Understanding Adoption of Electronic Medical Records (EMRs) during a Health Emergency: An Analysis of EMR Usage Logs from Rural Health Facilities in the Philippines

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ABSTRACT

Background and Objective. The adoption of electronic medical records (EMRs) in the Philippines has been initiated and adjusted since the last decade through the Philippine eHealth Agenda framework. EMRs are known to improve clinical management and have been widely adopted in advanced economies. However, empirical research on EMR implementation remains limited. This study aims to determine how public primary health care facilities in the country interacted with EMRs before and during the COVID-19 pandemic to understand EMR adoption.

Methods. More than 270,000 records generated from EMR usage logs in six rural primary health facilities in Western Visayas were analyzed. Average time of EMR use during work hours was estimated and compared before and during the pandemic. EMR adoption based on specific EMR features used was also determined.

Results. In 2020, EMR use ranged from less than one hour to more than eight hours in selected rural health units (RHUs). There was a statistical increase and decrease in use of features during the pandemic. Some EMR users had efficient use indicated by complete adoption of EMR features although such features were not as frequently used as those pertaining to basic adoption.

Conclusion. This study demonstrates that for EMR use in rural settings, progressive use from basic to complete may vary among users. Public health emergencies such as a pandemic may also affect EMR use. Future research directions should explore other mechanisms which affect user behavior and encourage full adoption of technology such as use of games or non-monetary incentives.

Keywords: adoption, EMR, interaction

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INTRODUCTION

Since 2005, the national health agenda prioritizes enhancing the use of information and communication technologies (ICT) for health or eHealth to improve the delivery of health services and provide real-time access to information for decision-making[1,2] but more importantly, to support the implementation of the Universal Health Care (UHC) Act or Republic Act No. 11223[3]. Most of the eHealth

efforts include encouraging and increasing the use of electronic medical records (EMRs) in health facilities. The government formed the Electronic Medical Records Expert Group consisting of academic, private, and public EMR providers to serve as a technical working group in providing EMR specific policies, corresponding implementation guidelines as well as technical solutions to facilitate the adoption of EMRs in rural health facilities.[4] In 2016, the Philippine Health Insurance Corporation (PhilHealth) mandated that all primary care benefit (PCB) providers select an EMR whose system/software passed the validation of the Joint Department of Health (DOH) and PhilHealth validation team.[5] The design, development and implementation of the Philippine Health Information Exchange LITE (PHIE-LITE) which allows for the submission of patient profiling and encounters to DOH and PhilHealth from different EMR providers as part of the PCB package, is considered a major milestone[6] as this initiated the gradual transition from paper-based records to digital health records for more than half of the country's primary health care facilities called rural health units (RHUs).

Challenges surrounding the implementation and adoption of EMR in the country stem from a lack of institutional structure at the national level that would provide directions and support for needed policies/legislations, infrastructure, interoperability, and human resources.[7,8] Varying levels of adoption within the country as well as lack of cooperation among stakeholders also added to these challenges.[7] The COVID-19 pandemic in 2020 further disrupted eHealth strategies as the country's health system, particularly its workforce, was heavily burdened.

Overview of the Philippine Health and Information Systems

EMR use in the country remains at nascent stage, even following the extensive review on e-government capabilities in 2011 and the subsequent adoption of a DOH Enterprise Architecture which applies to the entire health sector nationwide. This Enterprise Architecture enabled data collection based on a standard set of indicators, single data warehousing, and integrated systems for consolidation, analysis, and provision of reports.[9] While there have been improvements in office automation and the use of ICTs in supporting health functions in the past decade, little is known regarding use and adoption of EMRs outside of DOH.

The Philippine health system has a nearly 60:40 private-public sector split. While under the regulatory oversight of the DOH, private providers operate independently from the public system. At primary care levels, public health facilities are outside the direct supervision of the DOH and are managed at local levels by town and district administrations.[9] The new UHC Act seeks managerial and financial integration at local levels in the next ten years.[3]

At present, there are several free and open-source software by different developers, being used as EMRs among public hospitals and primary health care facilities in the country. These include the Integrated Hospital Operations and Management Information System (iHOMIS), the Integrated Clinic Information System (iClinicSys), the Community Health Information and Tracking System (CHITS), and SHINE (Secured Health Information and Network Exchange) OS+. All were required by DOH to collect data based on standard sets of indicators.[10] Other EMRs developed by third party providers were also validated by DOH.[7]

Figure 1 shows the structure of the EMR application used in the RHUs in this study. Each box in the diagram represents an entity in the EMR network while the bi-directional arrows represent the data transfer between the entities. RHUs utilize the system for medical recording, reminder setting, referrals, viewing reports, and filing of electronic claims. They also use this to transmit the mandatory reports required by government agencies such as PhilHealth and DOH.

