

TELEMEDICINE ADOPTION IN ONTARIO

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Abstract

Telemedicine (TM) is a term that describes the delivery of healthcare over distances. TM has evolved along with communication technology, creating a model of TM healthcare delivery that is constantly changing.

The primary advantage of TM is that it gives physicians the ability to reach out to patients remotely, providing healthcare to remote or isolated locations, thus greatly reducing the need for patient travel. The physician is the primary stakeholder of TM, but to date there is a paucity of research related to TM utilization by physicians. Specifically, it is not known whether TM is an efficient healthcare tool that allows more patients to be seen by a physician than could normally be seen face to face (F2F), hence increasing the potential volume of patient care.

This study describes the adoption and utilization characteristics within a “real” medical environment (the Ontario Ministry of Long-term Health Care) by analyzing established medical practices. Using OHIP data, this study shows TM utilization trends among physicians who were responsible for a large portion of TM patient activity within their respective specialties between 2011 and 2013. By understanding TM usage by physicians, the ministry can provide programs and incentives that may increase TM adoption, thus providing more efficient healthcare to underserved populations in Ontario.

The top three specialties from 2008-2013 using TM in Ontario were found to be General and Family (G&F) practice, Internal Medicine and Psychiatry, with G&F physicians using TM primarily to increase practice volumes for addiction medicine. Within the Internal Medicine specialty, TM appears to be a tool for healthcare delivery that helps offset some F2F events. Within the specialty of Psychiatry, many TM events seemed to have been performed by psychiatrists who have smaller volumes of F2F visits compared to their peers.

Trends in TM show that for some specialties and types of clinical events, TM can be used to see more patients than physicians could normally see when restricted to F2F visits only, thus reducing the number of F2F visits within some practices. \

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Introduction

Telemedicine History and Role

The term Telemedicine (TM) is a word that was created by Thomas Bird in the 1970's and is a blend of Greek and Latin; "tele" meaning distance and "medicus" meaning healing (1). In its basic form, TM is a form of healthcare delivery that is administered across distances with the assistance of telecommunication technology.

A wide spectrum of research has been published on TM, including what correctly constitutes TM and the merits of using TM in healthcare. One literature review summarized 104 published papers to determine a greater understanding of what defines TM, and concluded (2):

- *Technologies used in TM range from simple email transactions of images to complex remote surgical procedures (ex. Robots)*
- *The nature of TM will evolve as telecommunication technology is in a constant flux*
- *TM has potential benefits ranging from lowering costs, education(3), improving access and quality of medical services provided, and improved efficiencies.*
- *TM is a patient-centric model of care*

In summary, TM can be considered a patient-centric model of healthcare delivery that has the benefits of reaching out to underserved populations (i.e. remote isolated areas without adequate healthcare providers), lowering costs and improving efficiencies making it, at least in theory, an ideal method of healthcare.

TM Research Gap Literature Review

Though TM is considered a useful technology for healthcare access (4), there has been a lack of research or validation in TM utilization (effective use) by physicians. One review found that research with respect to TM involved clinical outcomes and patient satisfaction, but other performance metrics such as utilization were found to be rare (5). A white paper covering the period up to 2008 "Provider Utilization of TM: The Elephant in the Room" (6), found that TM has had significant funding and attention over the years, but research in actual utilization of TM

by physicians was considered “*disappointing by any standard*” casting doubt on whether the widely believed merits of TM had been verified.

TM’s ability to cover vast distances for healthcare delivery is often used to justify to the merits of telemedicine. Research done by the Ontario Telemedicine Network (OTN) over a 6-month period, 757,234km of travel was avoided resulting in an estimated savings of 185 metric tons of carbon dioxide pollutants (7) providing the environmental benefits of TM. Although TM may have a positive environmental impact and provides medical access to rural regions, from an economic benefit perspective the question of “does TM save money for healthcare systems” remains unclear. A systematic review of over the past 20 years of cost effectiveness identified 80 studies that were classed as full economic evaluations (8). The conclusion of this review was that there is no conclusive verification that TM was a cost-effective alternative to conventional healthcare.

A measure a physician’s utilization of TM, a percentage ratio of: $100 \times \frac{\# \text{ of TM Events}}{\# \text{ of Total Clinical Events}}$ can be used as a proxy for TM effectiveness. This percentage indicates the physician’s usage or utility of TM. Even though TM is considered a patient-centric model of healthcare delivery (2), TM can cause a significant impact on physician workflow and processes (9, 10). Therefore physicians must be considered the primary stakeholders in TM adoption (11). Even if patients prefer TM over regular Face-To-Face (F2F) meetings, physicians possess the ultimate control on whether TM is used or not (6, 12). Therefore, TM utilization is influenced by the benefits that TM provides to physicians (13) and not necessarily the patients.

A higher TM utilization rate could be interpreted as physicians finding ways to incorporate more TM clinical events within the physician’s respective practice. A higher usage may imply a level of practice efficiency along the lines of patient through-put (14). The notion of practice efficiency comes from the shortage of healthcare providers in many countries, where healthcare delivery services such as TM might close this medical service gap (15, 16). Determining physician utilization is one way of evaluating if TM can help offset the potential imbalance between the availability of medical resources and the number of patients that require medical services.

A systematic review of reviews performed by Ekeland, Bowes and Flotropp (17) identified 50 systematic reviews from an initial scan of 1593 abstracts (1419 were excluded from an initial screen, 94 were excluded from 174 articles because of low quality and the final 50 were selected because these reviews discussed methodologies). The inclusion criteria were population/participant, interventions, comparisons and outcomes. The authors found that a group of reviews recommended larger and more rigorous studies to assess impacts of TM, while another group of reviews suggested that outcome measures should be standardized to enable meta-analysis of the outcomes.

Another study by Bashshur et al. (18) reviewed research on the merits of TM use in primary care. The review process involved four steps:

- A publication universe that spanned 10 years (2005-2015)
- Accepting research papers that used robust or rigorous methodologies for estimating population values and sample sizes in about 150 cases
- A categorical sorting of publications based on feasibility /acceptance, intermediate outcomes, health outcomes and cost
- Review of all relevant articles that were eligible to be included in the study.

From 2,308 articles in the Bashshur study, only 86 met the inclusion criteria and 8 of those studies evaluated cost differentials between TM and traditional F2F visits, cost avoidance, shorter consult time and cost savings from TM use. The consensus of this research found that TM has the potential to address the challenges related to primary care such as primary care physician shortages and quality of healthcare. However, the research also concluded that the challenge remains to validate the impact of TM on clinical outcomes with scientific rigor and standardized assessments on potential cost savings.

What is clear is that TM has been researched quite extensively and the benefits have been well stated but not necessarily validated. What remains unclear is whether TM is an effective way for physicians to deliver healthcare and specifically, whether it is an efficient method of healthcare for both patients and physicians.

Thesis Question

If TM can provide healthcare cost savings and can be a time efficient method for physicians to see patients(19), physicians should be able to grow their respective practices accordingly with TM use. Some healthcare systems such as the Ontario Ministry of Health and Long-Term Care (MOHLTC) have provided financial incentives that allow physicians to bill a premium when TM is used to increase adoption. This thesis attempts to answer the question: *Is current TM use in Ontario physician practices a growing fraction of their interactions with patients as compared to regular face to face patient visits?* The hypothesis is that if the purpose of TM is to improve access to healthcare, TM events should be an increasing portion of a physician's practice. Physician practice size may grow over time to meet this demand through more use of TM (as opposed to increasing face to face visits).

Literature Review of TM Utilization and Adoption

If physician utilization can be used as a proxy for TM popularity among physicians (9, 11, 20), utilization is likely a function of the perceived benefit that TM provides physicians. Surveys have been published that try to determine the degree of TM utilization and to assess where TM has been effective in healthcare delivery systems.

One U.S. study (21) surveyed a physician population consisting of 202 TM-users compared to 494 non-TM users and ranged across various specialties. Diagnosis and patient follow-ups were the most common use of TM, and users were more inclined to put up with some inconveniences of TM as the reduction of travel time for the patient was an important factor within their respective practices. This idea is supported by the OTN study (7) where TM was estimated to avoid 757,234 km of travel for patients. In contrast, non-users found that TM setup difficulties and the disruption in workflow caused problems that inhibited their use of TM. The results suggest that physicians have different opinions or attitudes towards TM which would impact their utilization, regardless of specialty (a hypothesis that physicians of the same specialty would have similar practice styles has been disproved (22)). Behavior models have been created to determine why a physician would use TM (10, 23, 24), but these models mainly focused on adoption theory and did not model TM usage. Hence the practical applications of these models

may be somewhat limited. An interesting observation from (21) suggested that there were a higher number of TM users in public clinics compared to private clinics. The rationale provided was based on the premise that private physicians are typically salaried and physicians operating in public clinics use a fee for service model. Consequently, TM is likely considered to be an opportunity cost that would vary, depending on how the physician was compensated, thereby impacting TM utilization.

Though recent studies are difficult to find with respect to empirical data analyzing TM usage by physicians¹, a study completed in Kansas interviewed 28 rural physicians and found that only 9 physicians (32%) had used TM consultations, and the number of consultations was found to be low compared to regular F2F visits (25). However the study discovered that store-and-forward² applications were found to be quite useful and no less effective than traditional means of exchanging medical information media such as medical images (10).

Store-and-forward was found to have quicker turnaround times than traditional methods. These time savings were attributed to quicker contact with the specialists using TM by the Arizona Telemedicine Program (ATP)³ (14). Though the study showed that ATP patients had quicker access to specialists, the authors concluded that more research was required to determine clinical impact of TM. As well, there was no evidence that quicker turnaround times led to higher numbers of patients seen compared to traditional F2F events. A study done by the US Department of Veterans Affairs did find that the use of TM had an average savings of 145 miles and 142 minutes per visit from a patient perspective (26). However, the same study noted that, even though TM events grew over the period of the study, the numbers of TM events were still very small relative to traditional F2F visits.

In Saskatchewan, TM is being used to increase access to First Nations Communities (27). This study assessed the potential for long distance diagnostic technologies such as Remote Presence Robotic Technology (RPRT), portable fibro scans for liver clinics and internet-based videoconferencing. The research preliminary findings indicated that these TM technologies do fill in gaps in healthcare access, but its use is limited as TM can never completely replace the

¹ Most studies revolve around behavior models for technology acceptance models (TAM)

² Store-and-Forward: Where digital data is created, stored and then forwarded/sent to the specialist

³ <http://TM.arizona.edu/about-us/home>

advantages of a direct or in-person meeting of patient and doctor. The researchers concluded that TM does improve access, but further research is required to determine the use of these technologies as a safe and clinically and cost-effective approach to delivery healthcare.

A study from the Ontario TM Network (OTN) endeavored to determine TM utilization by aggregating TM visits from 2008/2009 to 2013/2014 (28). The study was based on “patient-physician visits” data captured by OHIP (Ontario Health Insurance Plan) and the Ontario TM Network. The research showed during the 5-year time period, that 652,337 scheduled TM visits were recorded and, 89.1% were completed. Only 10.7 % were cancelled or missed and only 0.2% were not completed due to technical difficulties. This indicates that TM is technically viable and can be considered a suitable mode of healthcare delivery.

From a geography perspective, the OTN research analyzed TM activity between rural and urban centers within Ontario and it was also divided between southern and northern Ontario. In Southern Ontario TM, 82% of visits were with patients from Southern Ontario urban centers. In Northern Ontario, it was found that 50% of the TM patients were from urban centers meaning patients from Rural areas were using TM as much as their urban counterparts. However, the nature of the TM visits was found to be different between the Northern and Southern regions of Ontario. Though 62% of TM visits overall were used for Mental Health and addiction treatments, 70% of these cases were found in urban southern Ontario. In rural Northern Ontario, only 42% of TM cases were related to Mental Health and addiction, and there was proportionally more surgical, oncology and internal medicine use with TM.

The interpretation of the OTN findings was that TM was being used to fill gaps resulting from the lack of readily available specialists such as oncology, internal medicine and surgery (consultation and follow-up), which all had higher utilizations compared to the other regions of the province. The study concluded that TM was being used to improve access to medical care services. However, it is unclear whether TM increased the number of patients having access to healthcare or that physicians were able to attend to more patients with TM than regular face to face (F2F) visits.

An example of TM being used to increase patient loads may be found in the field of dermatology. With advancements in smartphone technology, Boissin et al (29) showed that most smartphone cameras were more than adequate substitutes for dedicated digital cameras for medical teleconsultation. Nami et al (30) showed that “tele-dermatology time” was quicker using a smartphone camera instead of a dedicated digital camera attached to a computer. The study concluded that “tele-dermatologic consultations” were shorter than traditional F2F events and reasoned “..that a tele-dermatologist can see more patients than an ordinary dermatologist”(30). The deduction from this finding is that certain specialties may be more efficient in using TM compared to other fields of medicine that require a more “hands on approach”, making these fields less “TM friendly”.

Another practical example of TM addressing patient loads is during a time of crisis. An example documented by Moughrabi and Weinert (31) is a good example of TM effectiveness. In December 2012, during the Syrian war crisis, a tele-ICU program was launched within Syria. Inexpensive, off the shelf cameras, free social media applications and volunteer intensivists in North America and Europe were organized to support this tele-ICU program. Within a year, 90 patients per month were receiving tele-ICU services. By 2015, for 24 hours each day, 20 intensivists were providing clinical decisions support to 5 civilian ICU’s within Syria. This program employed cloud-based medical electronic records for doctors and medical administration records for nurses, virtual chat rooms for patient rounds, training and radiology review. The distance between patient and volunteer clinicians averaged over 6000 km and covered multiple time zones. This example shows what a small number of committed physicians can do with TM.

Literature Review Summary

The review of scientific evidence about the relative adoption and utilization of TM for healthcare delivery has not provided a clear answer. Many factors such as specialty, reimbursement models, physician practice style, etc. tend to impact physician use of TM since all physicians are trained in physical examinations, but few are familiar with the use of TM techniques. Nevertheless, advocacy of the potential benefits from using TM is strong (32-35) and its ability to cover vast distances to provide healthcare services is well documented and proven. However,

TM can be disruptive to physician workflow (10), thus impacting utilization and clouding the picture of whether or not TM is helping physicians to work more efficiently.

