Final report

Clinic Management Information System (CMIS)

Pilot study in Myanmar

Alexander Fertig
Julia Park
Russell Toth

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Prepared by: Alexander Fertig, Julia Park, and Russell Toth

Introduction

Koe Koe Tech (KKT), a Myanmar based information technology social enterprise, is developing a Health Management Information System (HMIS) for use by doctors and other health staff in Myanmar's public and private hospitals. In parallel to the development of HMIS, KKT has also been designing and testing a version of the software known as CMIS, or Clinic Management Information System, designed for use specifically in Myanmar's vast network of rural and urban health clinics. The software is optimized for low-resource settings, intended to run on relatively inexpensive tablets, and built around a simple interface. While there is a decades-long legacy of over-engineered, inefficient, and expensive electronic medical records (EMR) systems in the developed world, KKT is pioneering a practical, streamlined, and user-oriented solution (Kunzmann, 2019). As a replacement to the outdated paper-based records system currently in place throughout the country, CMIS is meant to increase the efficiency and accuracy of recording patient medical information, leading to faster consultations, more effective treatment, and ultimately improved health outcomes for patients.

This report provides a brief overview of the current state of the healthcare system in Myanmar, reviews the existing literature on EMR systems in comparable settings around the world, and summarizes the results of a pilot evaluation of the CMIS technology conducted by Innovations for Poverty Action (IPA). The report concludes with general recommendations for implementing partners and suggestions for further research.

Background

Healthcare in Myanmar

The World Health Organization ranked Myanmar's healthcare system 190th out of 191 countries in a 2002 report on health system performance (Tandon et al., 2002). The main provider of health services in Myanmar is the Ministry of Health and Sports (MoHS data), comprising six departments which facilitate national aspects of healthcare, including primary healthcare, basic health services, and access to effective treatments and rehabilitation services (Latt et al., 2016). Despite the range of duties and departments, the Burmese government has consistently spent less than 3 percent of their budget on healthcare and education combined (MoHS data). Given the lack of resources allotted to healthcare, quality remains very low. Prior to the country's recent democratic elections in 2015, there were only 61 medical doctors per 100,000 people within Myanmar, compared to a world average of

160 per 100,000 (WHO data). Despite these shortages, the number of enrolled medical students has since been cut in half to 1,200 nationally. The private sector, though still underdeveloped, has greater access to resources than the public sector. In 2015, the Department of Medical Services reported 193 private hospitals and 4,112 private clinics nationwide, staffed with a total of 18,443 medical doctors. In comparison, the public healthcare system comprised 1,072 hospitals (including 16 that practice primarily traditional medicine) and 2,199 general clinics, staffed with only 13,099 doctors in total (MoHS data).

Both public and private health sectors in Myanmar currently lack the administrative capacity to maintain sufficient patient care and reduce morbidity and mortality rates. Though national-level data on mortality is inconsistent, annual hospital statistics in 2012 identified a drug-resistant form of malaria as the leading cause of death, and tuberculosis rates over three times the global average (Department of Health Planning). Estimates from the 2014 Census show that Myanmar's fertility rates have been steadily falling since 1965 and are now just above replacement levels in urban and surrounding areas (Latt et al., 2016). Additionally, as Myanmar opens its borders to foreign investment for the first time in decades, international pharmaceutical companies are pouring in to service the virtually untouched market of approximately 60 million people. However, the government's monitoring of this industry is minimal: drug registration processes are not stringent, and the country lacks the infrastructure to efficiently manage its decentralized pharmaceutical procurement and stocking systems.

Over the last decade, international donors, non-governmental organizations, and civil society organizations have started programs to support healthcare provision in Myanmar (Latt et al., 2016). Koe Koe Tech (KKT), a local information technology start-up, is developing and piloting their Clinical Management Information System (CMIS), a tablet-based application that facilitates the management of digital health records, including patient identity and medical history. CMIS comes pre-installed on a touch-screen tablet and was first distributed to select clinics around Yangon in May of 2017. The implementation of an electronic medical record (EMR) system such as CMIS could provide many benefits for both patients and doctors, including long term maintenance of accurate patient medical histories, access to reliable data on health trends, and transparency in pharmaceutical markets.

Paper-based systems do not operate efficiently once large patient numbers are reached (Douglas et al., 2010). As Myanmar expands its public and private insurance industries and repatriation begins on the Eastern borders, this issue is becoming more prevalent. The potential of EMR systems to transform medical care practice has been recognized over the past decades (Williams and Boren, 2008), as they have been shown to generate improvements in the accuracy of pharmaceutical stock lists, the legibility of notes and prescriptions, and the availability of patient data and clinical support (Car et al., 2008; WHO, 2006; Chetley, 2006; Nguyen et al., 2011).

Nonetheless, through interviews conducted in 2016 with clinic staff from a non-governmental healthcare provider, Marie Stopes International Myanmar (MSI-M), respondents expressed concerns about EMR implementation. Worries included the extra workload and training required during the transition stage, accessibility and confidentiality of data held under the new system, the provision of technical support, and the suitability of current infrastructure (Thit et al., 2016). Further evidence around the efficacy of EMR systems—as well as potential threats to implementation—will be critical to reforming healthcare in Myanmar.

EMR in Other Countries

The potential to improve patient care through better compliance with standardized guidelines, clinical decision support and other measures is promising, even in countries which lack human expertise and financial resources (Kawamoto et al., 2010; Williams and Boren, 2008). While developing-world EMR implementation is in the early stages, a preliminary evaluation of an EMR system implemented by the Ministry of Health in Malawi found improvements to both data quality and efficiency of patient management (Waters, 2010; Kumitawa et al., 2017). Estimated cost savings (related to consultation length, transcription time, and laboratory use) totaled US$284,395 annually. Even after accounting for the costs of installation and maintenance, a net financial gain was realized by the third year of implementation, and after five years the total net benefit was estimated to be US$613,681 (Driessen et al., 2013). Many existing EMR systems, including those in Malawi, Kenya, Peru, Haiti, Uganda, and Brazil, were conceived as treatment programs for specific diseases such as HIV and tuberculosis (Fraser et al., 2005). The experience gained from the implementation of these systems can provide the foundation for a comprehensive understanding of the benefits and challenges of introducing EMRs within developing countries.

