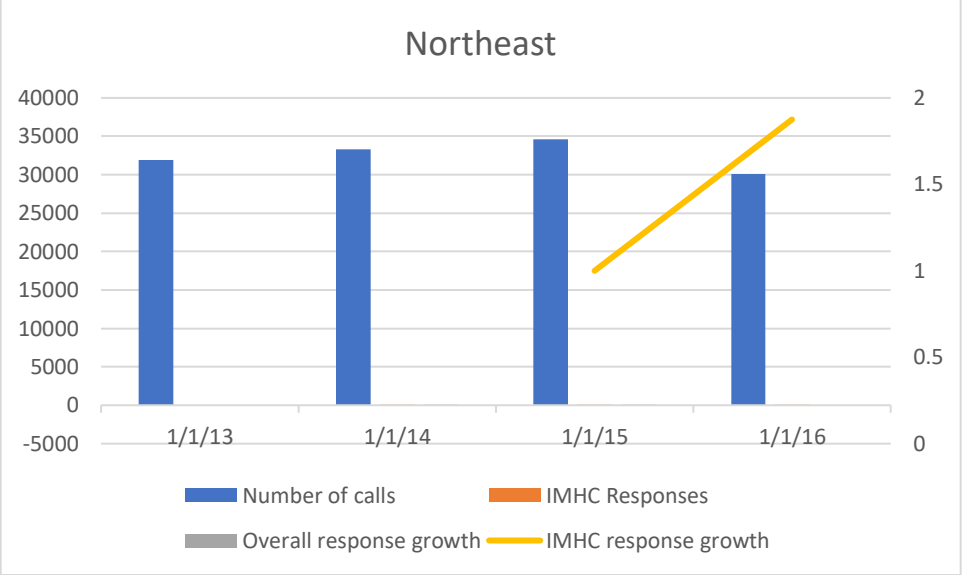
Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
MAYO REGIONAL HOSPITAL EMS	1/1/13	4767	6		
MAYO REGIONAL HOSPITAL EMS	1/1/14	5164	276	8.33%	4500.00%
MAYO REGIONAL HOSPITAL EMS	1/1/15	5584	402	8.13%	45.65%
MAYO REGIONAL HOSPITAL EMS	1/1/16	5557	358	-0.48%	-10.95%