Data and Methodology

Data Source

The data used to measure TM usage in my research is from the Ontario Health Insurance Plan (OHIP) captured through IntelliHealth⁴, a knowledge repository that contains clinical and administrative data from the Ontario healthcare system. The Ontario Health Insurance Plan (OHIP) provides financial incentives for using TM via billing codes known as TM Premiums. The two codes that are used to capture TM activities are the following:

- B100: The billing code used for the first TM event of the day. This is a \$45 premium and is considered the 1st patient that is seen using TM for that day by a physician.
- B200: The billing code used for every subsequent TM event for that day. This is a \$15 premium and is applied for to every TM consult after the 1st patient.

Therefore, in a standard practice, a physician will perform their first day TM event with a B100 code and will use a B200 code for every subsequent patient till the day end. Using OHIP data and focusing on these TM billing codes, TM usage can be captured and measured.

Ontario's healthcare environment can be a good representation of TM usage by physicians. It was found by Barton et al (21) that most users of TM were in public clinics compared to private clinics within their sample population. This relationship is important, as private clinic physicians were considered salaried as compared to public clinic physicians that worked under a fee for service model. The Ontario physician reimbursement structure is a fee for service structure and provides financial incentives for using TM, but no such incentive exists in salaried physician models. Therefore, OHIP data is a good proxy for determining physician behaviors and attitude towards TM as there is difficulty in capturing TM usage by salaried physicians.

⁴ <https://intellihealth.moh.gov.on.ca>

Methodology

To answer the thesis question, a macro level analysis of TM was used. This analysis was to determine any trends with respect to TM as a whole and by specialty over the time period 2008-2013. This initial analysis allowed for the identification of specialties containing sufficient sample sizes in terms of number of physicians and TM events that would focus on TM efficiencies. A TM event is considered any OHIP billable interaction using TM practices.

The subsequent analysis focused on the top three specialties that utilized TM and the corresponding number of TM visits that occurred between 2008 and 2013. This reviewed the total number of TM visits and the number of TM visits per physician to determine trends from a specialty perspective. The purpose was to examine collectively how physicians within a specialty utilized TM.

The follow-up analysis used a criterion to select physicians that achieved a certain threshold of TM events and performed a certain number of regular F2F events (Table 2). The utilization of these doctors can be measured using this formula: $100 \times \frac{\# \text{ of } TM \text{ Events}}{\# \text{ of Total Clinical Events}}$. The purpose of this selection criterion is to group physicians with similar activities based on the total number of billable events a physician performs as well as performing a certain number of TM events within a year. This allows a comparison among physicians since physicians who perform low numbers of TM events and a low number of F2F events are likely to have different styles of practices than physicians who performed a larger number of F2F and TM events. It was found that physicians who performed a large number of F2F in addition to a large number of TM events were representative of the physicians who performed the majority of TM events within their specialties, making this comparison ideal.

From the database, a few physicians with varying characteristics (number of F2F events and number of TM events) were selected and a temporal analysis was performed to evaluate the trends of TM usage relative to F2F visits. The purpose of this analysis was to provide some general ideas of physician behavior with respect to TM usage (these did not identify specific

trends as a larger sample of physicians would be required as a model of care; the sample size is too limited).

Results:

In Ontario, TM has seen rapid year over year adoption rates. Between 2008 & 2013, TM saw an average annual growth rate of 51.04%⁵. The data in Figure 1 is an aggregate of B100 and B200 billing codes for the years 2008 to 2013. This includes all specialties that used TM and each event is considered equal (All TM events are considered the same regardless of specialty).

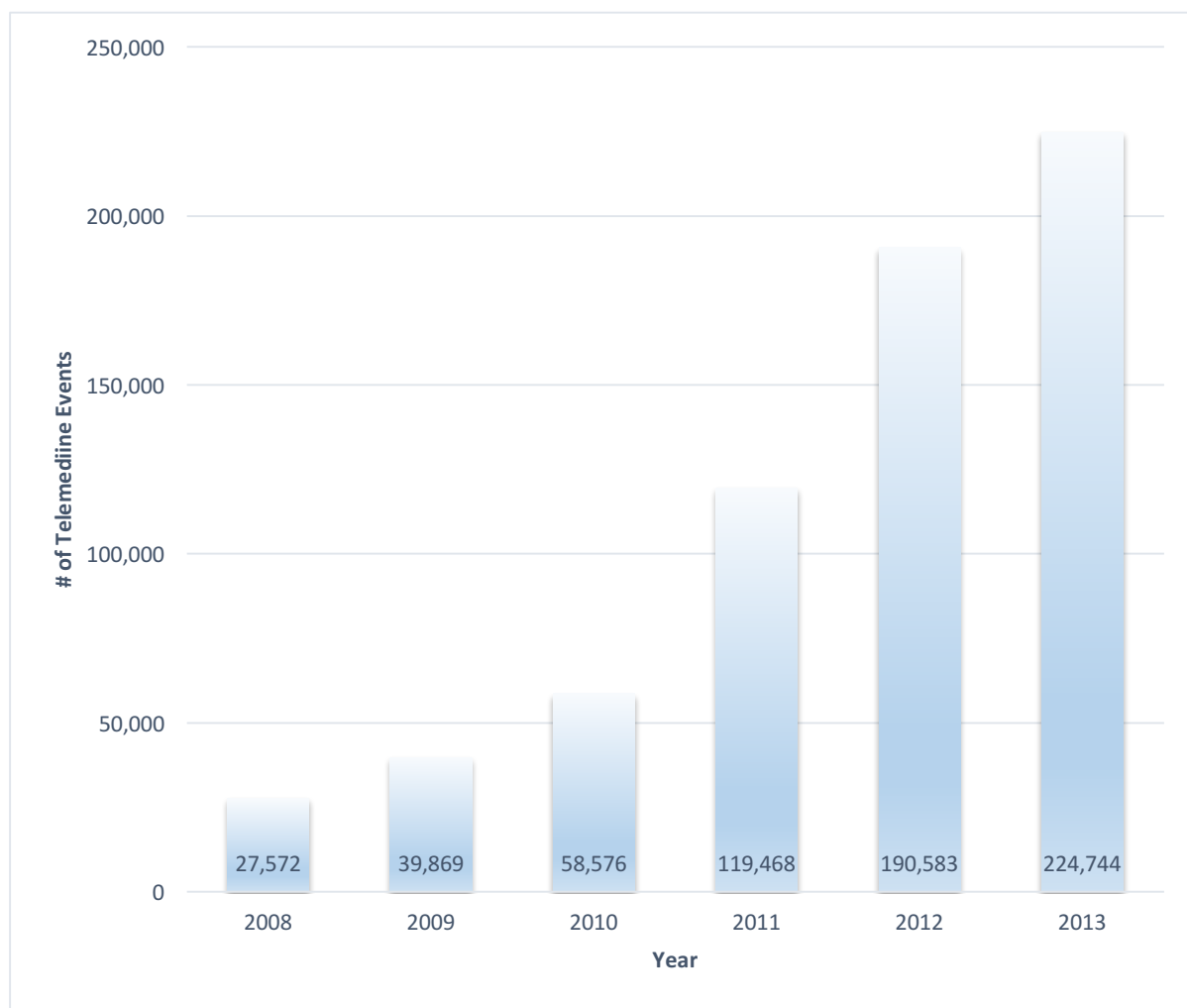


Figure 1: Ontario Telemedicine (TM) Events between 2008-2013

⁵ Refer to Appendix 1

Between 2010 and 2011, TM experienced “hyper-growth” where the number of TM events grew annually by 103% yet the rate of increase declined to 60% the following year. The rate of growth appeared to have increased between 2010 and 2012 yet tailed off considerably in 2013, where TM only grew 18%, the smallest growth rate of all the years. However, over the 5-year period, TM events grew within Ontario. It is unclear whether growth was driven by an increase of adoption by new physicians or TM was being used more frequently by pre-existing TM doctors.

To further investigate technology and adoption rates, an analysis by physician “cohort” was done. In this analysis, the “cohort” is defined as the number of unique physicians that first performed a single TM event within a given year. For example, in the 2008 Cohort, 387 individual physicians performed at least one single TM event. Within the same cohort (2008 TM Cohort Group), only 303 physicians performed at least one TM event in 2009. In the same year, 177 new physicians performed at least one TM event and formed the “2009 TM Cohort Group”.

This analysis was performed using B100 and B200 codes to identify physicians who performed TM events. B101 and B201 codes representing failed TM events were not included in this analysis as the percentage of these events were not significant as shown by the OTN study (28) where only 0.2% of TM activities were not completed due to technical difficulties in the collected OHIP data. Therefore, this analysis does not consider failed attempts as part of the adoption rate. Figure 2 summarizes the analysis from 2008 to 2013.

Cohort Group Separation

Cohort Group for Provid..	Fiscal Year					
	2008	2009	2010	2011	2012	2013
2008 TM Cohort Group	387	303	274	272	252	236
2009 TM Cohort Group		177	130	109	98	98
2010 TM Cohort Group			136	96	79	80
2011 TM Cohort Group				186	131	124
2012 TM Cohort Group					219	156
2013 TM Cohort Group						328
Grand Total	387	480	540	663	779	1,022

Figure 2: 5-year trend of TM physicians

In every year, after the first year, new TM physicians were recruited that offset the “dropouts” from the initial and following cohorts. Therefore, the overall number of physicians using TM was growing, thus explaining TM growth (i.e. more TM physicians, more TM events). To gain a clearer picture, it was determined that, from 2008-2013, the ratio of TM events to TM physicians increased from 71 to 220 events per physician⁶. This indicates that the number of TM events/physician in that period was growing faster than the rate of new TM physicians. The conclusion is that physicians who accepted TM as a healthcare delivery method were increasing their usage of this form of healthcare delivery year over year.

Over the time of the study, three specialties accounted for over 82% of all TM events in Ontario (Figure 3). General and Family practices alone accounted for 72.3% followed by Internal Medicine 6.12% and Psychiatry 3.83%. Focusing on physician practices within these higher use specialties could provide quantitative indications of whether TM was being used to increase efficiencies within medical practices.

⁶ Refer to Appendix II

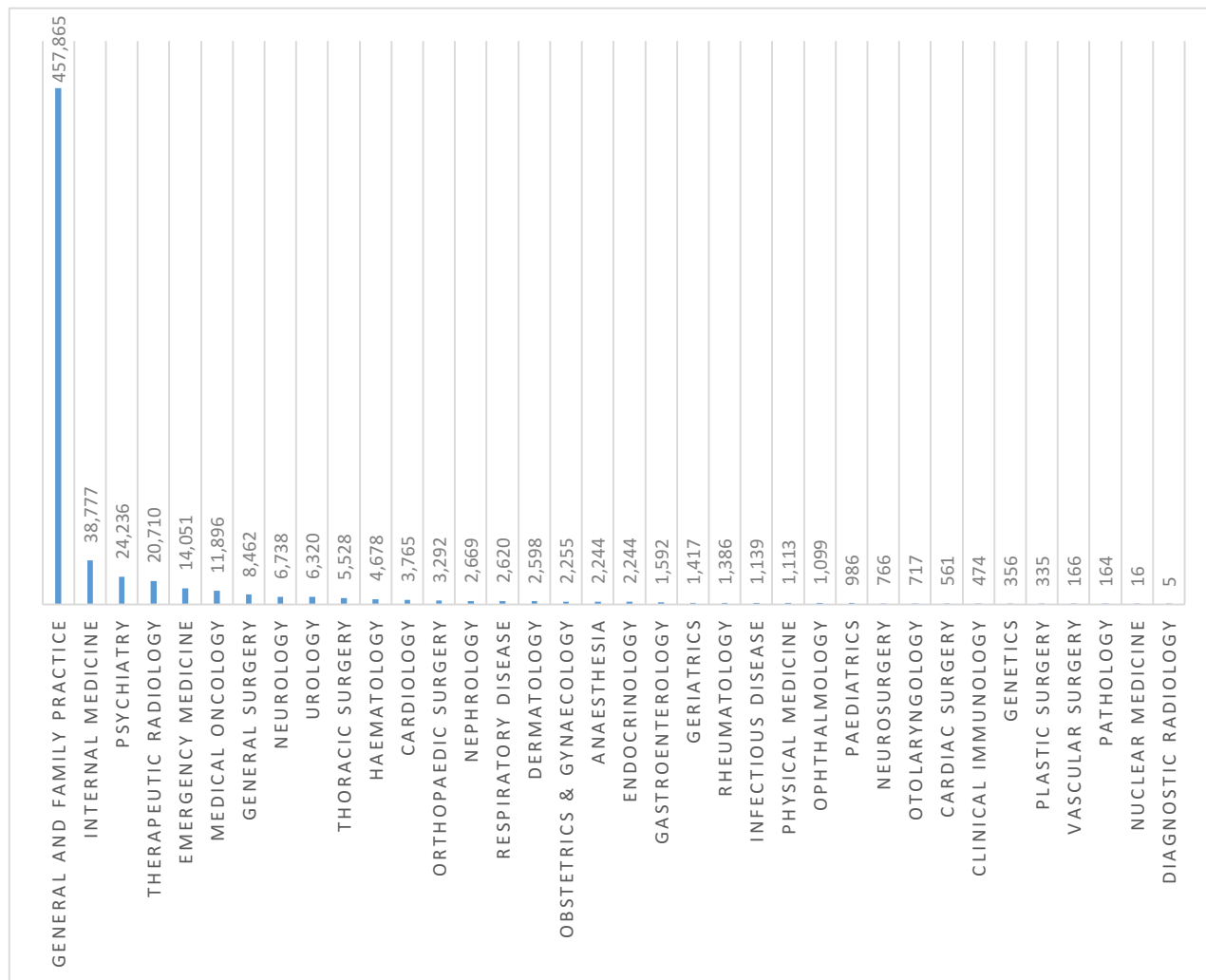


Figure 3: TM Event Summary over a 5 Year Time Period

Time-series analysis of aggregated data

Time-series analysis of aggregated data over a time-period can provide insights into the collective merits of TM within specialties. If TM adoption is a positive experience for physicians, it is likely that physicians would perform more patient consultations using TM (TM Events). Therefore, the expectation would be to see an increase in the “*number of TM events per physician*” over time within a specialty.