As the establishment of EMR systems in the developing world is at an early stage, research is still lacking. However, basic structural features of these systems are well known. EMRs in Haiti, Cameroon, and Kenya use satellite internet connectivity and IBM compatible microcomputers powered by an uninterrupted power supply with solar battery backup. In Haiti, NGOs launched an open source web-based HIV treatment program that collected data on patient demographics, previous treatments, symptoms, examination/lab results, and prescriptions (PIH, 2018). In Cameroon, where the public sector is the principle healthcare provider, an EMR system known as MEDCAB was released in 2003 for primary healthcare practitioners (Moluh et al., 2005). MEDCAB's many features and functions include user administration, patient registration, appointment management, report generation, and patient card tracking. In 2001, an EMR system known as MMRS was implemented in Kenya, covering six clinic types: adult medicine, pediatrics, infants and children under 5, antenatal care, family planning, and sexually transmitted infection. MMRS assigns unique patient IDs, generates monthly patient reports, and provides information on diagnoses necessary for treatment (Hannan et al., 2001).

Because of similarities in design and country context, the EMR system currently used in Malawi offers a comparison to KKT's CMIS project in Myanmar. In Malawi, Kamuzu Central hospital uses a touch screen patient management information system for a wide range of clinical situations, and as of 2017, they have established four pilot sites testing a pharmacy supply management and prescription fast-track software. The system has faced consistent challenges in implementation for four primary reasons: 1) a lack of trained medical personnel in rural areas, 2) low levels of computer literacy, 3) high workload due to an overall shortage of qualified staff, and 4) unreliable internet connectivity resulting from rudimentary infrastructure and limited technical support (Hannan et al., 2001).

Among all developing countries attempting to implement EMR systems, poor electricity and ICT infrastructures remain significant barriers, so establishing reliable electricity generation will be a necessary condition for successful implementation of EMRs. Another serious limitation to the success of EMR systems is a lack of hardware and software standardization (Williams and Boren, 2008). Because of the different needs of various hospital departments and clinic types, different technologies are used across the healthcare system, making communication between healthcare providers a challenge. There is thus a need for ICT technologies to enable interoperability, if not full integration.

Quality of data in EMRs varies due to sociotechnical factors surrounding individual users; benefits of the system are dependent on the quality of their implementation process and the extent to which user support is integrated (Car et. al 2008). The development of interactive tools to assist healthcare professionals with decision-making tasks is vital (Genxys). For example, access to the internet or SMS communication allows staff to seek specialist advice from remote physicians, communicate with patients, and disseminate health education messages. In developing countries where qualified physicians are located within urban areas (and rural areas lack access to reliable medical information), interaction between rural and urban physicians can be facilitated by an EMR system. Where inconsistencies in data-entry have led to poor data quality, implementers have added features that allow for dynamically adjusted validity ranges. Users are warned when data values appear implausible, and if they are completely out of range, the input is disallowed. The addition of these features, along with monthly data-cleaning processes, has led to significant data quality improvements (Douglas et al., 2010).

Evaluation

In designing and scaling the CMIS software, KKT will need to address the challenges and barriers faced by implementers of EMR systems in other developing countries. Additionally, generating evidence from early pilots and user testing in Myanmar will be crucial to inform optimal design and implementation strategies specific to the local context.

Since 2017, IPA has been working with KKT and Population Services International (PSI) to undertake the beginning phases of what will eventually become a randomized evaluation of the CMIS platform. To date, IPA has conducted four rounds of surveys on a small sample of doctors within PSI's 1000-strong network of private Sun Quality Health (SQH) providers. In total, 18 clinics from Yangon and Bago Regions, as well as Mon and Chin States, participated in these surveys. The purpose of this pilot evaluation is to follow the CMIS usage patterns and valuations of a small sample of doctors—as they become more familiar with the CMIS app—in order to better understand the system's long-term utility as a tool to increase clinic efficiency and patient services. We hypothesize that, as a complex and unfamiliar technology, CMIS might require a period of learning for doctors to fully value its benefits. This evaluation can also be useful as a form of early market research for KKT as they work to improve the functionalities and overall user experience of CMIS, and experiment with various pricing and dissemination strategies. The overall objectives of the evaluation are as follows:

Objective 1: Track doctor valuation of CMIS (as well as its specific functionalities) over time
Objective 2: Understand the effects of CMIS on a clinic's administrative efficiency
Objective 3: Understand the effects of CMIS on doctor-patient interaction
Objective 4: Analyze the patient experience with CMIS
Objective 5: Examine the effect of CMIS on healthcare costs

Baseline Survey

On May 28th, 2018, seven doctors from the Sun Clinic network were trained on the CMIS app (in addition to four doctors who had already received the software a few months prior). After the training, the seven new doctors were given a short survey to assess some of their initial impressions and

expectations for how the platform would affect their practice (See Appendix 1). In general, survey responses were helpful in establishing baseline characteristics and attitudes of this select group of doctors. Most importantly, all seven respondents were actively engaged in the interview process, agreeing to follow-up surveys and granting future access to their patients. All doctors were tech literate; each owned a smartphone, with more than half owning a computer as well. In terms of their consultation practices, everyone indicated that they employ an administrative assistant who takes notes during at least some of their consultations. In instances where the doctor takes their own notes, four of them said they prefer to take notes during the consultation, while the remainder wait for breaks or the completion of the patient's visit.