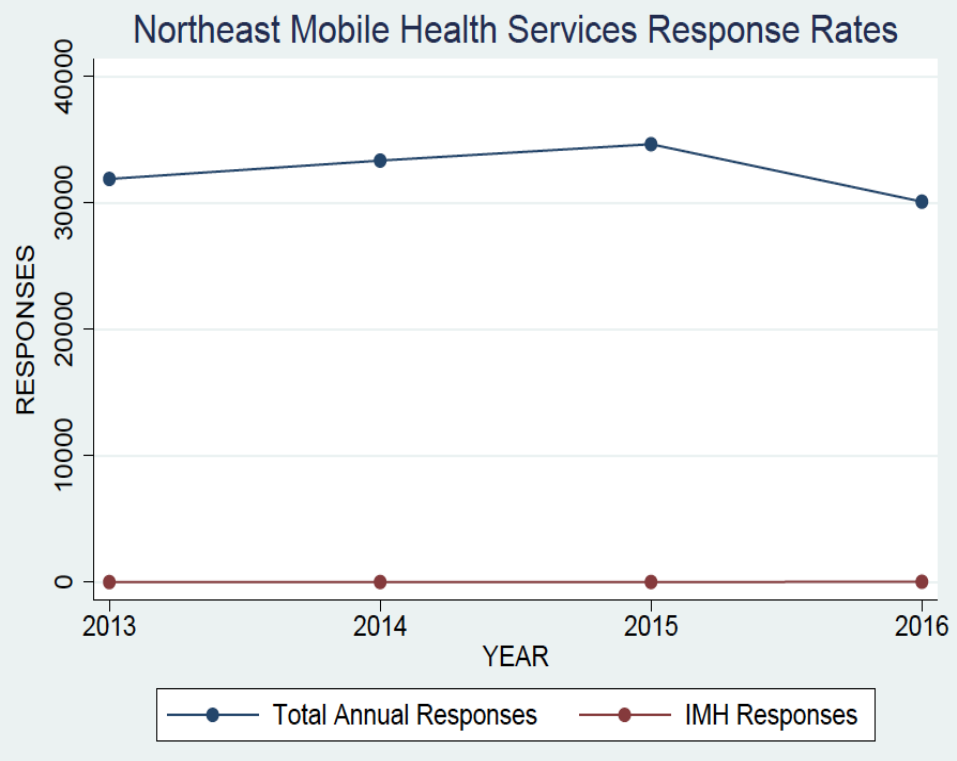

Mayo
6000
5000
4000
3000
2000
1000
0
-1000
5000.00%
4500.00%
4000.00%
3500.00%
3000.00%
2500.00%
2000.00%
1500.00%
1000.00%
500.00%
0.00%
-500.00%
1/1/13
1/1/14
1/1/15
1/1/16
Number of calls
IMHC Responses
Overall response growth
IMHC response growth


Mayo Regional Hospital EMS Response Rates
RESPONSES
0
2000
4000
6000
2013
2014
2015
2016
YEAR
Total Annual Responses
IMH Responses

Northeast Mobile Health

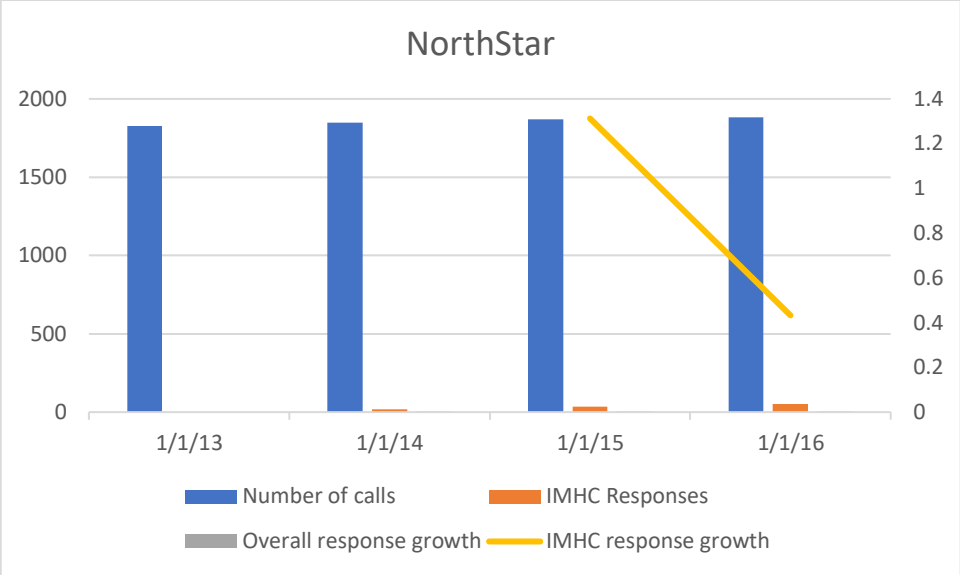
Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
NORTHEAST MOBILE HEALTH SERVICES	1/1/13	31888	0		
NORTHEAST MOBILE HEALTH SERVICES	1/1/14	33341	4	4.56%	
NORTHEAST MOBILE HEALTH SERVICES	1/1/15	34639	8	3.89%	100.00%
NORTHEAST MOBILE HEALTH SERVICES	1/1/16	30092	23	-13.13%	187.50%