The analysis in figure 4 is based on B100 and B200 codes recorded by OHIP during the study period. These codes represent TM Events that were completed and does not include TM events

that were either cancelled or not completed due to technical failures. The size of the circles represents the total number of TM events (# of TM Visits) and the Y-axis measures the “# of TM Events per Physician”

General and Family Characterization

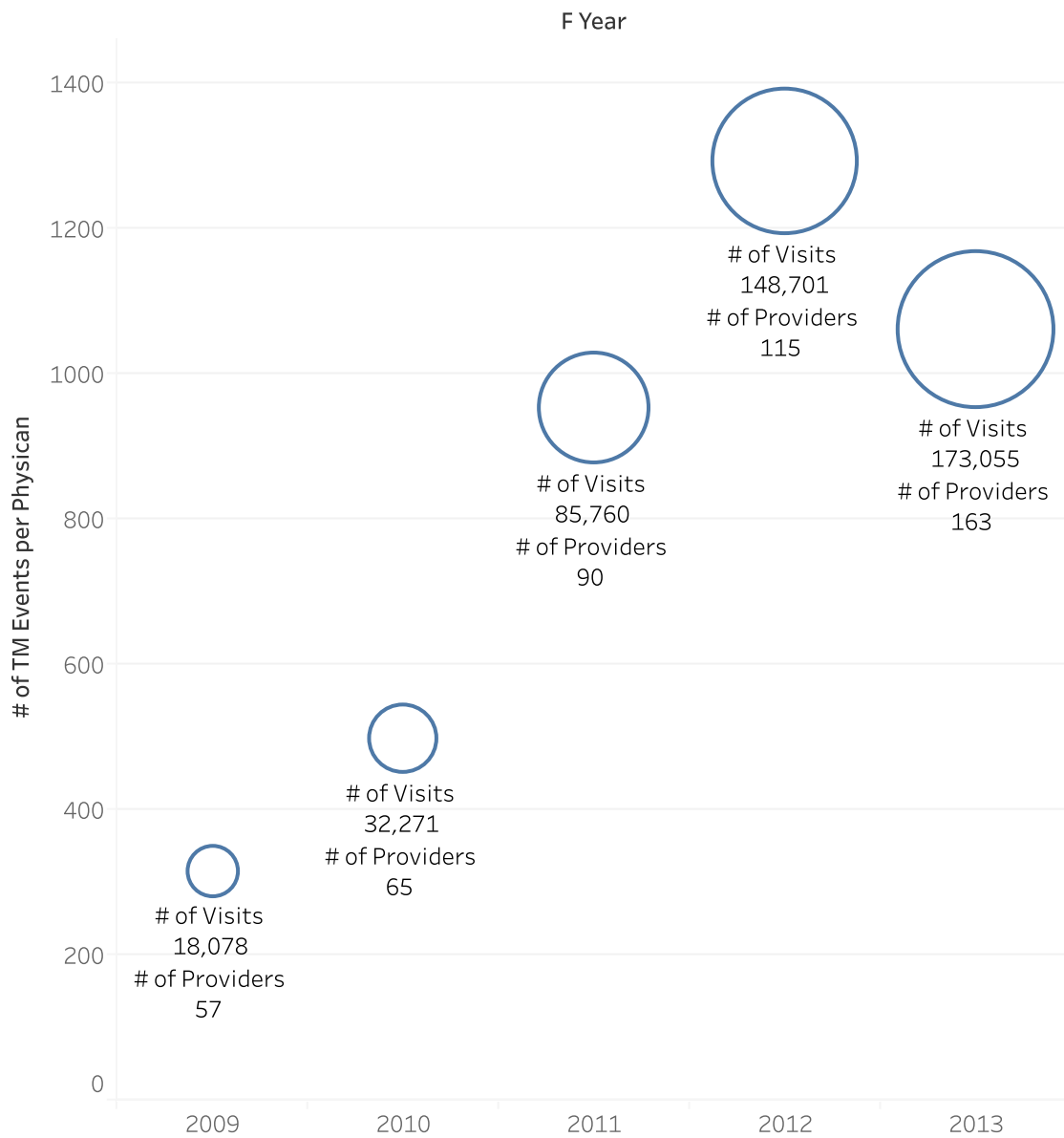


Figure 4: General and Family Practice TM Characterization

General and Family Practice showed a sharp rise in “Number of TM events per physician⁷” until 2013, (

Figure 4). During 2013, the “Number of TM events per physician” dropped even though increases were found in both the total number of TM events and the number of physicians performing TM. This may be an indication of TM saturation from an adoption perspective. That is, General and Family physicians who were utilizing TM might have been reaching their maximum ability to utilize TM.

Internal Medicine and Psychiatry Characterization

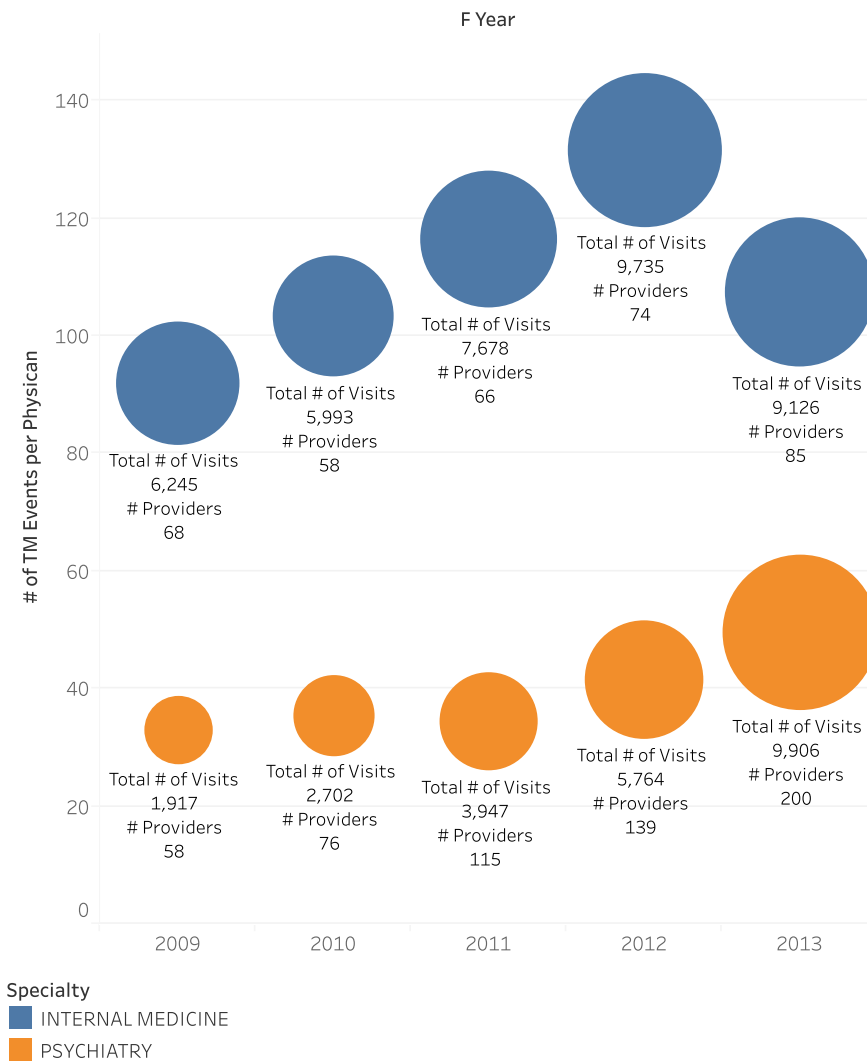


Figure 5 Internal Medicine and Psychiatry TM Consult Characterization

⁷ “Number of TM events per Physician” is the same as the “Number of Consults per Physician”. Different data sources use different terms for the same metric. Consults and Events are equivalent terms with respect to this research and analysis.

Figure 5 shows the next two most frequent users of TM, Internal Medicine and Psychiatry respectively, plotted using the same method as General & Family Practice (Number of Visits represents the total number of TM Events). The results show that TM usage by Internal Medicine physicians was in an upward trend indicating a rise in the number of TM events per physician. Psychiatry shows a more stable trend indicating that the rise in TM events is driven by the addition of physicians using TM.

In summary, growth of Internal Medicine TM events between 2009-2013, has been driven by an increased use of TM by physicians, and growth in Psychiatry TM events is driven by a growth of the number of doctors performing TM.

Inadequacy of Analysis

A limitation with an aggregated analysis such as this is that physician practices are unique even within the same specialty (22). Therefore, the use of TM as an efficient tool to increase practice will be dependent on the individual physician and practice style. Work has been done on physician behavior towards TM preference such as the Theory of Planned Behavior (23) where Attitude, Subjective Norm and Perceived Behavior Control are used to determine TM acceptance. However, these studies deal with rational comparisons with irrational behavior which is difficult to quantify. To assist in the current analysis, examining OHIP based results from individual physicians to determine if TM is being used for its benefit to the doctor or whether it is providing a medical service convenience is a form of quantifying this analysis.

Based on the aggregated data presented thus far, TM use is on the rise and it is likely that TM does provide some benefit for some physicians, as the “*Number of TM events per physician*” was growing in the time-period 2011-2013.

“Time Series” Trends of Individual Physicians

One approach to evaluate TM adoption is to see a comparison between TM Events and Face to Face (F2F) visits within an established practice. Using established practices for analysis might eliminate systematic (internal) factors that could affect TM adoption. These factors include small practices where patient F2F visits are not practical or haven’t been established due to the

infancy of the practice. An assumption in this approach is that practice size can be a proxy for “established practices”.

Examining data from established practices that use TM is one way for analyzing efficiencies, as these practices would show how TM is being used compared to F2F visits. Identifying established practices requires the segmenting of physicians based upon the number of events that they performed within a given year. Like other industries, where market share is not equal among industry participants, physicians within their recognized specialties provide care to different volumes of patients⁸. Therefore, to allow an appropriate comparison, physicians of interest were picked from a segmented group called the “Performer Group”. Physician preferences would be difficult to determine, based on the OHIP data available, so patient volume seemed to be a valid method for comparison.

The “Performer Group” is a group defined as a group that includes physicians who were most responsible for 50% of the “market share” of patient visits within their respective specialty. Their total of patient visits includes both TM and Non-TM events. The market criterion of 50% was selected for the following reasons:

- These physicians would be seeing the bulk of the patients within their respective specialties
- It’s likely that these physicians have established practices, making comparisons more significant
- Motivation towards TM adoption may be somewhat similar among physicians within this group because they are likely to already have established practices
- This narrows down the physicians of interest for comparison purposes
- The 50% criterion provide an adequate sample size across the 3 specialties.

⁸Refer to Appendix III

Table 1 summarizes the findings of the “Performer Group” methodology

Table 1

Fiscal YR 2013 Only	SPECIALTY		
	General and Family	Internal Medicine	Psychiatry
Total number of Physicians	13,335	1,961	2,128
Total number of Visits	59,575,119	8,023,672	3,059,356
Number of Physicians in “Performer Group”	3,056	369	430
Total number of Visits by the Performer Group (50%)	29,791,871	4,013,936	1,530,030
% of Physicians responsible for 50% of all Activity	22.9%	18.8%	20.2%
Total TM Events	194,672	10,080	11,231
TM Events done by “Performer Group”	183,506	6,136	4,669
% of TM Events done by “Performer Group”	94.3%	60.9%	41.6%
Number of TM Physicians in the "Performer Group"	78	28	46

Table 1 definitions:

Category	Description/Notes
Total number of Physicians	The total number of physicians captured by OHIP data by recorded medical specialty.
Total number of Visits	Total Number of Patient Visits for both TM and Non-TM
Number of Physicians in “Performer Group”	The total number of physicians that are responsible for 50% of all OHIP visits within their specialty
Total number of Visits by the Performer Group (50%)	50% of patient visits performed within the Fiscal year 2013
% of Physicians responsible for 50% of all Activity	The % of the total number of physicians who performed 50% of all activity within their specialty. A relatively small number of physicians perform 50% of the total OHIP visits.
Total TM Events	Total telemedicine (TM) events. Captured through using “Service Location Code” where “OTN” represents TM and “Non-OTN” represent NON-TM events.
TM Events done by “Performer Group”	The number of telemedicine (TM) events that were done by the physicians who are responsible for 50% of all regular OHIP visits within their respective specialty.

% of TM Events done by "Performer Group"	The % of TM events performed by the physicians who are responsible for 50% of all regular OHIP visits within their respective specialty
Number of TM Physicians in the "Performer Group"	The number of physicians who performed TM but are also responsible for 50% of all OHIP visits within their respective specialty

Using this segmentation methodology, 50% of all activity within a specialty is performed by only 18-23% of the physician population. Therefore, it's likely that comparisons among physicians can be made within this group. Also, from Table 1, the majority of TM events are performed by the "Performer Group" with the exception of Psychiatry. For example, within General and Family, 94% of all TM activity was performed by only 78 physicians. This could indicate that practice activity may be correlated with TM use. However, with Psychiatry, TM events appear to be spread across the physician population. Therefore, it is prudent that both physicians within the "Performer Group" and "Non-Performer Group"⁹ be examined for this specialty.

Usage Analysis

To determine the influence of TM on physician practices, a 3-year trend from 2011-2013 was analyzed to provide insight into TM usage – whether TM was used to grow physician activity (i.e. see more patients within a given year) or if TM was used to replace traditional F2F visits.

Physicians were selected from the "Performer Group" using criteria based on minimum volumes of clinical and TM events.

Table 2

Specialty	Min No. of Total Clinical Events (2013)	Min No. TM Events (2013)
General and Family Practice	20,000	1,000
Internal Medicine	4,000	100
Psychiatry	2,000	150

⁹ "Non-Performer Group" is defined as the group of physicians that deliver less than 50% of the total clinical events within a specialty.

The criteria in Table 2 were established arbitrarily and selected to obtain a sufficient sample of medical practices to analyze because TM events were not a common practice in general. Also, the selection criteria helped identify physicians whose practices were likely in a steady state condition (i.e., these physicians are not actively seeking to grow their practices).

General and Family Practice

Within the General and Family practices, 12 physicians were identified that met the criteria in Table 2 which is listed in Table 3.