EMR Adoption and Interaction

The COVID-19 pandemic saw a surge in technological advancements and use of digital tools to keep everyone informed of the developments - to share data, trace contacts, report cases, communicate risks, and other surveillance tasks in public health. Indeed, the pandemic accelerated the use of telemedicine, underscoring the need for efficient EMR systems which "provide real-time access and monitoring of patients' conditions."[7] Health information systems are vital to health services' functioning not only for daily operations but more so during health emergencies, for early detection and diagnosis, prompt treatment, and pandemic control.[11]

The use of EMRs forms part of a process where inputs comprise infrastructure and data entry capacities, while outputs consist of data, some visualization, and its use for simple or advanced operational functions. A systematic review of studies on utilization of electronic health records in Asia reported that inputs to the system were related to conceptual approaches and cultural considerations. Infrastructure considerations such as hardware and software technologies as well as interventions based on digital platforms and user training were considered important inputs. On the EMR output process, the review reported variability on ICT interventions, standardization, and interface issues.[12]

Based on the findings of the said review[12] as well as the factors identified as drivers of the eHealth strategy in the Philippines[7,8], an IPO (input-process-output) framework[13], commonly used in organizational behavior research, was adopted for this study (Figure 2). The model posits that adoption or use of EMR requires several direct inputs from the environment to produce the identified outputs. Other external factors may also influence the inputs and processes.

Several challenges to the implementation of EMR based on the IPO model were identified. Evidence from earlier studies cited in the review acknowledged that implementation

of EMR interventions in low- and middle-income countries (LMIC) was an 'evolving' and lengthy process. Barriers relating to organizational culture and infrastructure were observed, citing non-adoption of the system by physicians and health professionals as well as lack of interoperability among information systems. Societal factors such as lack of political will and funding, ethical concerns on patient confidentiality and privacy, as well as factors affecting patient-health provider relationship such as cultural appropriateness and low levels of patient literacy were also named as barriers.[12]

In the Philippines, users of EMR in primary health care facilities reportedly increased by 2015.[9] As of 2020, coverage of public health facilities with EMRs also increased.[7] Despite presence of EMR systems in the facilities, however, some areas continued to encode patient data using paper-based methods.[14,15] An analysis of EMR usage logs from selected RHUs in the country, generated one to two years post-EMR implementation, showed that adoption of EMR was still basic since users mostly used features related to editing health records while more advanced features were performed by few users.[16]

EMR usage logs track information about the system, user or record involved in each feature as well as actions performed at different levels of granularity. Initially designed