The survey also asked questions about willingness to pay (WTP) for EMR technologies, which helped to establish a baseline understanding of how much doctors value the perceived benefits of the CMIS software. Each was asked how much they would be willing to pay (per month) for the following hypothetical technologies: a system that collects and organizes all patient notes for easy reference; a service that sends automatic SMS reminders to patients for recurring treatments or upcoming appointments; a dashboard of information on health trends and patterns to help doctors better understand their patients' needs. On average, the seven doctors valued the consultation note system the highest, indicating a price-point of 20,000 MMK per month. Much lower values were placed on the health dashboard and reminder system, at an average of 6,286 MMK and 5,857 MMK per month, respectively. Additionally, doctors were presented with a less specific form of the question, asking how much they would pay for "the CMIS software in the training you just completed." For this, respondents gave an average figure of 5,571 MMK per month, suggesting that there was some confusion about the previous questions or about the exact features of CMIS. Since the CMIS application is essentially a service that helps collect and organize patient notes and information, the disparity between the former (20,000 MMK) and latter (5,571 MMK) amounts is unexpected. Doctors were also asked how much they thought an average patient would be willing to pay for the CMIS software, which they predicted to be 86 MMK and 450 MMK per visit for one-time and chronic patients, respectively. The large difference between the two is in line with expectations, as chronic patients would presumably benefit more from a system that tracks medical history over time.

Doctors also had a fairly optimistic outlook on their anticipated productivity with CMIS, predicting that 52 percent of their patients could be registered in the system within one week, and 67 percent within the next month. Furthermore, when asked if they thought implementation of the software would be worthwhile, even though writing notes on the tablet might take more time than writing by hand, most doctors answered positively.

Follow-up Surveys

After about two months of using the CMIS software in their practices, the seven doctors from the initial training were visited at their clinics by IPA staff to administer a follow-up survey. In addition, IPA selected seven "control" doctors from within the SUN Clinic network as a comparison group. These doctors were never exposed to the CMIS software and were loosely matched to the seven treatment doctors based on age, location, and participation in various PSI health/medical initiatives. The four additional doctors that had attended the May 28th training—members of PSI's Universal Health Care (UHC) initiative—were also included in this data collection, though they are not considered in our subsequent analysis. These doctors had been using the CMIS software for several months longer than the treatment group and were not matched with any control clinics; they are included in this report

for descriptive purposes only. After being visited at their clinics for the first follow-up survey between July 11th and 18th, all doctors were contacted twice more via telephone—first between August 30th and September 4th, and again on October 8th—for two additional surveys. See Table 1 below for an overview of the sample.

Table 1: Description of Study Sample

TREATMENT			CONTROL			Matching	
Doctor ID	**Age**	**State/Region**	**Doctor ID**	**Age**	**State/Region**	**Location Match**	**Age Difference**
8	57	Yangon	**1**		Yangon	Yes	
9	58	Yangon	**2**	50	Yangon	Yes	8
10	70	Yangon	**3**	55	Yangon	Yes	15
11	33	Mon	**4**	32	Mon	Yes	1
12	32	Yangon	**5**		Yangon	Yes	
13	61	Yangon	**6**	57	Yangon	Yes	4
14	60	Bago (West)	**7**	69	Bago (West)	Yes	9
15*		Chin					
16*	53	Yangon					
17*	59	Yangon					
18*	52	Yangon					

*** UHC Clinic**

The usage habits and valuations of the 11 doctors who received CMIS were tracked across these three surveys, while some basic information regarding patient load and duration of consultation was collected from the seven control doctors. The surveys examine how doctors use the app during a consultation and how that usage changes as they become more familiar with the platform. It also tracks their willingness to pay for different functionalities of CMIS (see Appendix II for table of results).

The first follow-up survey, administered during the second week of July, captured doctor feedback from just over one month of exposure to the CMIS software. At this stage, doctors reported a generally positive experience with the app. Doctors reported seeing approximately 60 patients per day, and that they had already registered 30 percent of their existing patients into the software (average time needed to register a first-time patient was just over 9 minutes, and the time spent recording subsequent consultation notes in the app was just over 7 minutes). However, doctors reported using the CMIS system on less than a third of their total consultations since the initial training, and in over 40 percent of these consultations the doctors only entered notes into the app after the appointment was over. On average, doctors estimated that using CMIS increased the length of a consultation by nearly seven minutes. Overall, 40 percent of doctors believed that CMIS improved the quality of patient interaction, 50 percent were satisfied with the tablet, and 67 percent were satisfied with the CMIS app itself. Average willingness to pay for the current version of the CMIS software increased from 5,571 Myanmar Kyats (MMK)[1] in the initial (baseline) survey to 9,714 MMK, an increase of 74

[1] As of the time of writing, 1 USD = 0.76 GBP = 1,513 MMK.

percent. Similarly, doctors were also more bullish in their estimation of how much the average patient would be willing to pay for the benefits of CMIS, citing figures of 1,714 MMK and 3,143 MMK per visit for one-time and chronic patients, respectively.

While this initial follow-up survey suggests positive reception of the CMIS software, subsequent surveys indicate trends towards decreasing satisfaction and increasing frustration with the system. For example, though doctors reported having registered nearly a third of their patients in the app after the first month and a half of use, only about 40 percent were registered by the second follow-up survey (another 1.5 months later), and merely 45 percent were registered by the final survey (occurring over one month after the second). This pattern highlights a serious decrease in the rate at which new patients were registered in the system. One would expect the time needed to register new patients—and to enter notes for existing patients—to decrease over time, as doctors become more familiar with the system, but this is not reflected in the data. In fact, average time needed for both shows a slight increase across the three survey periods.

While doctors reported using the CMIS app for just over 30 percent of their patients in the first follow-up, this number shrank to 23 percent for the second, and just over ten percent for the final survey. In addition, though one would expect CMIS usage rates to be highest for chronic patients—as these are the patients for which the advantages of digital health records are most obvious—this is not the observed outcome. On average, the overall reported CMIS usage rate was higher than the usage rate for a number of chronic conditions across all three survey rounds.