Table 3: General and Family Physician of Interest

Encrypted Provider ID	Service Location Group	2011	2012	2013	Growth Annualized
410670	Non-Telemedicine	28,151	27,631	26,079	-3.75%
410670	ONTARIO TELEMEDICINE NETWORK	5,910	5,294	5,027	-7.77%
76554	Non-Telemedicine	27,796	20,550	22,494	-10.04%
76554	ONTARIO TELEMEDICINE NETWORK	4,524	4,341	4,631	1.18%
72548	Non-Telemedicine	27,194	22,256	23,067	-7.90%
72548	ONTARIO TELEMEDICINE NETWORK	3,563	3,599	3,450	-1.60%
411353	Non-Telemedicine	31,125	22,555	20,356	-19.13%
411353	ONTARIO TELEMEDICINE NETWORK	1,841	2,110	1,092	-22.98%
514433	Non-Telemedicine	22,275	24,764	22,419	0.32%
514433	ONTARIO TELEMEDICINE NETWORK		4,182	4,452	6.46%
413890	Non-Telemedicine	14,938	21,070	21,393	19.67%
413890	ONTARIO TELEMEDICINE NETWORK	2,189	8,468	8,274	94.42%
244077	Non-Telemedicine	19,969	19,929	20,284	0.79%
244077	ONTARIO TELEMEDICINE NETWORK	1,601	1,830	1,936	9.97%
948003	Non-Telemedicine	16,936	19,202	21,780	13.40%
948003	ONTARIO TELEMEDICINE NETWORK	1,853	2,297	3,266	32.76%
313111	Non-Telemedicine	17,622	18,561	16,887	-2.11%
313111	ONTARIO TELEMEDICINE NETWORK	1,590	3,121	4,228	63.07%
413151	Non-Telemedicine	17,000	17,677	21,873	13.43%
413151	ONTARIO TELEMEDICINE NETWORK	381	1,701	3,057	183.26%
416629	Non-Telemedicine	17,757	14,758	22,384	12.28%
416629	ONTARIO TELEMEDICINE NETWORK	1,315	1,479	3,725	68.31%
412117	Non-Telemedicine	11,228	19,021	24,949	49.06%
412117	ONTARIO TELEMEDICINE NETWORK		128	1,446	1029.69%

In summary, within this “Performer Group”, TM growth has outpaced regular non-TM events and has become a higher percentage of physician medical care. Table 4 summarizes these observations.

Table 4: General and Family TM Utilization Summary

Summary	Fiscal Year			Annualized Growth
	2011	2012	2013	
Service Location Group	2011	2012	2013	
Non-Telemedicine	251,991	247,974	263,965	2.35%
ONTARIO TELEMEDICINE NETWORK	24,767	38,550	44,584	34.17%
% of TM	8.95%	13.45%	14.45%	

G&F-2011-2013

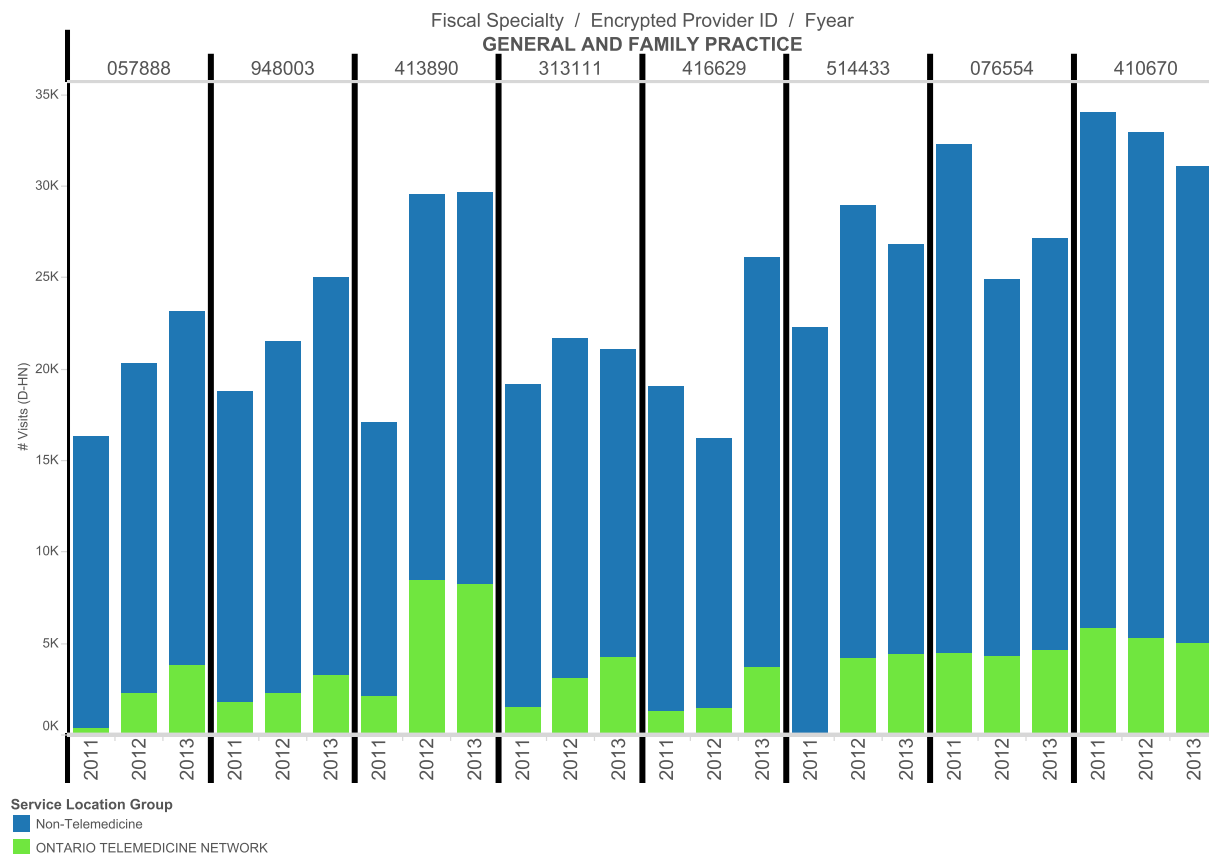


Figure 6 :General and Family Physician Activity Breakdown (Performer Group)

Selecting 8 physicians of interest and charting their respective activity in Figure 6, 3 physicians (ID# 057888, 948003 and 413890) showed growth in both total clinical activity and TM activity. Physicians ID# 416629, 514433 and 076554 also showed growth in TM activity and physician 410670 appears to have declined in practice volume (Figure 6).

Internal Medicine

Within the Internal Medicine practice, the criteria yielded 16 physicians of interest as listed in Table 5.

Table 5: Internal Medicine Physician of Interest

Encrypted Provider ID	Service Location Group	2011	2012	2013	Growth Annualized
949793	Non-Telemedicine	19,501	19,640	15,295	-11.44%
949793	ONTARIO TELEMEDICINE NETWORK	1,510	3,158	2,148	19.27%
84777	Non-Telemedicine	14,590	13,667	12,974	-5.70%
84777	ONTARIO TELEMEDICINE NETWORK	355	339	542	23.56%
585695	Non-Telemedicine	14,222	14,018	9,571	-17.97%
585695	ONTARIO TELEMEDICINE NETWORK	407	368	345	-7.93%
518545	Non-Telemedicine	10,913	12,466	11,115	0.92%
518545	ONTARIO TELEMEDICINE NETWORK	188	159	155	-9.20%
561210	Non-Telemedicine	8,830	9,194	8,323	-2.91%
561210	ONTARIO TELEMEDICINE NETWORK	207	177	193	-3.44%
508498	Non-Telemedicine	7,652	7,720	7,302	-2.31%
508498	ONTARIO TELEMEDICINE NETWORK	128	184	198	24.37%
508809	Non-Telemedicine	7,008	6,156	5,844	-8.68%
508809	ONTARIO TELEMEDICINE NETWORK	1,001	460	452	-32.80%
312520	Non-Telemedicine	6,130	6,404	6,288	1.28%

312520	ONTARIO TELEMEDICINE NETWORK	234	303	410	32.37%
805121	Non-Telemedicine	5,936	5,415	5,397	-4.65%
805121	ONTARIO TELEMEDICINE NETWORK	780	1,069	1,114	19.51%
563900	Non-Telemedicine	6,233	6,709	5,068	-9.83%
563900	ONTARIO TELEMEDICINE NETWORK	507	469	268	-27.30%
79486	Non-Telemedicine	4,754	5,315	4,928	1.81%
79486	ONTARIO TELEMEDICINE NETWORK	4	141	147	506.22%
416372	Non-Telemedicine	4,659	4,190	4,426	-2.53%
416372	ONTARIO TELEMEDICINE NETWORK	138	319	395	69.18%
72087	Non-Telemedicine		2,995	8,996	200.37%
72087	ONTARIO TELEMEDICINE NETWORK		6	192	3100.00%
246349	Non-Telemedicine	3,169	2,670	3,493	4.99%
246349	ONTARIO TELEMEDICINE NETWORK	600	634	623	1.90%
78253	Non-Telemedicine	570	1,894	4,504	181.10%
78253	ONTARIO TELEMEDICINE NETWORK		2	158	7800.00%

In summary, between 2011 and 2013, non-TM internal medicine visits showed a decline. However, there was a 6.8% increase in TM activities over the same time. Also, an increase of TM as a percentage of visits might be interpreted as indicating that physicians who adopt TM continue to increase their use of TM as a productive method of healthcare delivery. Table 6 summarizes these observations.

Table 6: Internal Medicine Summary of TM Usage

Summary	Fiscal Year			Annualized Growth
	2011	2012	2013	
Service Location Group				
Non-Telemedicine	81,469	80,436	69,977	-7.32%
ONTARIO TELEMEDICINE NETWORK	5,075	6,490	5,789	6.80%
% of TM	5.86%	7.47%	7.64%	

Internal Medicine physicians show different behaviors when compared to General and Family Practice physicians. In 2013, Internal Medicine used TM for 7.64% of clinical events compared to the 14.45% used by General and Family Practice. Also, the trend in TM practice did not appear to grow or decline as a function of practice activity. Figure 7 shows this observation graphically.

Internal Medicine 2011-2013

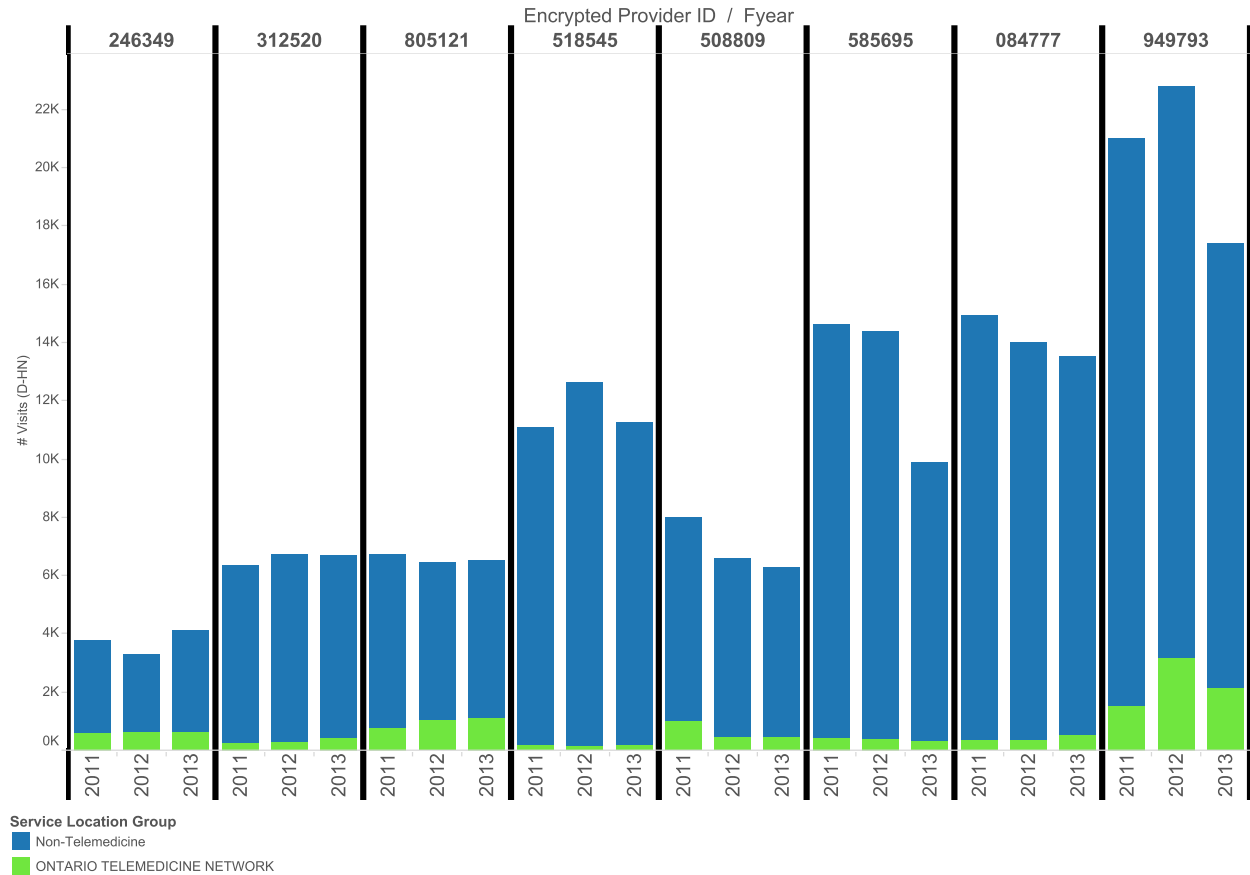


Figure 7 :Internal Medicine Physician Activity Breakdown (Performer Group)

Psychiatry

Table 7 list only 6 physicians that met the selection criteria.

Table 7: Psychiatry Physicians of Interest

Encrypted Provider ID	Service Location Group	2011	2012	2013	Annualized Growth
071440	Non-Telemedicine	2,218	4,264	6,333	68.98%
071440	ONTARIO TELEMEDICINE NETWORK		41	184	348.78%
080543	Non-Telemedicine	32,850	29,406	28,544	-6.78%
080543	ONTARIO TELEMEDICINE NETWORK	10	168	423	550.38%
091385	Non-Telemedicine	16,923	18,016	27,365	27.16%
091385	ONTARIO TELEMEDICINE NETWORK	20		784	526.10%
093592	Non-Telemedicine	3,911	4,250	3,761	-1.94%
093592	ONTARIO TELEMEDICINE NETWORK		192	928	383.33%
410754	Non-Telemedicine	4,006	3,458	3,812	-2.45%
410754	ONTARIO TELEMEDICINE NETWORK	174	429	471	64.53%
414906	Non-Telemedicine	7,020	11,500	12,497	33.42%
414906	ONTARIO TELEMEDICINE NETWORK		65	535	723.08%

In summary, psychiatry TM adoption has been growing since 2011. However, as of 2013, TM accounts for only a small proportion of Psychiatry activity, representing around 4% of all visits.