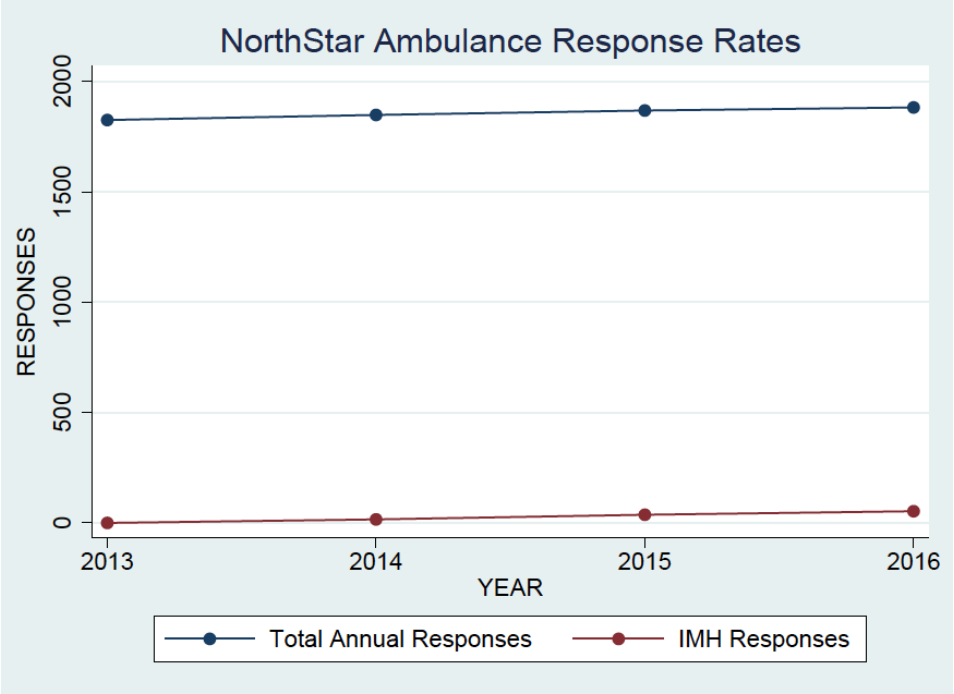




NorthStar Ambulance

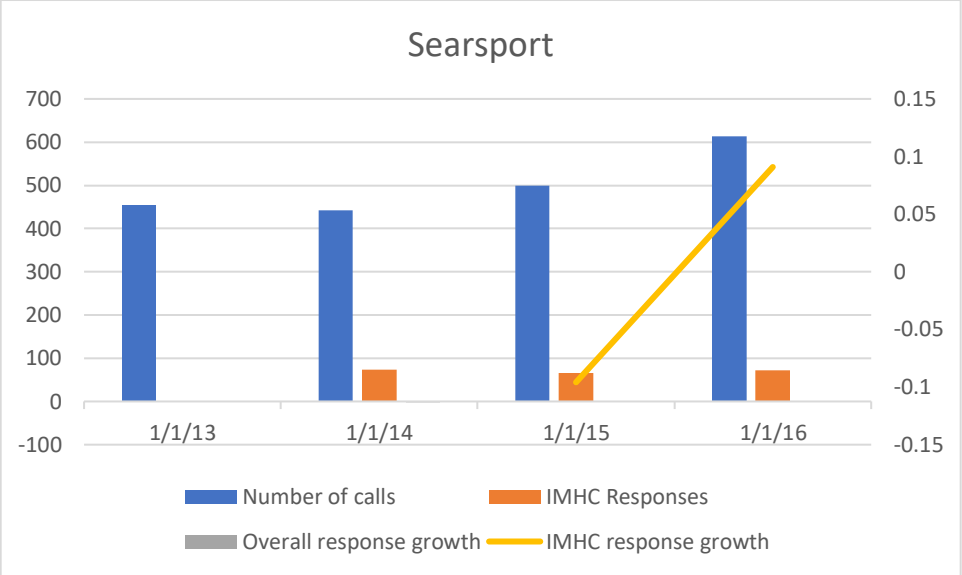
Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
NORTHSTAR	1/1/13	1825	0		
NORTHSTAR	1/1/14	1848	16	1.26%	
NORTHSTAR	1/1/15	1868	37	1.08%	131.25%
NORTHSTAR	1/1/16	1882	53	0.75%	43.24%