Perceptions of the software also became more negative over time. The percentage of doctors who felt that the software improved the quality of patient interaction fell from 40 percent in the first follow-up to 14 percent in the second, and finally zero percent by the third. Similarly, the percentage of doctors that were satisfied with the CMIS app decreased to 43 percent in the second follow-up round—from its previous figure of 67 percent—and landed at 14 percent in the final round. Finally, after observing an initial increase during the first follow-up (compared to the baseline survey) in doctors' willingness to pay for the CMIS software, we see a subsequent reversal of this trend in the following rounds, as the figure falls back to 5,571 MMK in the second and to 3,714 MMK in the third.

To detect any changes in pricing brought about by the introduction of CMIS, consultation fees were also tracked across survey rounds. With the exception of the first follow-up survey, for which these specific questions seem to have been misunderstood (rendering the data unreliable), we detected a minor increase in the average consultation fees charged by the treatment doctors, going from just under 2100 MMK to 2500 MMK (between the second and third follow-up survey rounds). Nearly all doctors charge a fixed consultation fee, regardless of the patient's condition or symptoms.

Analysis

Data from this evaluation can either be analyzed through change over time or treatment – control comparisons. Both methods provide useful context to the analysis. Comparing outcomes across treatment and control groups allows for causal inference (i.e., attributing any significant differences to the impact of the CMIS software itself) by controlling for time trends such as seasonality or other dynamic drivers of disease and injury that would be common to both treatment and control groups. However, because of the non-random selection of the control group and undersized sample in this study, we remain cautious in the conclusions drawn from this part of the analysis. Change over time

comparisons for the treatment group, though theoretically less compelling, allow us to instead track changes in important outcomes that were not measured in the control group (those relating to perceptions of and experience with the CMIS software).

Time-series analysis is performed by calculating mean outcomes in the treatment group for all three time periods separately, and comparing these averages via simple t-tests. Because of the extremely small sample of treatment doctors (n=7) in this pilot study, only very large mean differences yield significant t-values (see Appendix II).

For example, though we observe a continuous increase in the number of consultations conducted per day in the seven treatment clinics, the small sample (and large standard deviation in the distribution of this outcome) make it impossible to interpret this as anything more than random variation in the data. Furthermore, ignoring the questionable data on consultation fees from follow-up survey round one, the 400 MMK increase in these fees between rounds two and three is also not sufficiently large in magnitude to be interpreted with confidence. Finally, none of the changes in the willingness to pay indicators are statistically significant, due mostly to high variation in individual responses.

On the other hand, two of the key outcomes measuring doctor impressions of the software reflect statistically significant decreases between the first and third follow-up survey rounds. Specifically, the drop in the percentage of doctors believing that the CMIS software "improves the quality of patient interaction" from 40 to zero, and the reduction in the percentage of doctors "currently satisfied with the CMIS app" from 67 to 14 are both statistically significant changes. Similarly, the two variables measuring efficiency of consultations ("minutes needed to register first-time patient" and "minutes needed to enter patient consultation in CMIS") increased significantly between follow-up survey rounds one and three, indicating decreasing productivity with the software. The percentage of consultations for which CMIS was used to record information in real time decreased significantly at the same time, meaning that doctors are not only spending more time with the software during consultations, but increasingly spending time after the consultation to continue entering information in the app.

For treatment – control comparison analysis, we use a simple difference-in-difference estimator. This method has two benefits over a simple comparison of means: 1) it controls for differences in baseline characteristics between the treatment and control clinics (which are likely since the treatment was not randomly assigned), and 2) it produces more precise estimates by doubling the number of observations (since it incorporates data from two time periods). However, this analysis is limited to outcomes that were measured for both treatment and control clinics.

The important information from the results table (see Appendix III) is the coefficient on the "Interaction" variable, which tells us how much greater (or less) was the observed change (from follow-up survey round one to three) between the treatment and control groups. For example, a coefficient of -24 on the first outcome ("consultations conducted in the last day"), shows that, though there was an overall increase in the number of consultations between the first and last follow-up survey rounds, this increase was 24 consultations fewer in the treatment group. In general, a positive coefficient on the "Interaction" describes a positive treatment effect, while a negative coefficient describes a negative impact. The coefficients on the remaining indicators measuring consultation fees and number of patients are uniformly positive (with the exception of patient numbers for diabetes and family planning patients), suggesting that treatment doctors increased their patient loads—as well as the

fees collected from each patient—by a higher margin than the control doctors. However, since only one coefficient is statistically significant at even the ten percent level, we caution against drawing too strong of a conclusion from these results. As emphasized throughout this report, the analysis is limited by the small sample of this pilot study.

Conclusion

Findings

Though small in scale, the learning outcomes of this pilot study are still valuable as an early evaluation of CMIS integration into Myanmar's private health clinics, and broader implementation in the public system. Of the study's original stated objectives, progress on all five has been achieved, with further work being necessary to identify precise mechanisms through which doctors and patients are responding to CMIS. The following trends in perception and uptake are already apparent.

Objective 1: Track doctor valuation of CMIS (as well as its specific functionalities) over time
The value that doctors placed on the CMIS software was measured through direct feedback on satisfaction and assessments of willingness to pay by both doctors and patients. Though initial results indicated an upward trend in both WTP and satisfaction, this trend reversed after the first follow-up survey round, and by the end of the study all indicators of doctor valuation were far lower than initial levels. Treatment doctors not only expressed a lower WTP for the CMIS software itself, but also for potential features that would expand the utility of the platform (e.g., an SMS patient reminder system and dashboard of aggregated patient data / local health trends).