Table 8 summarizes these observations.

Table 8: Psychiatry TM Usage Summary

Summary	Fiscal Year			Annualized Growth
Service Location Group	2011	2012	2013	
Non-Telemedicine	66,928	70,894	82,312	10.90%
ONTARIO TELEMEDICINE NETWORK	204	895	3,325	303.72%
% of TM	0.30%	1.26%	4.04%	

Psychiatry is the only specialty out of the 3 top TM specialties where most of the TM events were performed by physicians who were not part of the “Top Performer Group”. Within this sample, TM makes only a minor contribution to physician activities, as shown in Figure 8.

Psyc-2011-2013

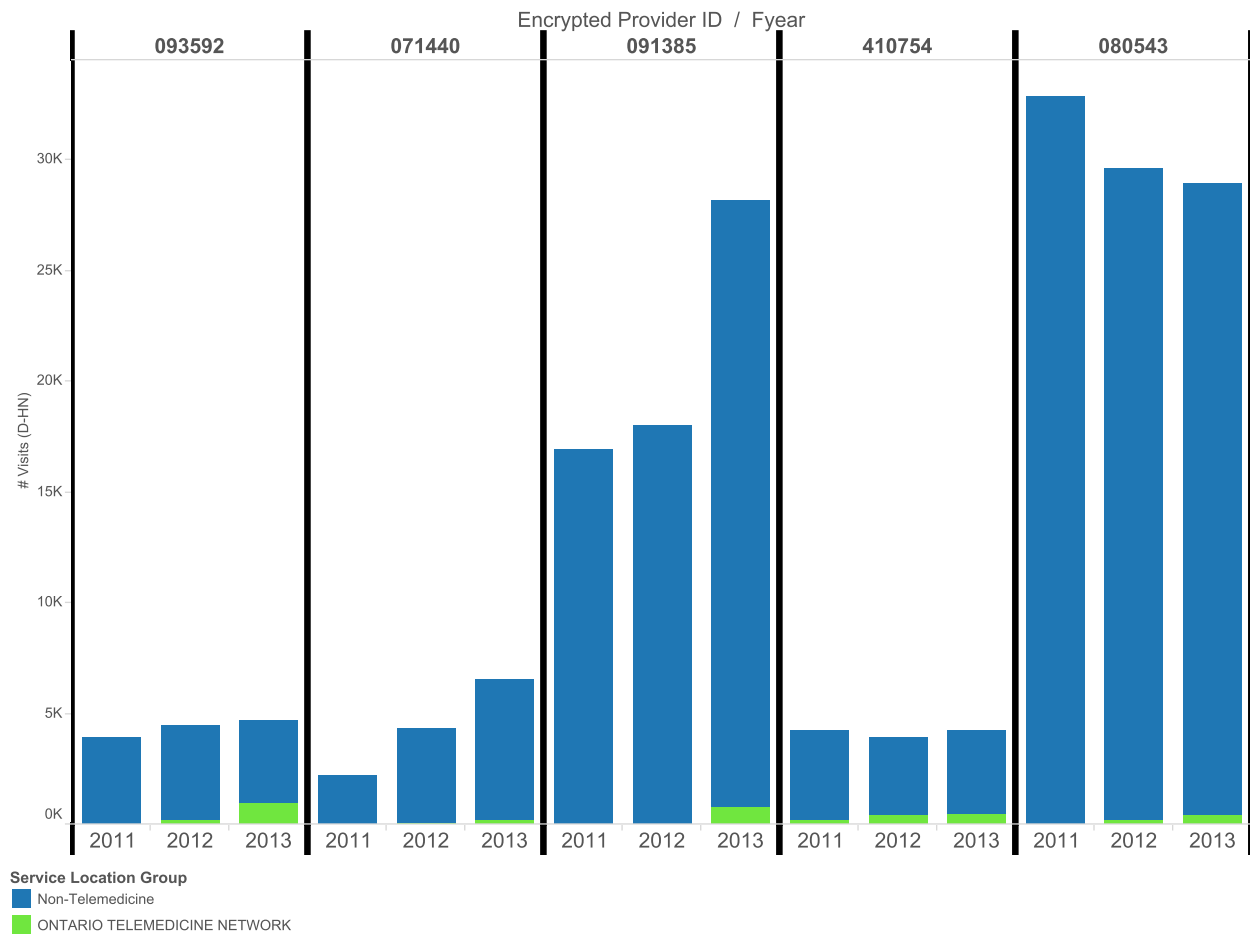


Figure 8 :Psychiatry Physician Activity Breakdown (Performer Group)

Within the “Non-Performer Group¹⁰”, nine psychiatry physicians were selected that performed over 100 TM events in 2013. In Figure 9 , TM plays a more prominent role in their respective practices. For physician ID# 074492, 419385 and 594657, TM has not only grown their respective practices, but TM is a significant growth driver. Interestingly, other physicians such as 072115, 352263 and 323568 saw a decline in their event total but maintained or grew their TM portion of their practices. This may be a result of physician recognition of the merits of TM.

¹⁰ Non-Performer Group: This group represents physicians who contribute collectively under 50% of the total clinical activity within their respective specialty.

Psyc-Lower #

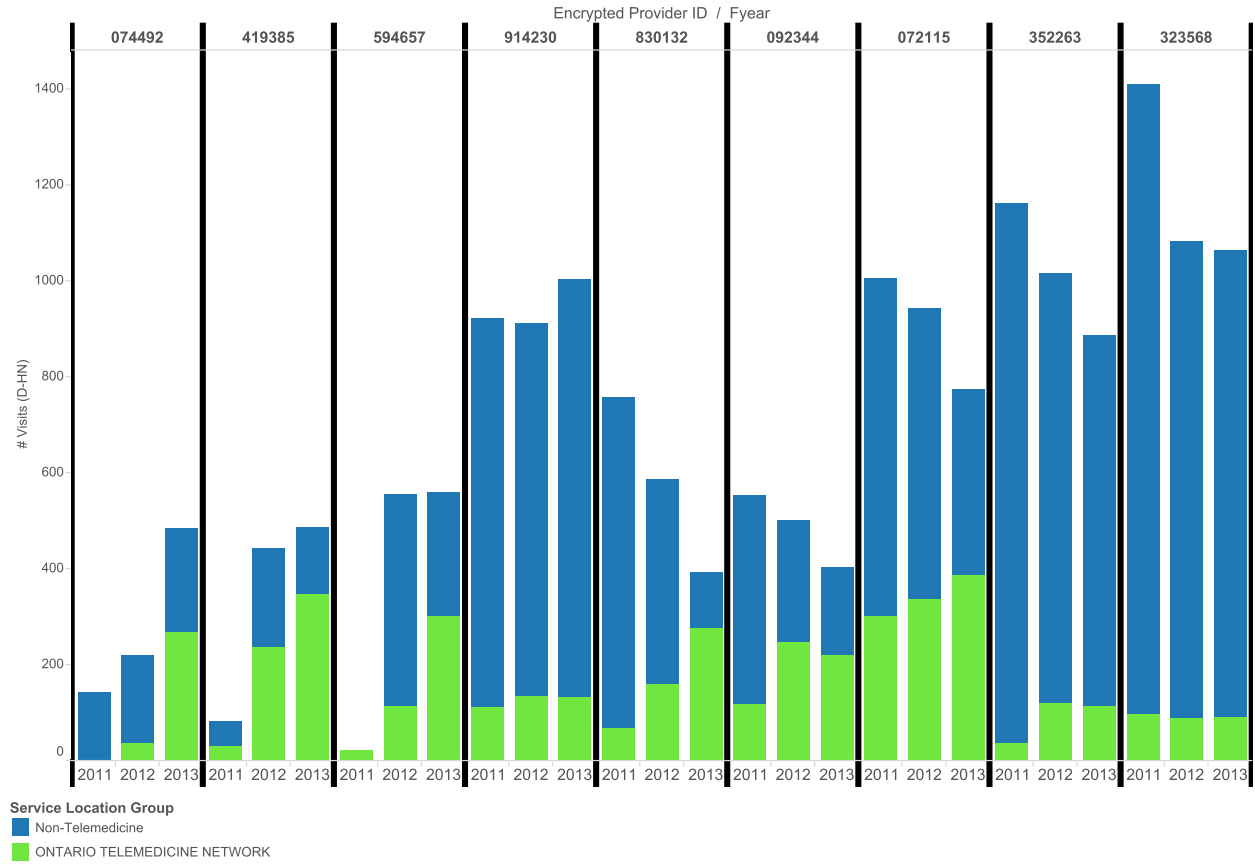


Figure 9 :Psychiatry Physician Activity Breakdown (Non-Performer Group)

Trend Analysis

In trend analysis, it is typical to use methods of statistical analysis to determine if trends actually exist. There are multiple methods to use to determine if trends exist in the relative numbers of TM events compared to in-office events. For example, the Mann-Kendall Test¹¹ or box plots can monitor changes over time. Visually, it is also possible to show graphs showing potential changes in the data over time. However, statistically this is difficult as the data for the individual physicians is limited to only 3 years, resulting in 3 data points.

Visually, the following charts can be generated:

Figure 10 is a Box Plot showing the % change in TM use by physicians in General and Family Practice over the 3-year time period.

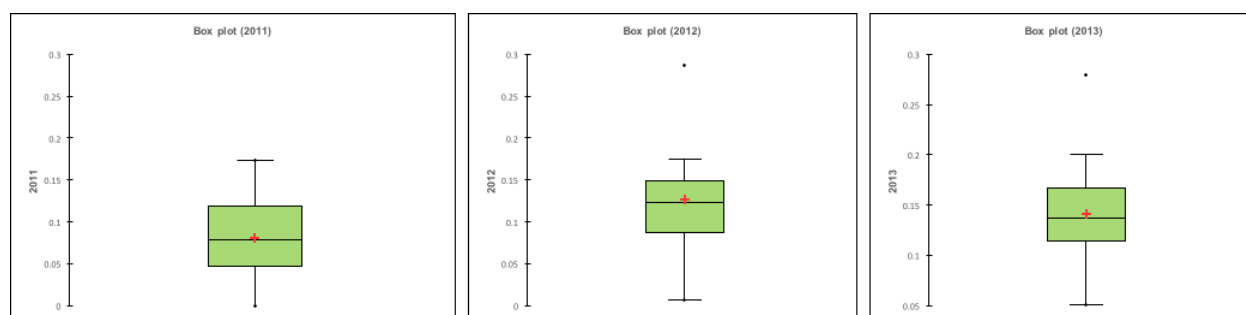


Figure 10: Box Plots for % use of TM

Since General and Family Practice has the highest percentage use of TM, changes should be more visible for this segment of medical practice. However, with only 3 years' worth of data, it is difficult to determine statistically whether there are actually trends in TM use.

With only 3 data points and a large difference between TM events and Non-TM events, statistical tests like the Mann-Kendall test do not appear to be appropriate since the differences are “lost in the weeds” in this case. TM events are measured in thousands, while Non-TM events

¹¹ https://vsp.pnnl.gov/help/Vsample/Design_Trend_Mann_Kendall.htm

- Mann-Kendal Test: (Statistic Package: XLSTAT)
- Appendix IV

are measured in ten-of-thousands. This imbalance makes it difficult to measure significant trends, especially with so few data points.

Though statistical testing is not appropriate for this data set, it is still possible to look at the data empirically to try to comprehend TM usage by doctors. Visually, this view tends to support the idea that TM use relative to normal office visits in general and family practice appears to be growing over this time period.

Discussion

Low TM adoption creates difficulties in accurate and definitive interpretations, but the data on actual events is helpful in determining if TM is regarded as an efficient tool by Ontario physicians.

From 2008, TM within Ontario has seen growth that could be described as phenomenal but can also be characterized as misleading. The growth rate of TM over this 5-year period had an annual growth rate of 52%, but over the same period TM in total represented only 0.24% of all medical events (Appendix I). It is difficult to determine if this is significant or not. Reasons include, but are not limited to: TM availability, nature of the clinical consult (i.e. are traditional F2F visits TM friendly) and the sub-specialty of physicians within a given specialty (i.e. some Psychiatry physicians may see a subset of patients that are more amenable to TM than other types of patients).

Considering that the retention rate of TM adopters averaged 73% from the Cohort analysis, it is likely that physicians who have had a positive impression or experience of TM are more likely to continue and potentially increase their use of TM. There are many factors affecting adoption. For example, Kuo et al (23) found that Planned Behavior Attitude (AT), Social Norm (SN) and Perceived Behavior Control (PBC) were all positively related to behavior intention (to use TM in this case) but their effects varied between experienced and non-experienced physicians. Therefore, the reasons behind TM adoption is a difficult measure to understand without interviewing the individual physicians and understanding the different attributes of their practice

style. Consequently, understanding TM usage from a physician perspective is only one way to study TM adoption.

One factor that may lead to adoption is related to the specialty of the physician. In Ontario, 72% of all TM events were related to the specialty General and Family Practice. Within this group, 76% included the OHIP billing Code (A957): *Focused Practice Assessment-Addiction Medicine*, and the next most prevalent code was (A007) *Intermed.Assess/Well Baby Care F.P/G.P./PAED* at 13%¹². Both these codes are associated with addiction and these events are primarily associated with Methadone Clinics. An OTN study validated this observation (28), supporting the idea that addiction clinics are being used for TM methods of healthcare.

For Internal Medicine, the top codes billed for TM involved some form of assessment, and Psychiatry involved some form of consultation or interview¹². For these specialties, physicians that continued to deliver healthcare services through TM are likely to find that TM use was ideal in settings where no physical contact was required, perhaps creating a new form of patient-physician relationship (36).