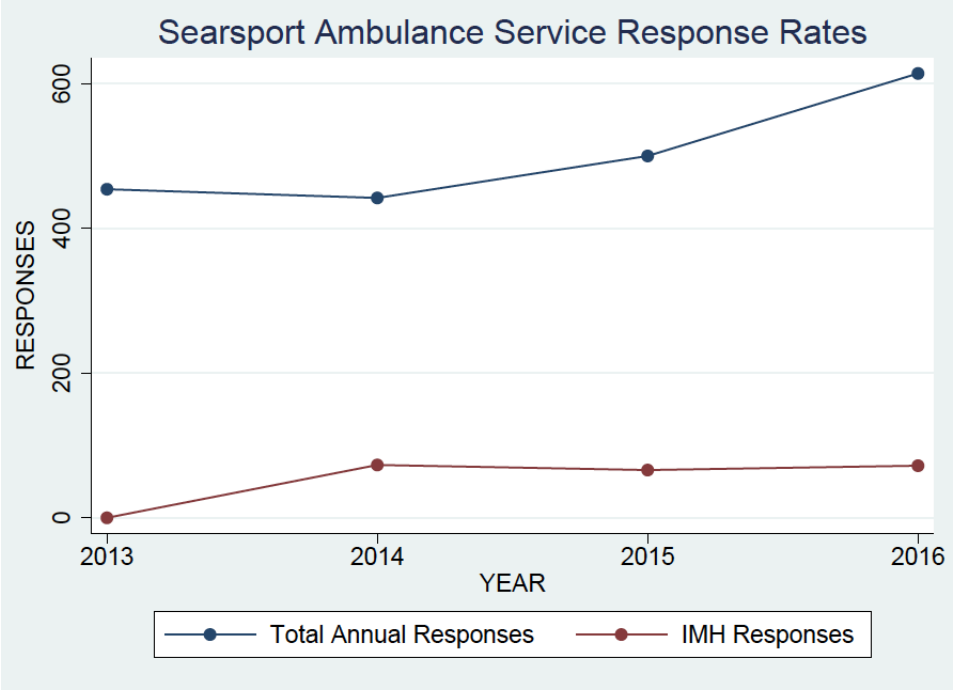

NorthStar
2000
1500
1000
500
0
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/13
1/1/14
1/1/15
1/1/16
Number of calls
IMHC Responses
Overall response growth
IMHC response growth


NorthStar Ambulance Response Rates
RESPONSES
0
500
1000
1500
2000
2013
2014
2015
2016
YEAR
Total Annual Responses
IMH Responses

Searsport Ambulance Service

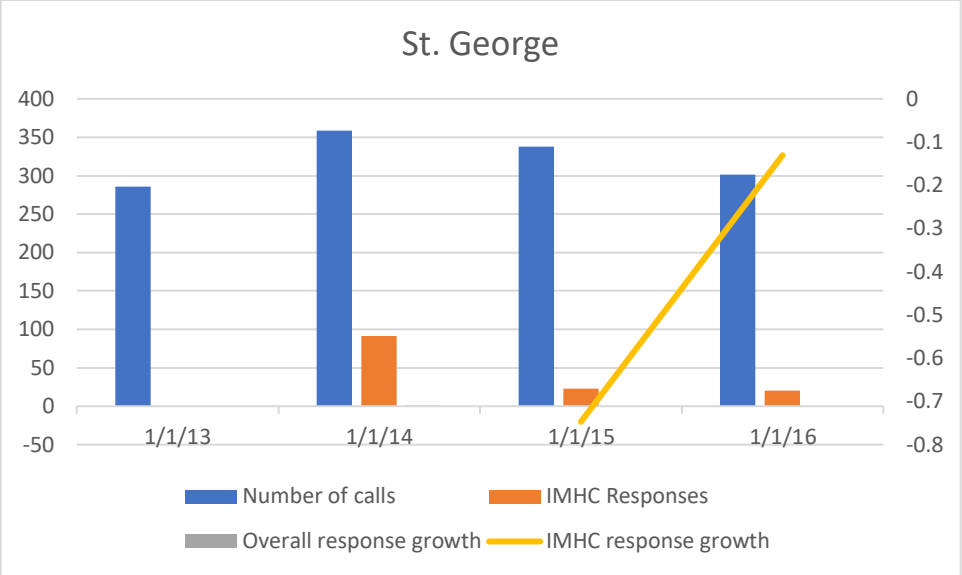
Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
SEARSPORT AMBULANCE SERVICE	1/1/13	454	0		
SEARSPORT AMBULANCE SERVICE	1/1/14	442	73	-2.64%	
SEARSPORT AMBULANCE SERVICE	1/1/15	500	66	13.12%	-9.59%
SEARSPORT AMBULANCE SERVICE	1/1/16	614	72	22.80%	9.09%