Objective 2: Understand the effects of CMIS on a clinic's administrative efficiency
The study measured clinic administrative efficiency in various ways: total consultations per day, time spent registering first-time patients in CMIS, and time spent entering patient information in CMIS. Surprisingly, though one would expect the latter two values to decrease as doctors become more familiar with the software, these measures actually increased among treatment doctors. Our difference-in-difference analysis further suggests that CMIS led to an average decrease in consultations per day, though this effect is not statistically significant. Other indicators, such as the percentage of patients for which CMIS was used, and the percentage of CMIS consultations for which information is entered in real time (during the consultation), also decreased across survey rounds, suggesting increasing frustration with the time and labor burden of the CMIS platform.

Objective 3: Understand the effects of CMIS on doctor-patient interaction
Though the study only tracked one indicator directly related to doctor patient interaction, the story told by the data is quite apparent. When asked if they believe that CMIS improves the quality of doctor patient interaction, 40 percent of doctors initially responded positively, which decreased to 14 and then to zero percent in subsequent survey rounds.

Objective 4: Analyze the patient experience with CMIS
Since we were not able to speak directly with patients during this study, our understanding of the patient experience is limited, and an area where further research will be important. The only patient-side indicator tracked in this study was doctor expectation of what a patient would be willing to pay—

on a per-visit basis—for the benefits of the CMIS platform. As expected, doctors predicted that patients with a chronic condition would pay a higher amount than one-time patients, though both of these predictions decreased across survey rounds. By the end of the study, treatment doctors said unanimously that patients with chronic conditions would not pay anything for the use of CMIS.

Objective 5: Examine the effect of CMIS on healthcare costs

In the long run, the question of CMIS pricing will be important for KKT and others to consider. Identifying a sustainable business model that maintains an affordable price point will be essential to the success of the platform. KKT will not only have to decide on a specific pricing scheme (e.g. monthly subscription vs. volume-based pricing), but will also need to consider the percentage of costs that can be directly or indirectly passed on to patients. Though doctors in this pilot study were not paying a fee for use of the CMIS software, they were required to pay the up-front cost of purchasing the tablet. We theorized that doctors may try to recoup this cost by increasing consultation charges in the short-run. Though the data shows that consultation fees increased by a higher margin in the treatment group compared with the control group, the increase was small and not statistically significant, making it impossible to attribute this (with any confidence) to CMIS directly.

Initial results from both the baseline survey and first follow-up survey strongly suggest that doctors are open to, and even actively seeking, a transition to an EMR system. Though initial WTP figures and satisfaction levels for the CMIS system were promisingly high, these numbers dropped significantly over the course of three months, as did usage rates. Based on the amount of time that doctors are spending on each CMIS consultation, and the fact that this time spent is not decreasing (it is actually increasing), we suspect two main reasons for the declining interest: 1) the number of required fields and data-entry burden for each consultation is too high (due in part to donor requirements, as explained below), and 2) doctors do not receive enough support and training to overcome the steep learning curve of adjusting to an EMR system. As seen in the experiences of other countries transitioning to EMR, lack of digital literacy among health staff and general labor shortage for data entry are two of the most prominent barriers to success. For KKT and PSI to avoid the pitfalls of previous attempts at establishing EMR platforms, providing adequate levels of support and streamlining data entry as much as possible should be two of their top priorities moving forward.

Recommendations

We make the following broad recommendations for all present and future stakeholders of EMR systems in Myanmar.

Recommendation 1: Reduce the burden of data entry and administrative functions on medical staff as much as possible without sacrificing the quality of information

All doctors participating in the study are members of PSI's Sun clinic network, and thus have certain reporting requirements set by international donors—with the most severe being imposed on the small set of UHC clinics. Even those fields meant to be optional for non-UHC patients are not adequately distinguished from required fields in the tablet, leading many doctors to waste time recording information that will never be used. By imposing strict requirements, donors often create perverse incentives to collect non-essential medical data, slowing clinic efficiency and making doctors less likely to adopt new technology. PSI and other EMR implementers in Myanmar should remember that user interface and software design should always prioritize the needs of patients and doctors over the needs of donors.

Typing on a tablet, especially in Burmese, is not the most time-effective way to record information, so new technologies can also go a long way towards improving the efficiency of the CMIS software and ease-of-use for medical staff. KKT should experiment with features such as auto-fill, word prediction, and speech to text as they continue to conduct user testing and regional pilots. However, newer input technologies also increase the risk of data entry errors. Following the example of EMR implementers in Malawi, KKT should pair these technologies with data validation and cleaning processes to minimize these risks.

Recommendation 2: Provide more frequent training and full-time technical support for all medical and administrative staff using the EMR software

Though the seven treatment doctors participating in this study were given an initial full-day training on the use of CMIS, there was little to no follow-up support or secondary training offered over the next three months. It seems clear from our data that this is a major missed opportunity for KKT and PSI, as we observed no improvements in productivity, and declining usage rates, over three survey rounds.

While all treatment doctors in this study had previously owned a smartphone, less than half of them had owned a tablet, and none had ever used any kind of EMR software in the past. Considering that low computer literacy has been a major barrier to EMR success in other developing countries, support in this area should be a priority for KKT in the next phases of CMIS development. In addition to the initial full day training already offered, we recommend monthly follow-up trainings, conducted at the clinic, for at least the first three months. KKT should also maintain a dedicated technical support number that doctors can reach during standard clinic operating hours.

Recommendation 3: Continue researching optimal design features and building evidence on impact as CMIS scales and evolves

This pilot study was always intended as just one of the first steps in a continual and iterative process of design, evaluation, and scale.[2] Though the results have been informative in revealing some of the more obvious limitations of the CMIS platform at this stage, we do not yet have any insight into the patient experience or long-term impacts on actual health outcomes. These are areas that need to be explored fully in future research. Subsequent evaluations should also be conducted on a larger scale, as the current study was not sufficiently powered to yield statistically significant estimates of impact (for effect sizes well within the range of interest). Additionally, further research should aim for true randomization of the treatment group, which will require much closer collaboration between research and implementation partners, but will produce more accurate estimates of CMIS impact. Given adequate funding, IPA hopes to conduct a randomized controlled trial (RCT) of the CMIS platform on 100 clinics in Yangon and Bago regions by 2020. Ideally, this would be a one to two-year evaluation that would incorporate patient interviews as well as measurements of health outcomes.