It is clear, from the data for the specialties General & Family and Psychiatry, that these physicians have not only increased the number of TM events year over year, but the growth is being driven by an increase in the number of TM events per physician. However, within Internal Medicine, the same metric is either stable or dropping. This may be because physicians within Psychiatry and General and Family are finding efficiencies within their practices, resulting in growth. On the other hand, Internal Medicine may have reached a steady state in terms of adoption, and TM growth may have been driven primarily by an increase in the number of Internal Medicine physicians using TM. These observations were made by aggregating physician activity within a specialty. Consequently, they are subject to a loss of “analysis resolution”. What is meant by “analysis resolution” is the amount of detail derived from the data analysis. With data aggregation, details such as medical practice characteristics, physician behavior, and patient effects are not accounted for or are lost during the aggregation.

¹² Refer to Appendix V

Consequently, interpreting these data must be done with caution, even though systematic trends can be deduced from the data.

Analyzing TM usage with respect to physician age and education may explain some aspects of TM adoption. Figure 11 shows the age demographic of physicians within Ontario as of 2013.

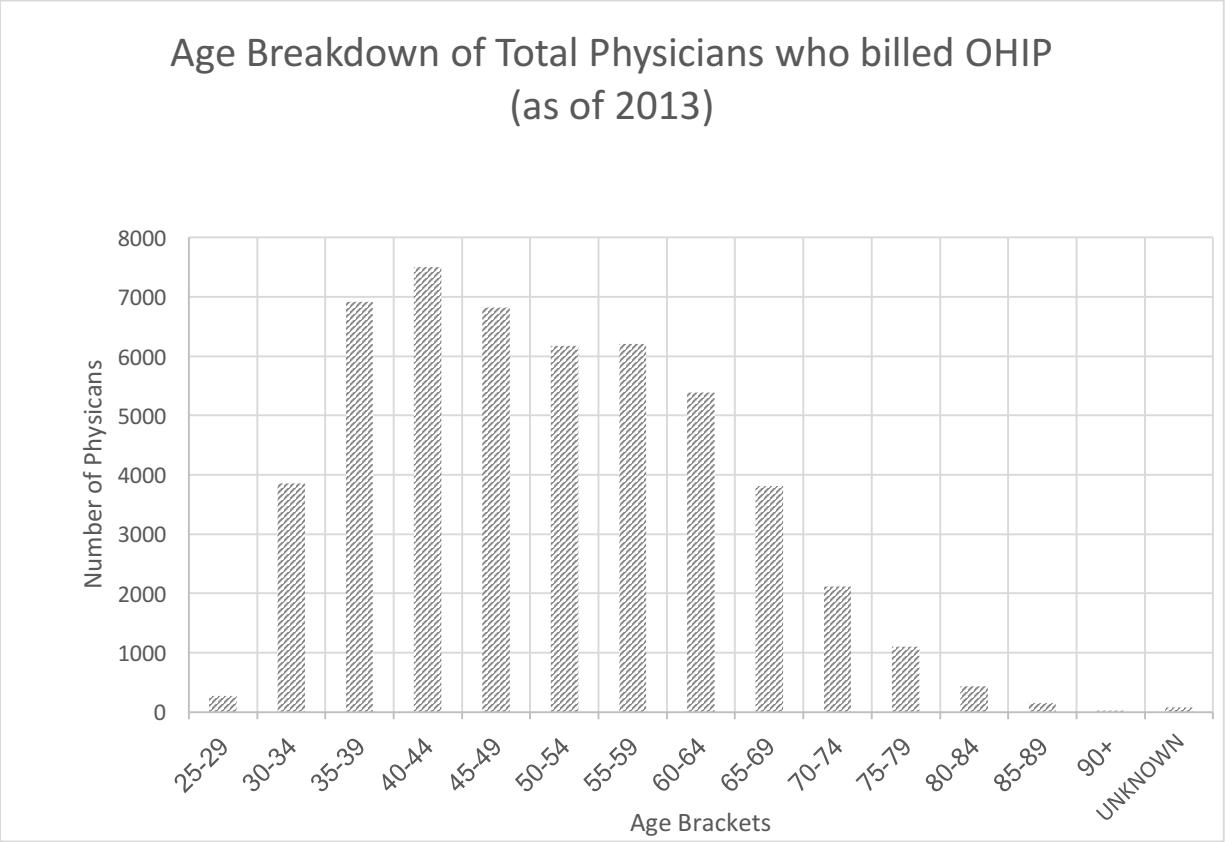


Figure 11: Physician Age Demographic (2013)-All

The data represents the “physician population” and is positively skewed, showing that the majority of physicians are under 55 years of age.

Figure 12 aggregates the number of physicians performing TM (as of 2013) by age range and the number of TM visits within each age group.

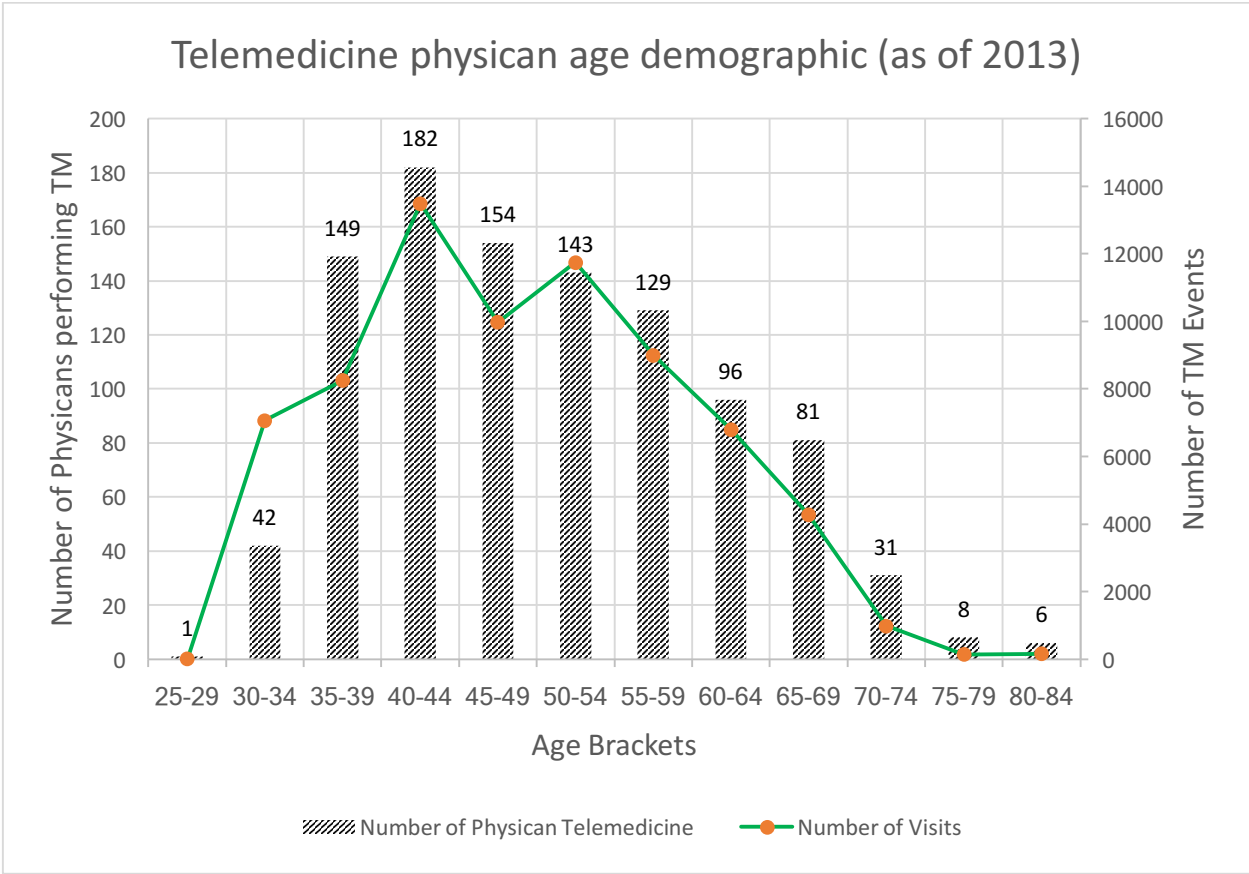


Figure 12: Demographic Analysis of TM Physicians (source Intellihealth)

The data shows that the TM physician distribution is similar to the physician population and the “Number of TM events” appears to follow a similar distribution. However, if the analysis is normalized and the number of visits (events) per physician is evaluated, Figure 13 shows that physicians between 30-34 years of age are performing the highest number of TM events per capita. A possible explanation for this observation is that physicians may view TM as a method to grow their respective practices to a minimum critical size as these younger doctors may be more open to using technology methods for patient interaction.

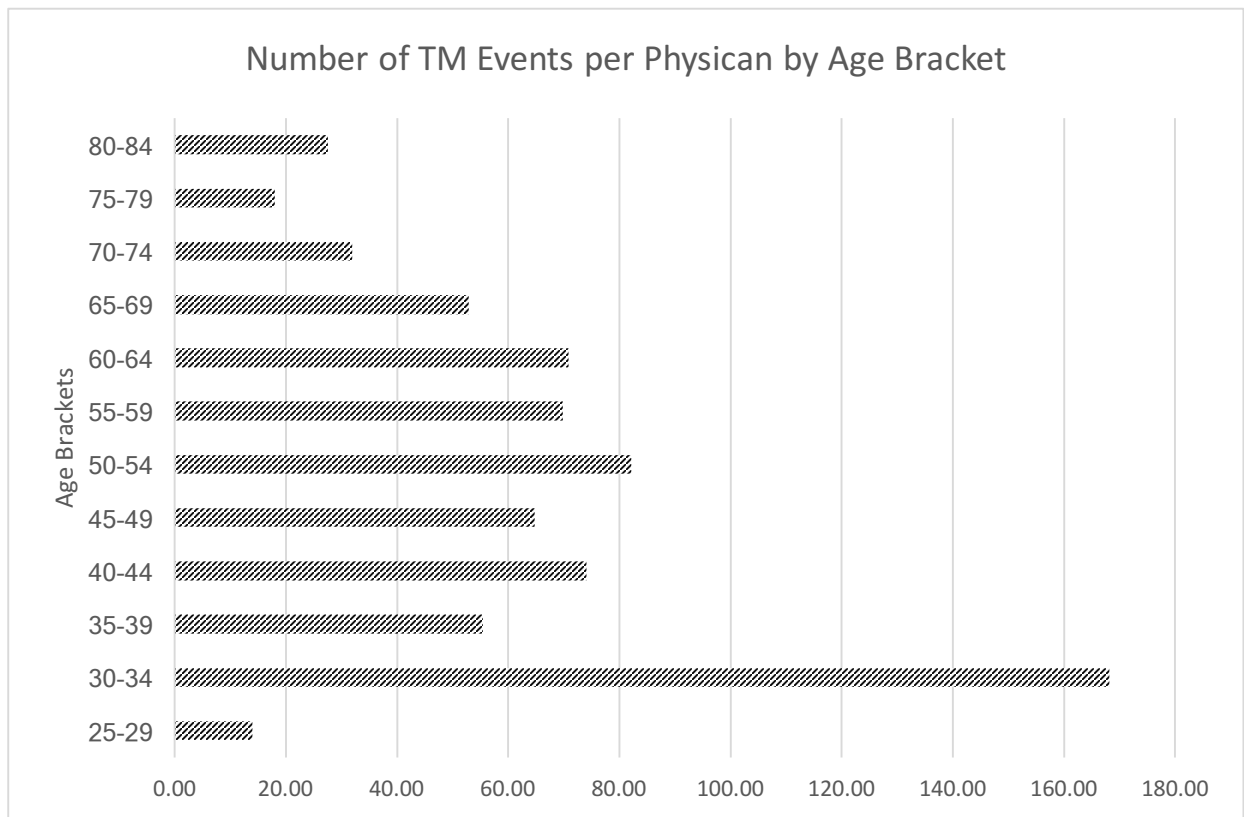


Figure 13: Number of TM Events per Physician by Age Bracket

However, to determine the impact of physician age on TM adoption is not conclusive as this analysis requires multiple snapshots in time to determine the changes in the “mean age”. Therefore, this current analysis does not provide much information except that most TM events are performed by younger doctors as of 2013.

A fee-for-service reimbursement model is a common financial structure under OHIP. In this case, the number of patients is critical to a successful business medical practice, so seeing as many patients as possible may be an objective for newly practicing physicians who may have a small patient load. Established medical practices do not necessarily have these pressures and may not be seeking to use TM for the same reason, or are simply accustomed to F2F events and are not willing to change.

Another factor that could play a role in TM usage is the condition or ailment within the patient population that is being cared for. As physicians become experts at working with certain specific conditions within their specialties, these physicians would likely focus on these types of patients

and if these patients are not “TM amenable”, they would not contribute to TM growth. This is unlike other physicians whose practice might be made up of “TM friendly” patients. The latter group of physicians would be in a strong position to exploit the benefits of TM by performing activities where assessments/event can be undertaken without any hands-on examinations. There is some evidence of this, based on billing code analysis presented in Appendix V.

Analysis of the aggregated data makes it difficult to provide definitive conclusions in determining “*is current TM use an efficient method to grow physician practices or is it being used to substitute regular patient visits*”. TM use is driven by physician behavior, as they are the primary stakeholders in TM adoption. Therefore, it’s essential to explore specific medical practices from a physician perspective over time to see how physicians have used TM within their practices.

General and Family Practice

With most TM events focused on methadone addiction, the selected physicians are likely physicians treating addicted patients. This is an important attribute since it can be said in general that physician practice style differs among physicians within the same specialty. There are likely more similarities in practice styles within methadone clinics than in other types of medical settings due to the nature of the practice.

One observation from the table is that physicians who have grown their practice sizes¹³ or patient activity between 2011 and 2013 saw an increase in TM events. As an example, Physician ID 057888 performed 6886 more events over 3 years (combining Non-TM and TM¹⁴ events), representing a growth in activity of 42% over the period. TM accounted for 50% of this growth. Physician ID 413890 increased consult activity by 73%, where 49% of the growth was TM related. Physician ID 514433 is an outlier where the physician generated events using TM to drive 97% of that growth. On the opposite end of the spectrum some physicians saw declines in activity which could be attributed to various factors. However, the key observation from this

¹³ These sizes are based on OHIP billings, so when practice size is mentioned, it represents the number of patients that were seen by the physician and were billed by OHIP and not necessary the number of patients on record by individual physician.

¹⁴ TM Events are events that were recorded by OHIP with a service location group “Ontario Telemedicine Network”

sample is that TM had less of a decline than their F2F events (example: Physician ID 410670) or grew even when there was a decline in F2F events (example Physician ID 076554).