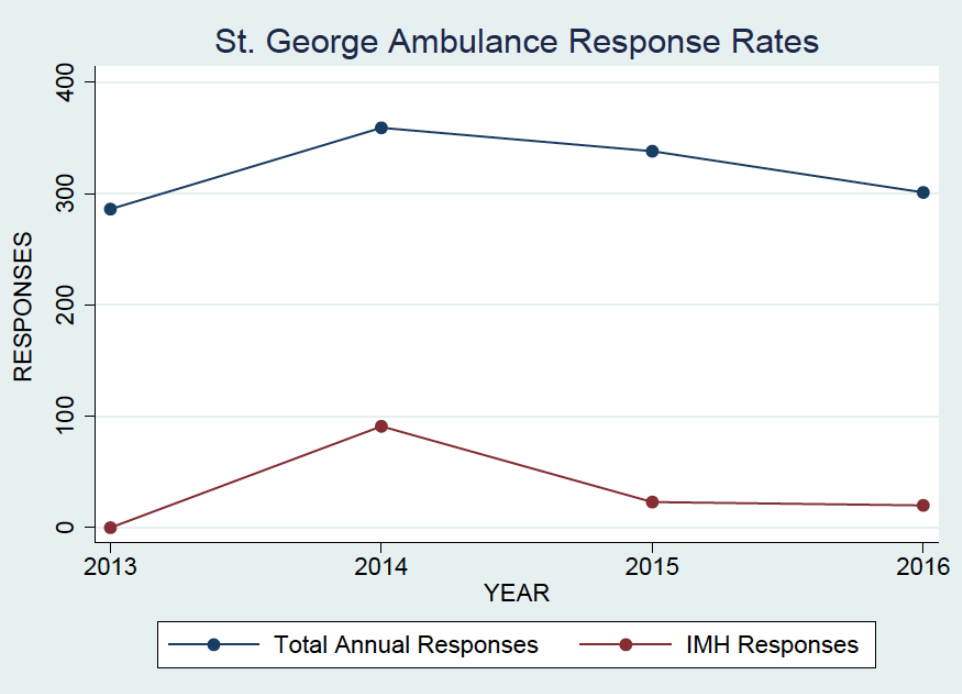




St. George Ambulance

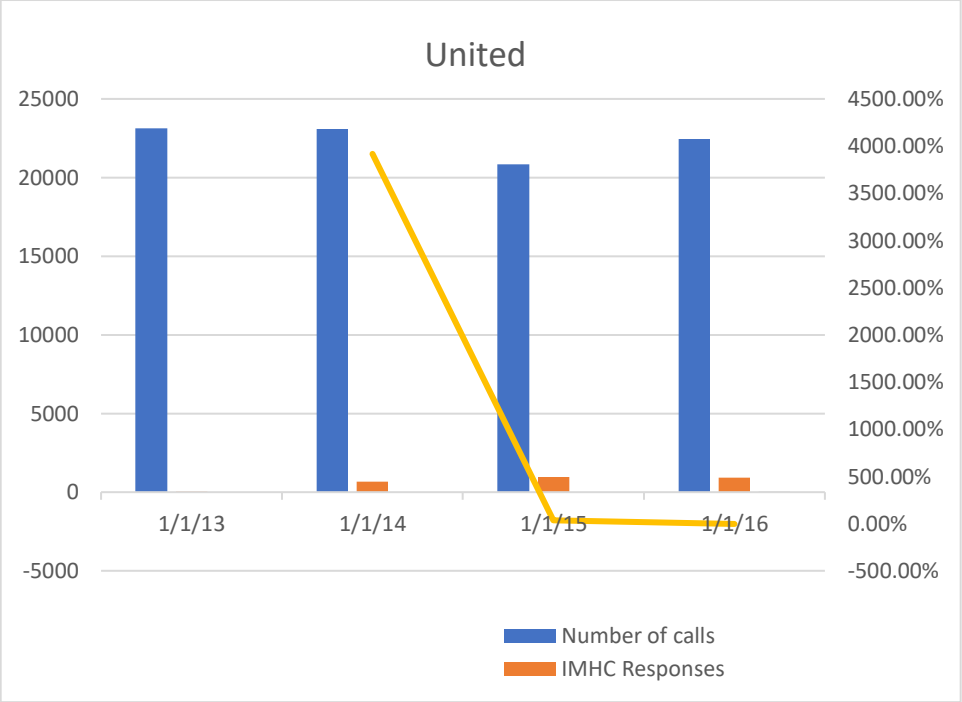
Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
ST GEORGE AMBULANCE	1/1/13	286	0		
ST GEORGE AMBULANCE	1/1/14	359	91	25.52%	
ST GEORGE AMBULANCE	1/1/15	338	23	-5.85%	-74.73%
ST GEORGE AMBULANCE	1/1/16	301	20	-10.95%	-13.04%