Before committing to additional research, however, we hope that the findings of this evaluation can be incorporated into the next phase of CMIS design and implementation. As CMIS expands to more clinics, implementers should make every effort to reduce the added administrative burden placed on medical personnel, and provide their users with continuous, high quality training and support.

[2] KKT and PSI have also conducted qualitative research and user testing that mostly corroborates the findings of this study.

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Appendix I: Baseline Survey Results

Survey Question	Doctor 8	Doctor 9	Doctor 10	Doctor 11	Doctor 12	Doctor 13	Doctor 14
Do you own a mobile phone?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
How long have you owned it?	2+ Years	2+ Years	2+ Years	2+ Years	2+ Years	2+ Years	2+ Years
What type of phone is it?	Smart Phone	Smart Phone	Smart Phone	Smart Phone	Smart Phone	Smart Phone	Smart Phone
How many minutes do you spend on your phone per day?	15	120	15	120	90	40	60
Do you own a tablet?	No	Yes	No	Yes	No	Yes	No
How long have you owned it?		2+ Years		2+ Years		< 1 Month	
How many minutes do you spend on your tablet per day?		160		15		40	
Do you own a laptop or desktop computer?	No	Yes	No	Yes	Yes	Yes	Yes
How long have you owned it?		2+ Years		2+ Years	2+ Years	2+ Years	2+ Years
How many minutes do you spend on your computer per day?		60		30	30	60	20
How often do you use Facebook?	About once per day	Mult. times per day	Never	Mult. times per day	About once per day	About once per day	Mult. times per day
Do you typically see patients alone, or with an assistant?	With an assistant	With an assistant	With an assistant	With an assistant	With an assistant	With an assistant	With an assistant
Who do you keep records for?	Regular Clients only	Chronic Patients only	All Clients	All Clients	Some Clients	All Clients	Chronic Patients only
What information/findings/notes do you usually record?	Treatment History	Personal Info, Physical Exams, Consultations, Diagnoses, Admin. and Next Appt.	Medical History, Diagnoses	Patient ID, Medical History, Physical Exams, Treatment, Consultations	Patient ID	Patient ID	All Information for regular patients
Do you usually refer to previous records when old patients come back?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
What information do you usually refer back to?	Treatment History	Previous Diagnosis and Management	Diseases and Medical History	All Patient Information	Drug history and Provisional Diagnosis	Drug Allergies, Medical History	Medical History for Regular Patients
How do you typically take notes during a consultation?	I wait for a pause in the discussion or the end of the consultation to take notes	I actively take notes while my patient is speaking	I wait for a pause in the discussion or the end of the consultation to take notes	I actively take notes while my patient is speaking	I wait for a pause in the discussion or the end of the consultation to take notes	I actively take notes while my patient is speaking	I actively take notes while my patient is speaking
How often do you reference your notes about a patient?	I only save the notes for patients I see regularly, such as patients with ongoing treatment.	I only save the notes for patients I see regularly, such as patients with ongoing treatment.	I reference my previous notes for every patient, or they carry the notes in a book.	I reference my previous notes for every patient, or they carry the notes in a book.	I only save the notes for patients I see regularly, such as patients with ongoing treatment.	I reference my previous notes for every patient, or they carry the notes in a book.	I reference my previous notes for every patient, or they carry the notes in a book.
Why do you want to use electronic medical records in your practice?	To keep records of chronic disease cases	To keep records more easily and efficiently and refer to them quickly on follow-up visits	For convenience	To upgrade my patient record system	To get information more easily	To rapidly refer to a patients medical history	To treat patients more effectively
How can electronic medical records improve your practice?	Help to adapt more quickly to patient progress	It will help save time and allow me to focus on patients	Things may not improve; I could be spending more time typing	Make record keeping more systematic	Make things more convenient for patients	Would be most useful for chronic patients	My practice will improve
How much would you be willing to pay per month for a technology that collects all of your patients' visit notes? (MMK)	5000	5000	5000	100000	10000	5000	10000
How much would you be willing to pay per month for a technology that sends your patients regular SMS or Facebook Messenger reminders about treatments? (MMK)	5000	5000	0	0	10000	1000	20000
How much would you be willing to pay per month for a technology that provides a dashboard of information on trends in health outcomes for your patients? (MMK)	5000	5000	5000	5000	3000	1000	20000
How much would you be willing to pay per month to use the CMIS software? (MMK)	5000	5000	0	10000	15000	2000	2000
How much do you think your typical one-off patient would be willing to pay for the services provided by the CMIS system? (MMK)	0	0	0	0	100	200	300
How much do you think your typical patient with chronic illness would be willing to pay for the services provided by the CMIS system? (MMK)	200	500	0	0	200	2000	250
What percentage of your patients do you think you would register in the CMIS in the next week?	20	50	10	99	60	50	75
What percentage of your patients do you think you would register in the CMIS in the next month?	30	50	60	85	85	100	60
How many weeks do you think it would take for you to be able to provide the same level of patient interaction using the CMIS as your current handwritten method?	12	4	48	1	8	10	8
How many weeks do you think it would take after implementing CMIS to make your clinic's performance better than it was before?	12	4	12	1	8	20	8
How much do you agree with the following statement: "It would be worthwhile to implement the CMIS at my clinic even though it takes slightly longer than writing notes by hand because the notes will be easier to look up later and less error prone."	Agree somewhat	Disagree strongly	Neither agree nor disagree	Neither agree nor disagree	Agree somewhat	Agree strongly	Agree somewhat
How many weeks do think it would take for you to become fully proficient with the CMIS?	12	4	12	4	8	40	24
Would you recommend other general practitioners to use CMIS?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Appendix II: Mean Comparisons, Treatment Group