Though the sample size was small, there is some evidence to support TM as a growth driver for medical practices and that physicians may be seeing improved efficiencies as a result and are using TM to grow their practices.

Internal Medicine

Within Internal Medicine, it was found that 61% of TM activity within the specialty is performed by physicians who are responsible for 50% of the total OHIP activity within Internal Medicine. The eight physicians selected represent 57% of all the TM performed within the specialty.

Collectively, these selected physicians had increased their TM activity by 14% over the 3-year period. Individually, some physicians had declines in both TM and F2F activity while others (ID 949793, 084777, 805121) had declines in F2F visits but had a positive growth in TM. From this subset of physicians, it's unclear whether TM was a more efficient method of healthcare within their respective practices. In summary however, it appears that the percentage of TM usage had grown over the 3 years but these observations must be treated with caution due to the limited sample size.

Psychiatry:

The observation that the majority of TM events are performed by physicians who perform most of the F2F visits is not valid in the area of Psychiatry. Therefore, focusing on both the Performer and Non-Performer segments of the physician population is necessary to understand TM activity within this specialty.

Evaluating the physicians that met the criteria in Table 2 accounted for 82,312 Non-TM events in 2013, or 2.7% of all Non-TM activity, yet the same group accounted for 29.6% of all the TM activity within Psychiatry. Due to the low volumes, the percentage growth measurements appear wildly over stated. Therefore, comments must be limited to general statements. Over the three years, Physician ID 410754 had a substantial increase in TM activity. Similarly, 093592 grew in

TM activity substantially. Physicians ID 091385 and ID 080543 had the largest number of visits in the sample group. Physician 091385's growth was attributed to F2F visits, whereas physician 080543 had a decline in activity but grew the TM segment of their practice. In summary TM growth was substantial. However, within this group, TM events made up a very small portion of total events, making it difficult to determine TM adoption or utilization characteristics.

In contrast, physicians who were not considered part of the "Performer" group were nine physicians accounting for 3908 Non-TM Events (represents 0.13% of all Non-TM activity). Yet these physicians accounted for 19.03% of all TM activity within Psychiatry.

The "Non-Performer" psychiatry group is summarized in Table 9:

Table 9: Selected Physicians in the "Non-Performer Group" for Psychiatry

Encrypted Provider ID	Service Location Group	2011	2012	2013	Delta (2013-2011)
74492	Non-Telemedicine	141	180	216	75
	ONTARIO TELEMEDICINE NETWORK		39	268	268
	% of TM in Practice	0.00%	17.81%	55.37%	
419385	Non-Telemedicine	51	205	139	88
	ONTARIO TELEMEDICINE NETWORK	31	237	347	316
	% of TM in Practice	37.80%	53.62%	71.40%	
594657	Non-Telemedicine		441	257	257
	ONTARIO TELEMEDICINE NETWORK	23	114	302	279
	% of TM in Practice	100.00%	20.54%	54.03%	
914230	Non-Telemedicine	809	777	869	60
	ONTARIO TELEMEDICINE NETWORK	112	135	132	20
	% of TM in Practice	12.16%	14.80%	13.19%	
830132	Non-Telemedicine	687	424	116	-571
	ONTARIO TELEMEDICINE NETWORK	69	160	275	206
	% of TM in Practice	9.13%	27.40%	70.33%	
92344	Non-Telemedicine	436	253	181	-255
	ONTARIO TELEMEDICINE NETWORK	118	248	221	103
	% of TM in Practice	21.30%	49.50%	54.98%	
72115	Non-Telemedicine	703	604	386	-317
	ONTARIO TELEMEDICINE NETWORK	301	337	387	86
	% of TM in Practice	29.98%	35.81%	50.06%	
352263	Non-Telemedicine	1125	897	771	-354
	ONTARIO TELEMEDICINE NETWORK	37	118	115	78
	% of TM in Practice	3.18%	11.63%	12.98%	
323568	Non-Telemedicine	1310	993	973	-337
	ONTARIO TELEMEDICINE NETWORK	99	88	90	-9
	% of TM in Practice	7.03%	8.14%	8.47%	

Within this group, all the physicians (except for Physician ID 323568) had positive growth in TM activity over the 3-year period.

A method to review TM contribution to growth in a physician’s practice is to compare F2F with TM over the period, as shown in Table 10.

Table 10: Growth Contribution Analysis

Physician ID	Total 3 Year Difference	% of F2F	% of TM
074492	343	26%	74%
419385	404	64%	36%
594657	536	11%	89%
914230	80	75%	25%
830132	-365	156%	-56%
092344	-152	168%	-68%
072115	-231	137%	-37%
352263	-276	128%	-28%
323568	-346	97%	3%

By examining the “Growth Contribution” the percentages represent the proportion of growth attributed to F2F and TM events respectively. For example, physician ID 074492 saw a total growth in activity of 343 events (141 to 494 events) over the 3-year period. For that growth total, TM was responsible for 74% and F2F was responsible for 26%. This observation indicates that this physician used TM to grow the practice instead of traditional F2F events.

From Table 9, where overall growth was negative (Physician ID 830132, 92344, 72115, 352263 and 323568), the TM contribution shows a negative percentage contribution and F2F is positive. The mathematical translation is as follows: Example Physician ID 830132:

- The physician performed a net total of 365 fewer events (-365) over a 3-year term (includes both F2F and TM)
- Since the decline in F2F visits was larger (571 fewer F2F events), the F2F contribution to this decline was 156% since the F2F decline was greater than the net Total of 365 events
- Therefore, by definition, TM events were positive and contributed to growth that reduced the impact of the decline. Therefore, the TM contribution was negative
- In this example, the decline of F2F visits by 156% was offset by a positive TM contribution of 56% (The total contribution must equal 100%).

This analysis shows that many of these physicians experienced a positive TM growth. From inspection, there appears to be some evidence that TM became a larger part of their respective medical practices.

Summary

The work presented here was not able to use standard statistical methods because of the magnitude of differences between TM and non-TM events, making it difficult to measure the direction in trend of TM use. Also with only 3 data points, employing statistical methods is challenging. However, examining the data empirically to gain a better understanding of TM usage by physicians is still possible and valuable.

The “Cohort” analysis provided some evidence that not all physicians continued to use TM after initial adoption. However, based on the increase in “TM events per physicians”, it does appear that some physicians found TM to be a suitable mode of healthcare delivery.

In Ontario, TM is dominated by the General and Family specialty, with addiction medicine being the primary application of TM. The next two specialties in which TM is popular are Internal Medicine and Psychiatry. Their use of TM is also growing but through different mechanisms. Internal Medicine TM growth has been because physicians are seeing more patients, but Psychiatry TM has grown through new physician adoption. Therefore, it appears that physicians in General and Family and Internal Medicine are finding efficiencies in using TM as a method of care in comparison with Psychiatry.

When examining a sample of the individual physicians within each specialty, the following observations can be made, based on the selected sample:

- TM is being used as a method of healthcare within General and Family Practice, particularly with respect to addiction medicine.
- Internal Medicine physicians appear to be using TM to offset reductions in F2F visits
- TM within Psychiatry is predominately being used by physicians who are not as active (i.e. Non-Performer Group) as some of the other active physicians (Performer Group). It

appears that psychiatric physicians who have lower patient loads are using a higher percentage of TM than F2F for their patient visits.

In general, TM within Ontario appears to be providing a relatively increasing number of physician-patient interactions, with the caveat that its extent of use is highly dependent on the medical specialty and the nature of visits. From the sample, the billing codes used for TM have primarily involved non-contact types of medical processes which would be more amenable to TM. However, referring back to the original research question, we are unable to state categorically that the hypothesis about increased relative use of TM in physician – patient interactions over the period covered by this study can be accepted statistically.

This study demonstrates empirically that TM may be increasingly used by physicians in specialties where non-contact medical assessments are acceptable. In these situations, the potential exists for physicians to use TM to see more patients than they would normally see with traditional methods. In these cases, TM appears to be a benefit not only to the patient but to the physician.

Limitations

OHIP data were used in this research; the data are limited in the following ways (28):

- *Patient Visits are understated as it does not include First Nation community services*
- *Only Patient-Physician interactions are captured*
- *Non-medical clinical use is excluded.*
 - *Example: nurses may also use TM, but their use would not be captured through OHIP billing data; neither would be training sessions nor physician - physician events be captured.*

These limitations should not impede the usefulness of this work as any fee-for-service OTN procedure by physicians would be captured by OHIP. Therefore, the data are representative of TM usage in Ontario.

Recommendations for Future Work

This study was an attempt to determine if TM was being used to increase patient through-put and/or is it being used to replace F2F visits. There are many factors that can impact use of TM and not all were explored in this study. The following areas of research should be used to further this investigation to guide the development of future healthcare policies:

- Impact on distance: TM's primary function is to provide medical care at distance. As traffic congestion in major cities continues to grow, should physicians be encouraged to use TM in urban settings also.
- Factors impeding adoption: In partnership with OTN, it would be worthwhile to investigate physician attitudes and styles towards TM adoption. With OTN as a partner, it may be possible to correlate physician OHIP usage with their personal attitudes about TM.
- Physical specialty preference: It would be particularly useful to analyze specialties to determine what specific specialties are more amenable to TM, with OTN support. More specifically, to evaluate OHIP codes billable as TM would enable identifying procedures that are TM compliant. This would provide the impetus to do a more thorough analysis to compare F2F with TM events to provide a better understanding in adoption and utilization when using telemedicine.

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Appendices

Appendix I: Growth Rate Calculation (2008-2013):

F Year	Total Visits ((D-HN)	Growth %	Wt.%	% Growth Allocation
2008	27,572	NA	NA	0
2009	39,869	44.60%	6.30%	2.81%
2010	58,576	46.92%	9.25%	4.34%
2011	119,468	103.95%	18.87%	19.61%
2012	190,583	59.53%	30.10%	17.92%
2013	224,744	17.92%	35.49%	6.36%
Total 2009-2013	633,240			51.04%

Average Growth (Mean Calculation): 54.59%

Weighted Average Growth: 51.04%

TM Overall Usage 2013:

Source: 2013 OHIP data provided by Intellihealth

Clinical Event Type	Visits (D-HN) 2013
Non-TM	121,293,290
ONTARIO TM NETWORK	257,210
Total	121,550,500
% of TM Events	0.21%

Appendix II: TM Cohort Analysis

Cohort Group for Providers	Fiscal Year					
	2008	2009	2010	2011	2012	2013
2008 TM Cohort Group	387	303	274	272	252	236
2009 TM Cohort Group		177	130	109	98	98
2010 TM Cohort Group			136	96	79	80
2011 TM Cohort Group				186	131	124
2012 TM Cohort Group					219	156
2013 TM Cohort Group						328
Total TM Doctors	387	480	540	663	779	1022
Total # of TM Events	27,572.00	39,869.00	58,576.00	119,468.00	190,583.00	224,744.00
# of TM Events/Physician	71	83	108	180	245	220

of TM Events/Physician Annual Growth Rate: 25%

	F Year	F Year	F Year	F Year	F Year	F Year
Cohort Group for Providers	2008	2009	2010	2011	2012	2013
2008 TM Cohort Group	387	303	274	272	252	236
2009 TM Cohort Group		177	130	109	98	98
2010 TM Cohort Group			136	96	79	80
2011 TM Cohort Group				186	131	124
2012 TM Cohort Group					219	156
2013 TM Cohort Group						328
Decay Rate						
	2008	2009	2010	2011	2012	2013
2008 TM Cohort Group		-22%	-10%	-1%	-7%	-6%
2009 TM Cohort Group			-27%	-16%	-10%	0%
2010 TM Cohort Group				-29%	-18%	1%
2011 TM Cohort Group					-30%	-5%
2012 TM Cohort Group						-29%
2013 TM Cohort Group						
Decay Rate after initial adoption	-27%					

Averaging the initial decay of adoption from year to year was found using 27%. Therefore, the retention rate after initial adoption for TM can be calculated by (1- “initial decay”) rate of 73%.

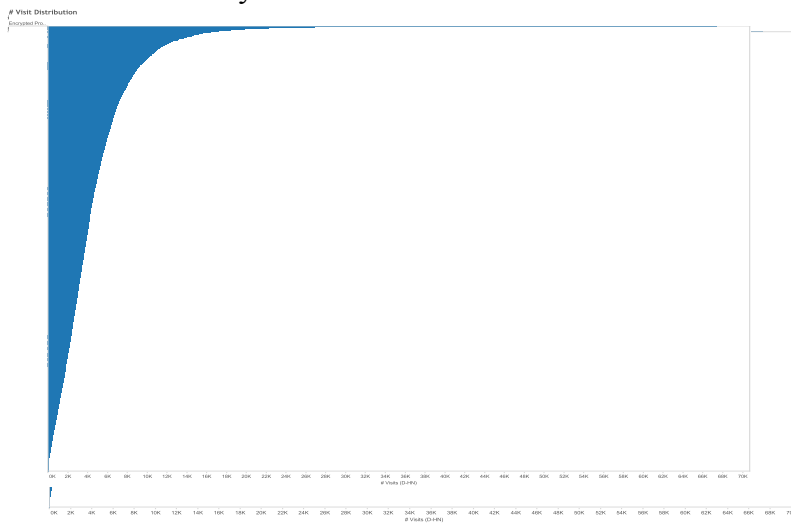
Appendix III: Provider Activity Distribution for Top 3 Specialties

Patient Visit Distribution (2013):

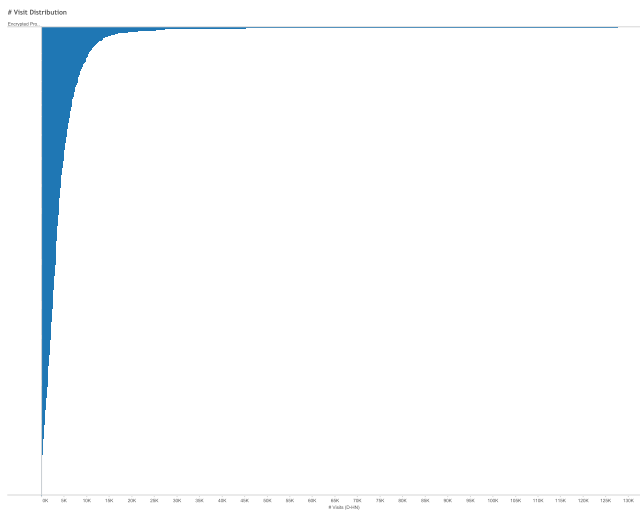
- X-Axis is the total number of Visits billed by a single physician
- Y-Axis is Physician ID (can't be seen as data was "shrunk" to capture all physicians) resulting in a distribution chart.