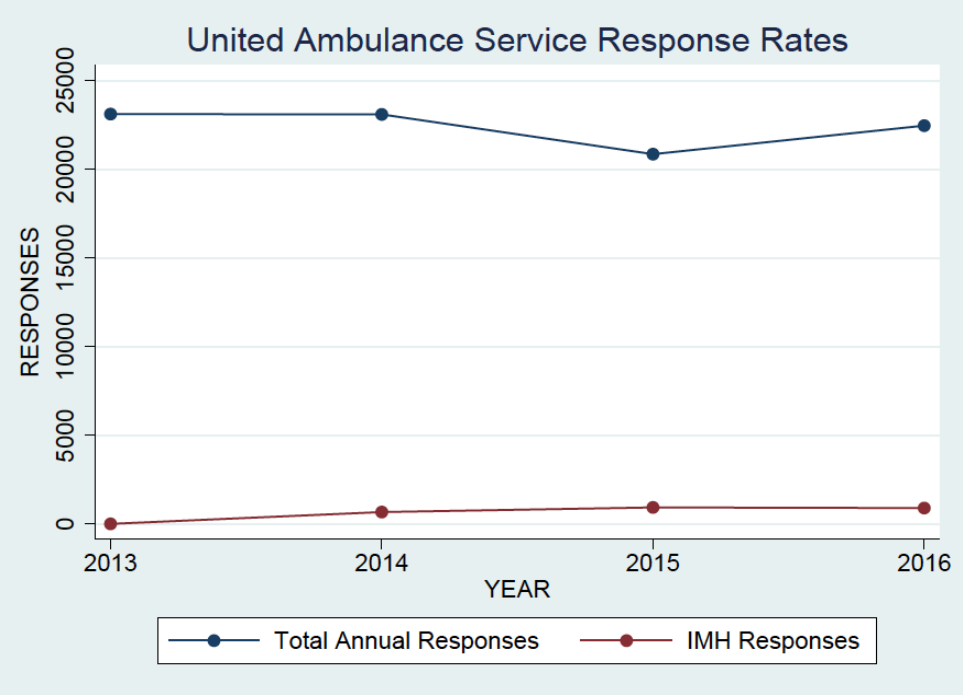

St. George
400
350
300
250
200
150
100
50
0
-50
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
1/1/13
1/1/14
1/1/15
1/1/16
Number of calls
IMHC Responses
Overall response growth
IMHC response growth


St. George Ambulance Response Rates
RESPONSES
0
100
200
300
400
2013
2014
2015
2016
YEAR
Total Annual Responses
IMH Responses

United Ambulance

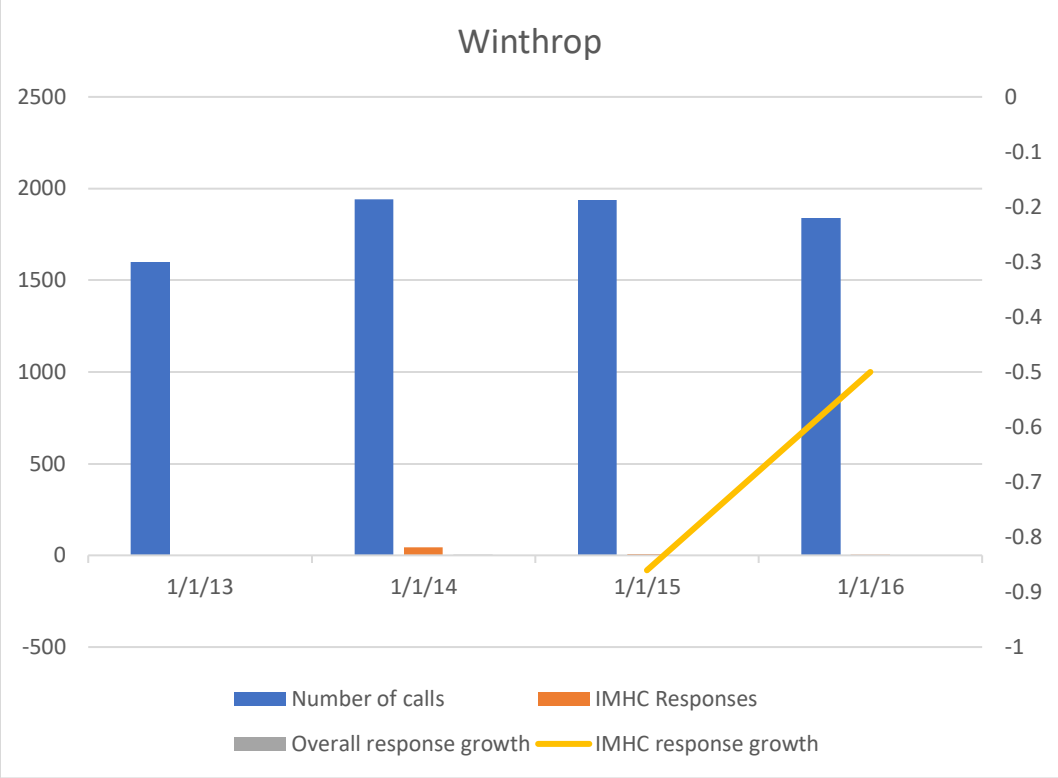
Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
UNITED AMBULANCE SERVICE	1/1/13	23118	17		
UNITED AMBULANCE SERVICE	1/1/14	23098	683	-0.09%	3917.65%
UNITED AMBULANCE SERVICE	1/1/15	20858	943	-9.70%	38.07%
UNITED AMBULANCE SERVICE	1/1/16	22464	908	7.70%	-3.71%