	FOLLOW-UP SURVEY ROUNDS			T-TESTS		
	(1)	(2)	(3)	(1) vs. (2)	(2) vs. (3)	(1) vs. (3)
Consultations conducted in the last day	59.429 (17.597)	83.571 (14.003)	77.143 (8.007)	24.143 (22.489)	-6.429 (16.131)	17.714 (19.333)
Hours per day clinic is open	6.643 (3.153)	13.643 (0.672)	13.131 (0.698)	7.000* (3.224)	-0.512 (0.969)	6.488* (3.229)
Charges a fixed rate for consultations [proportion]	0.143 (0.143)	0.857 (0.143)	1.000 (0.000)	0.714*** (0.202)	0.143 (0.143)	0.857*** (0.143)
Number of hypertension patients since CMIS training	53.571 (25.088)	253.333 (33.830)	421.429 (24.046)	199.762*** (41.352)	168.095*** (40.613)	367.857*** (34.751)
Fee for hypertension related consultation	714.286 (359.516)	2071.428 (276.642)	2500.000 (327.327)	1357.143*** (453.632)	428.571 (428.571)	1785.714*** (486.204)
Number of tuberculosis patients since CMIS training	5.429 (1.875)	40.429 (19.054)	52.143 (4.062)	35.000* (19.146)	11.714 (19.482)	46.714*** (4.474)
Fee for tuberculosis related consultation	285.714 (285.714)	2071.428 (276.642)	2500.000 (327.327)	1785.714*** (397.697)	428.571 (428.571)	2214.286*** (434.483)
Number of diabetes patients since CMIS training	54.286 (22.158)	240.000 (60.663)	364.286 (17.976)	185.714** (60.719)	124.286* (59.062)	310.000*** (28.533)
Fee for diabetes related consultation	785.714 (375.708)	2071.428 (276.642)	2500.000 (327.327)	1285.714** (466.569)	428.571 (428.571)	1714.286*** (498.296)
Number of HIV patients since CMIS training	1.167 (0.307)	2.000 (1.549)	4.429 (1.412)	0.833 (1.439)	2.429 (2.125)	3.262* (1.561)
Fee for an HIV testing consultation	333.667 (333.267)	2071.428 (276.642)	2500.000 (327.327)	1737.762*** (429.189)	428.571 (428.571)	2166.333*** (469.448)
Fee for an HIV treatment consultation	333.333 (333.333)	2071.428 (276.642)	2500.000 (327.327)	1738.095*** (429.232)	428.571 (428.571)	2166.667*** (469.487)
Number of family planning patients	32.143 (19.936)	102.857 (33.997)	75.000 (1.890)	70.714* (39.411)	-27.857 (34.049)	42.857* (20.025)
Fee for a family planning consultation	400.000 (400.000)	2083.333 (327.024)	2500.000 (327.327)	1683.333*** (510.960)	416.667 (465.726)	2100.000*** (513.809)
Amount spent on pharmaceuticals per month	5142857.000 (1869919.375)	2757142.750 (721723.188)	2257142.750 (491769.000)	-2385714.250 (2004366.000)	-500000.000 (873339.063)	-2885714.250 (1933503.375)
Pct. of patients registered in CMIS (non-UHC)	29.429 (12.406)	39.571 (10.021)	45.000 (2.182)	10.143 (15.947)	5.429 (10.256)	15.571 (12.596)
Minutes needed to register first-time patient	9.167 (2.442)	10.714 (1.375)	15.000 (0.000)	1.548 (2.696)	4.286*** (1.375)	5.833** (2.243)

Pct. of consultations for which CMIS was used	31.571 (11.976)	23.143 (11.396)	10.714 (3.695)	-8.429 (16.532)	-12.429 (11.980)	-20.857 (12.533)
Minutes needed to enter patient consultation in CMIS	7.167 (1.905)	9.714 (1.409)	12.429 (0.948)	2.548 (2.326)	2.714 (1.698)	5.262** (2.031)
Pct. of hypertension consultations for which CMIS was used	20.714 (13.203)	21.429 (13.205)	12.143 (3.595)	0.714 (18.673)	-9.286 (13.686)	-8.571 (13.684)
Minutes needed to enter hypertension consultation in CMIS	7.000 (4.000)	8.571 (1.232)	10.714 (0.714)	1.571 (3.083)	2.143 (1.424)	3.714 (2.644)
Pct. of diabetes consultations for which CMIS was used	25.000 (13.844)	20.571 (10.202)	10.714 (2.974)	-4.429 (17.198)	-9.857 (10.627)	-14.286 (14.160)
Minutes needed to enter diabetes consultation in CMIS	7.000 (4.000)	9.714 (1.714)	10.714 (0.714)	2.714 (3.614)	1.000 (1.857)	3.714 (2.644)
Pct. of tuberculosis consultations for which CMIS was used	13.000 (12.834)	1.571 (1.110)	1.286 (0.837)	-11.429 (12.882)	-0.286 (1.390)	-11.714 (12.861)
Minutes needed to enter tuberculosis consultations in CMIS	7.500 (2.500)	10.000 (0.000)	10.000 (0.000)	2.500 (1.863)	0.000 (0.000)	2.500 (2.500)
Pct. of HIV consultations for which CMIS was used	12.857 (12.857)	0.286 (0.286)	1.571 (0.685)	-12.571 (12.860)	1.286 (0.742)	-11.286 (12.875)
Pct. of family planning consultations for which CMIS was used	18.571 (12.427)	45.286 (16.164)	20.714 (7.574)	26.714 (20.389)	-24.571 (17.850)	2.143 (14.553)
Minutes needed to enter family planning consultations in CMIS	6.500 (3.500)	11.333 (1.944)	10.714 (0.714)	4.833 (3.913)	-0.619 (1.947)	4.214* (2.054)
Pct. of consultations for which CMIS was used to record info in real time	22.857 (12.481)	20.429 (13.563)	3.286 (0.644)	-2.429 (18.432)	-17.143 (13.578)	-19.571 (12.498)
Pct. of consultations for which CMIS was used to record info afterwards	43.000 (15.628)	31.714 (13.105)	55.000 (5.669)	-11.286 (20.396)	23.286 (14.279)	12.000 (16.625)
Pct. of consultations for which assistant used CMIS to record info in real time	47.143 (17.824)	13.667 (13.271)	0.143 (0.143)	-33.476 (22.894)	-13.524 (12.194)	-47.000** (17.824)