Observation: In all three specialties, it is clear that the bulk of the physician activity is done by a few physician's relative to the rest of the physician population.

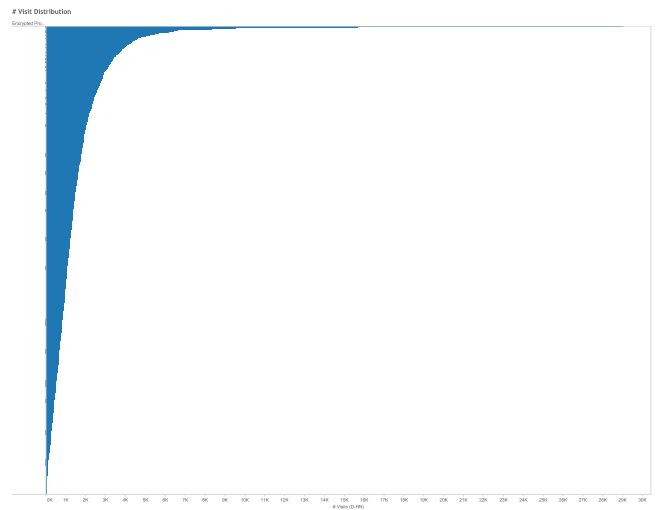
General & Family



Internal Medicine



Psychiatry



Appendix VI: Mann-Kendall Test

Reference: https://vsp.pnnl.gov/help/Vsample/Design_Trend_Mann_Kendall.htm

- Mann-Kendal Test: (Statistic Package: XLSTAT)

General and Family							
XLSTAT 2017.7.48622 - Mann-Kendall trend tests - Start time: 2017-12-15 at 9:30:13 AM / End time: 2017-12-15 at 9:30:13 AM							
Time series: Workbook = Mann-Kendall Trial.xlsx / Sheet = General and Family / Range = 'General and Family'!\$C\$35:\$C\$37 / 3 rw and 1 clm							
Date data: Workbook = Mann-Kendall Trial.xlsx / Sheet = General and Family / Range = 'General and Family'!\$B\$35:\$B\$37 / 3 rw and 1 clm							
Significance level (%): 10							
Confidence interval (%)(Sen's slope): 95							
<input type="text"/> <input type="button" value="v"/>							
Summary statistics:							
Variable	Observations	with missing	without missing	Minimum	Maximum	Mean	Std. deviation
Var1	3	0	3	209424.000	227224.000	218676.333	8920.898
Mann-Kendall trend test / Two-tailed test (Var1):							
Kendall's tau	-0.333						
S	-1.000						
Var(S)	3.667						
p-value (Two-tailed)	1.000						
alpha	0.1						
An approximation has been used to compute the p-value.							
Sen's slope:	-3922						
Confidence interval:	##### -3227.575 [

Internal Medicine

XLSTAT 2017.7.48622 - Mann-Kendall trend tests - Start time: 2017-12-15 at 9:40:00 AM / End time: 2017-12-15 at 9:40:01 AM

Time series: Workbook = Mann-Kendall Trial.xlsx / Sheet = Internal Medicine / Range = 'Internal Medicine'!\$B\$43:\$B\$45 / 3 rw

Date data: Workbook = Mann-Kendall Trial.xlsx / Sheet = Internal Medicine / Range = 'Internal Medicine'!\$A\$43:\$A\$45 / 3 rw a

Significance level (%): 10

Confidence interval (%)(Sen's slope): 95

Summary statistics:

Variable	Observations with missing	without missing	Minimum	Maximum	Mean	Std. deviation	
Var1	3	0	3	106184.000	110665.000	108319.000	2247.939

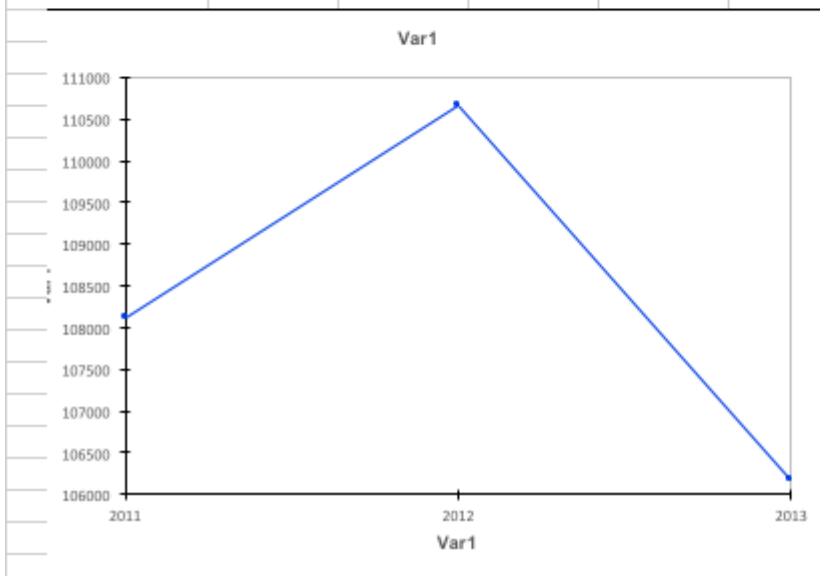
Mann-Kendall trend test / Two-tailed test (Var1):

Kendall's tau	-0.333
S	-1.000
Var(S)	3.667
p-value (Two-tailed)	1.000
alpha	0.1

An approximation has been used to compute the p-value.

Sen's slope: -962

Confidence interval: ##### -786.050 [



Psychiatry

XLSTAT 2017.7.48622 - Mann-Kendall trend tests - Start time: 2017-12-15 at 9:43:30 AM / End time: 2017-12-15 at 9:43:30 AM

Time series: Workbook = Mann-Kendall Trial.xlsx / Sheet = Psychiatry / Range = Psychiatry!\$B\$24:\$B\$26 / 3 rw and 1 clm

Date data: Workbook = Mann-Kendall Trial.xlsx / Sheet = Psychiatry / Range = Psychiatry!\$A\$24:\$A\$26 / 3 rw and 1 clm

Significance level (%): 10

Confidence interval (%)(Sen's slope): 95

Summary statistics:

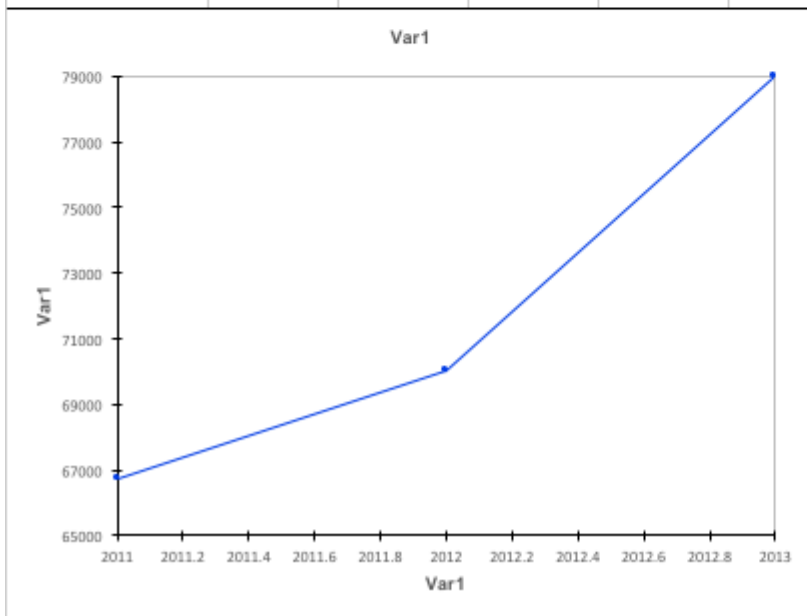
Variable	Observations with missing	without missing	Minimum	Maximum	Mean	Std. deviation	
Var1	3	0	3	66724.000	78987.000	71903.333	6349.422

Mann-Kendall trend test / Two-tailed test (Var1):

Kendall's tau	1
S	3.000
Var(S)	3.667
p-value (Two-tailed)	0.333
alpha	0.1

An approximation has been used to compute the p-value.

Sen's slope: 6132
Confidence interval:] 5988.675, 6274.325 [



Appendix V: Billing Code Analysis

Billing codes for TM

General&Family Physican TM Codes

Encrypted Provider ID (copy)	Grand Total	Fee Schedule Code					
		(A957) FOCUSED PRACTICE ASSESSMENT - A..	(A007) INTERMED. ASSESS/WELL BABY CARE-F.P./..	(K680) SUBSTANCE ABUSE - EXTEND..	(A001) MINOR ASSESS.-F.P./G.P.	(A003) GEN. ASSESS. -F.P./G.P.	(K005) INDIVIDUAL CARE PER 1/2 HR
414745	10,614	10,426	180			7	1
072466	9,054	8,886	12	155		1	
413890	8,274	8,270					4
411438	7,374	7,293	77				4
079209	7,136	7,126	6	2		2	
433134	5,939	5,933	6				
419021	5,008	4,119	874	10		5	
410670	3,924	3,701		223			
Grand Total	57,323	55,754	1,155	390	15	5	4

Psychiatry

Fee Schedule Code	Encrypted Provider ID (copy)						Grand T..
	091385	093592	410754	414906	080543	075208	
Grand Total	697	652	471	440	291	122	2,673
(K198) PSYCHIATRY-PSYCHIATRIC CARE 1/2 HR OR PART	38	465	294	332		114	1,243
(A007) INTERMED.ASSESS/WELL BABY CARE-F.P./G.P./PAED.	623				291		914
(A195) CONSULT.-PSYCHIATRY	30	109	177	108			424
(K196) FAM PSYCH CARE OUT-PT PER 1/2 HR OR MAJ PART THEREOF		37				5	42
(K188) HIGH RISK COMMUNITY PSYCH CARE		15					15
(A193) SPECIFIC ASSESS.-PSYCHIATRY		11					11
(K195) FAMILY THERAPY-2 OR MORE FAMILY MEMBERS-OUT PER 1/2 HR.PSYCH		9					9
(A190) SPECIAL PSYCHIATRIC CONSULTATION		4					4
(K187) ACUTE POST-DISCHARGE COMMUNITY PSYCH CARE						3	3
(A001) MINOR ASSESS.-F.P./G.P.	2						2
(A003) GEN. ASSESS. -F.P./G.P.	2						2
(A194) PARTIAL-ASSESS. -PSYCH.	1						1
(A196) RE-CONSULT.-PSYCHIATRY		1					1
(K007) IND. PSYCHOTHERAPY PER HALF HOUR - GP	1						1
(K197) PSYCHOTHERAPY-INDIVIDUAL-OUT-PER 1/2 HR PSYCHIATRY		1					1

Internal Medicine

Fee Schedule Code	Encrypted Provider ID (copy)										Grand T..
	246349	312520	084777	072659	508809	416372	415178	508498	075268	072087	
Grand Total	844	779	480	457	396	358	283	276	262	237	4,372
(A135) CONSULT.-INTERNAL MED.	3	36	432	83	273			28			855
(E078) CHRONIC DISEASE ASSESSMENT PREMIUM	16	369		106		1	45	93	88	64	782
(A131) COMPLEX MEDICAL SPECIFIC RE-ASSESSMENT	124	369		65	1					52	611
(A133) MEDICAL SPECIFIC ASSESSMENT	203		20	61	100			3		108	495
(A475) CONSULT.-RESPIRATORY DISEASE					6	234		73			313
(A134) MEDICAL SPECIFIC RE-ASSESSMENT	138		27	4				81		12	262
(A138) PARTIAL-ASSESS. -INT- MED.	102				8			70		1	181
(G512) WEEKLY PALLIATIVE CARE CASE MANAGEMENT	129						28				157
(A473) MEDICAL SPECIFIC ASSESSMENT						72		73			145
(G382) D./T. PROC.-INJ./INFUSION-SUPERVISION	79						53				132
(G388) MNGT OF SPECIAL ORAL CHEMOTHERAPY-FOR MALIGNANT DISEASE	50						19				69
(A441) MEDICAL ONCOLOGY - COMPLEX MEDICAL SPECIFIC RE-ASSESSMENT							61				61
(A474) MEDICAL SPECIFIC RE-ASSESSMENT						45		9			54
(A155) ENDOCRINOLOGY & METABOLISM - CONSULTATION				46							46
(A151) ENDO & METABOLISM - COMPLEX MED SPECIFIC RE-ASSESS				42							42
(A153) ENDOCRINOLOGY & METABOLISM - MEDICAL SPECIFIC ASSESSMENT				39							39
(A444) MEDICAL ONCOLOGY - MEDICAL SPECIFIC RE-ASSESSMENT							26				26
(A443) MEDICAL ONCOLOGY - MEDICAL SPECIFIC ASSESSMENT							25				25
(A448) MEDICAL ONCOLOGY - PARTIAL ASSESSMENT							21				21
(A471) COMPLEX MEDICAL SPECIFIC RE-ASSESSMENT						5		12			17
(A154) ENDOCRINOLOGY & METABOLISM - MEDICAL SPECIFIC RE-ASSESSMENT				9							9
(A478) PARTIAL ASSESS. -RESP. DIS.							1	6			7
(A765) CONSULT (MED. SPECIALIST) PATIENT 16 YEARS OF AGE AND UNDER					7						7
(A136) RE-CONSULT.-INTERNAL MED.		2	1	1	1						5
(K029) INTENSIVE INSULIN THERAPY COUNSELING		3									3
(K013) COUNSELLING-ONE OR MORE PEOPLE-PER 1/2HR.							1	1			2
(K015) COUNSELLING-RELATIVE ON BEHALF OF PT.SEE PARA.B20 (C)							2				2
(A158) ENDOCRINOLOGY & METABOLISM - PARTIAL ASSESSMENT				1							1
(A445) MEDICAL ONCOLOGY - CONSULTATION							1				1
(A446) MEDICAL ONCOLOGY - REPEAT CONSULTATION							1				1
(A476) RE-CONSULT.-RESPIRATORY DISEASE								1			1

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