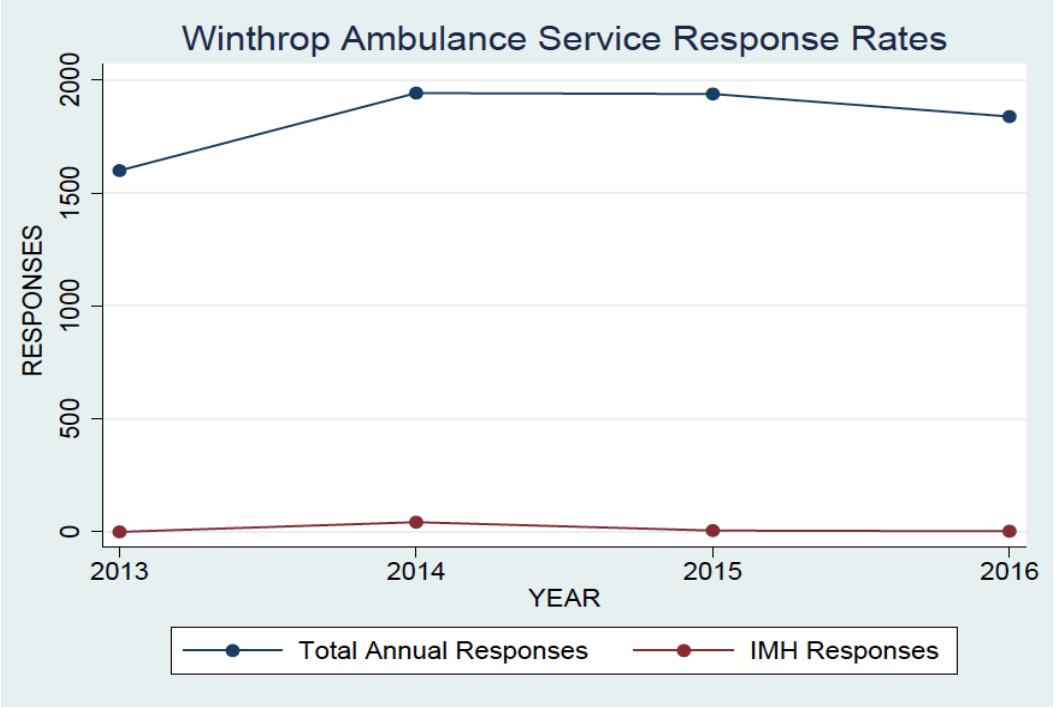




Winthrop Ambulance Service

Service	Year of Observation	Number of calls	IMHC Responses	Overall response growth	IMHC response growth
WINTHROP AMBULANCE SERVICE	1/1/13	1599	0		
WINTHROP AMBULANCE SERVICE	1/1/14	1942	43	21.45%	
WINTHROP AMBULANCE SERVICE	1/1/15	1938	6	-0.21%	-86.05%
WINTHROP AMBULANCE SERVICE	1/1/16	1838	3	-5.16%	-50.00%


Winthrop
2500
2000
1500
1000
500
0
-500
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
1/1/13
1/1/14
1/1/15
1/1/16
Number of calls
IMHC Responses
Overall response growth
IMHC response growth


Winthrop Ambulance Service Response Rates
RESPONSES
0
500
1000
1500
2000
2013
2014
2015
2016
YEAR
Total Annual Responses
IMH Responses