Believes CMIS improves quality of patient interaction [prop.]	0.400 (0.245)	0.143 (0.143)	0.000 (0.000)	-0.257 (0.266)	-0.143 (0.143)	-0.400* (0.203)
Thinks CMIS has shortened length of consultations (when used in real time) [prop.]	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Minutes that CMIS has increased consultation length	6.600 (2.657)	6.286 (0.606)	6.857 (0.508)	-0.314 (2.317)	0.571 (0.791)	0.257 (2.283)
Pct. of consultations in which CMIS is explained to patient	34.200 (18.779)	12.571 (8.100)	3.857 (0.459)	-21.629 (18.338)	-8.714 (8.113)	-30.343* (15.560)
Is satisfied with CMIS tablet [prop.]	0.500 (0.224)	0.143 (0.143)	0.286 (0.184)	-0.357 (0.258)	0.143 (0.233)	-0.214 (0.287)
Is currently satisfied with CMIS app [prop.]	0.667 (0.211)	0.429 (0.202)	0.143 (0.143)	-0.238 (0.293)	-0.286 (0.247)	-0.524* (0.248)
Willingness to pay for patient reminder service (MMK)	7142.857 (4344.831)	2857.143 (1696.335)	285.714 (285.714)	-4285.714 (4664.236)	-2571.428 (1720.228)	-6857.143 (4354.214)
Willingness to pay for health trend analysis software (MMK)	6000.000 (2023.669)	6000.000 (1480.026)	5000.000 (1091.089)	0.000 (2507.133)	-1000.000 (1838.737)	-1000.000 (2299.068)
Willingness to pay for CMIS software (MMK)	9714.286 (3616.854)	5571.429 (1231.668)	3714.286 (714.286)	-4142.857 (3820.817)	-1857.143 (1423.802)	-6000.000 (3686.711)
Amount a one-time patient would be charged to cover CMIS costs	1714.286 (1409.395)	1785.714 (342.559)	1357.143 (446.071)	71.429 (1450.428)	-428.571 (562.429)	-357.143 (1478.301)
Amount a chronic patient would be charged to cover CMIS costs	3142.857 (1791.894)	1571.429 (428.571)	0.000 (0.000)	-1571.429 (1842.433)	-1571.429*** (428.571)	-3142.857 (1791.894)

*Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Appendix III: Difference-in-Difference Estimates

VARIABLES	(1) Consultations conducted in the last day	(2) Hours per day clinic is open	(3) Charges a fixed rate for consultations	(4) Standard consultation fee	(5) Number of hypertension patients since CMIS training	(6) Fee for hypertension related consultation	(7) Number of tuberculosis patients since CMIS training	(8) Fee for tuberculosis related consultation
Treatment/Control	42.629**	-6.117**	-0.429**	83.333	45.171	71.429	-115.857	71.429
	(16.800)	(2.876)	(0.179)	(468.237)	(35.653)	(440.063)	(81.882)	(440.063)
Baseline/End-line	41.867**	0.004	0.429**	250.000	333.267***	250.000	-77.119	250.000
	(17.373)	(2.993)	(0.186)	(468.237)	(36.870)	(458.032)	(85.225)	(458.032)
Interaction (T/C * B/E)	-24.152	6.484	0.429	166.667	34.590	178.571	123.833	178.571
	(23.174)	(4.151)	(0.258)	(662.187)	(49.180)	(635.177)	(118.186)	(635.177)
Observations	25	27	27	26	25	27	27	27
R-squared	0.387	0.234	0.571	0.060	0.910	0.063	0.083	0.063
Adj. R-squared	0.300	0.134	0.516	-0.0676	0.898	-0.0597	-0.0369	-0.0597
Mean Dep. Var.	39.64	12.76	0.769	2115	190.2	2115	85.69	2115

VARIABLES	(9) Number of diabetes patients since CMIS training	(10) Fee for diabetes related consultation	(11) Number of HIV patients since CMIS training	(12) Fee for an HIV testing consultation	(13) Fee for an HIV treatment consultation	(14) Number of family planning patients	(15) Fee for a family planning consultation	(16) Amount spent on pharmaceuticals per month
Treatment/Control	48.086*	71.429	-74.833***	71.429	71.429	23.000	83.333	2776190.476
	(24.371)	(440.063)	(25.521)	(440.063)	(440.063)	(14.765)	(468.237)	(2052990.274)
Baseline/End-line	327.133***	250.000	-73.500***	250.000	250.000	66.690***	250.000	550,000.000
	(25.203)	(458.032)	(25.521)	(458.032)	(458.032)	(15.368)	(468.237)	(2103689.026)
Interaction (T/C * B/E)	-17.133	178.571	76.762**	178.571	178.571	-23.833	166.667	-3435714.286
	(33.618)	(635.177)	(32.474)	(635.177)	(635.177)	(21.311)	(662.187)	(2637113.755)
Observations	25	27	22	27	27	27	26	23
R-squared	0.946	0.063	0.373	0.063	0.063	0.557	0.060	0.172
Adj. R-squared	0.938	-0.0597	0.268	-0.0597	-0.0597	0.499	-0.0676	0.0410
Mean Dep. Var.	184.6	2115	27	2115	2115	39.92	2115	2.733e+06

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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