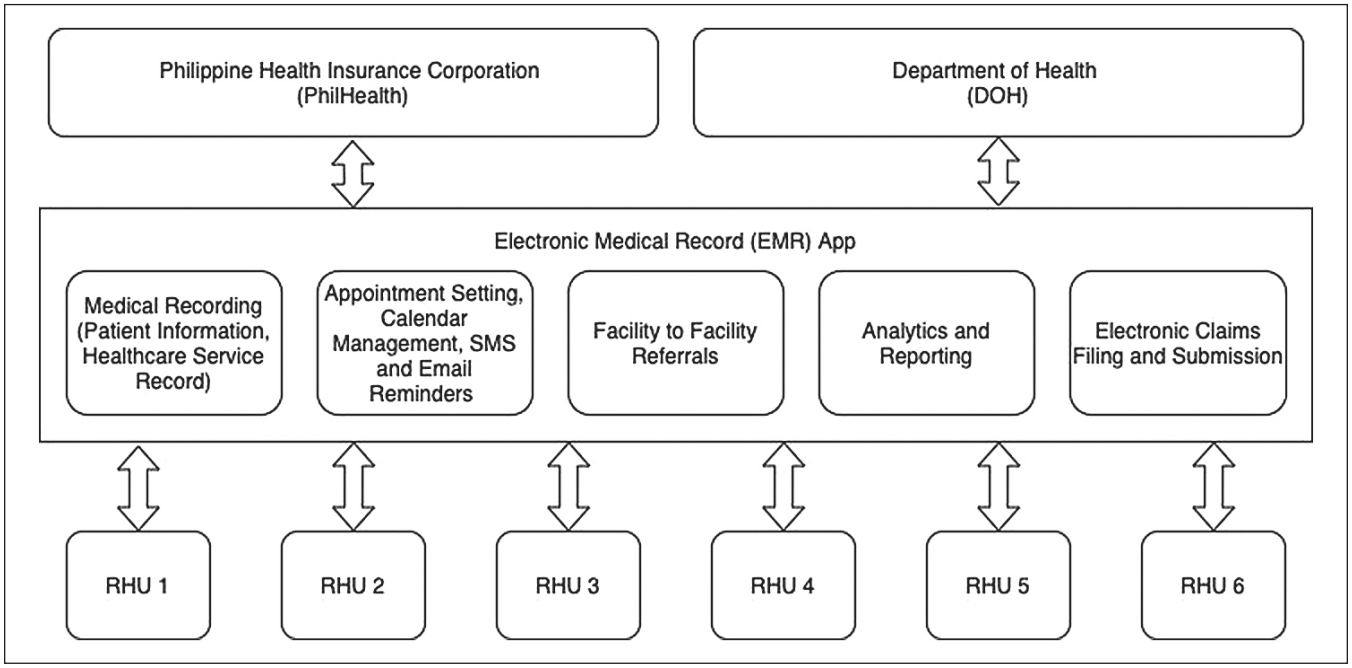

Figure 1. EMR Application Architecture.

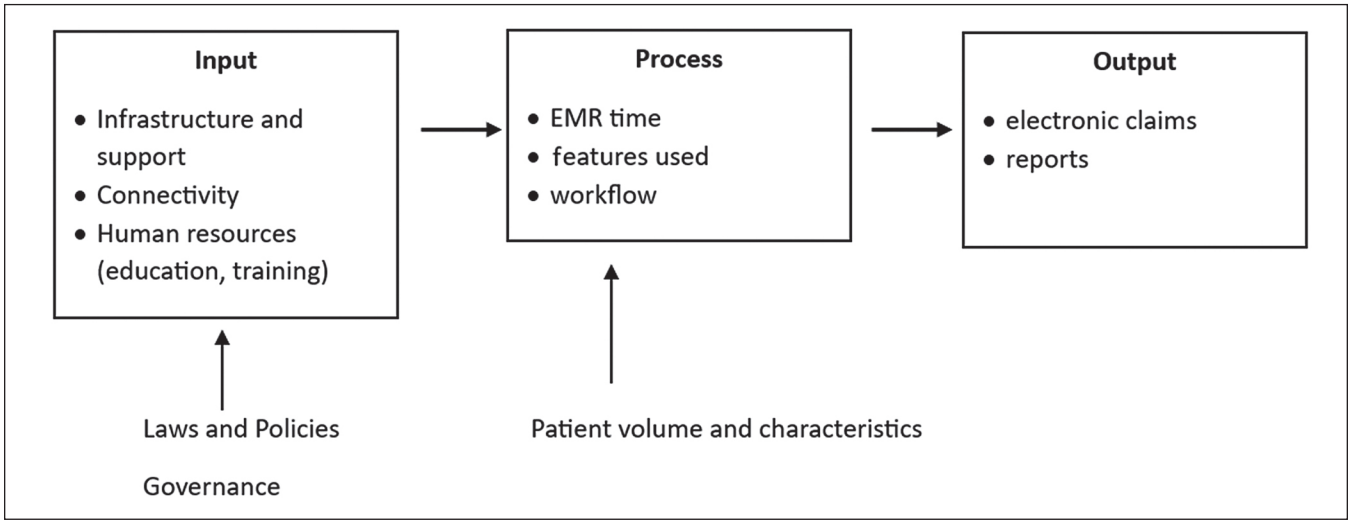

Figure 2. Conceptual model for the adoption of EMR.

to monitor record access, evidence pointed to the practicality of mining usage logs to study direct EMR use including duration and patterns of use across features as well as obtain a picture of clinical workflows[17] which have implications for improving quality, safety, efficiency, and costs of health care[18]. In a local study of usage logs, authors have mapped and classified the level of EMR adoption based on usage of features in the system.[16]

Researchers have proposed several metrics in assessing interactions with EMR such as time spent on patient-related activities. One of these is total time on EMR (during and outside of clinic sessions) per 8 hours of patient scheduled time.[19] The use of time duration in usage logs research increased since 2016 although studies were still limited and mostly done in non-primary care settings.[17]

The present study seeks to provide empirical evidence on interactions with EMR in public primary care settings. We will examine how selected RHUs, the public primary health care facilities in the Philippines, interact with EMRs before and during the COVID-19 pandemic to understand adoption according to duration of use and features performed. Results will provide important insights for understanding adoption of EMRs during public health emergencies such as pandemics. Information on current use of EMR at primary care levels, especially in the rural areas, can help in the design and implementation of information technology interventions to support the health system and its capability for pandemic response and preparedness.

METHODS

All EMR usage logs from January to December 2020, with a total of 272,785 records, were extracted and examined from the EMR databases of six RHUs in Western Visayas, situated in the central part of the Philippines. These RHUs were located mostly in 4th class municipalities and have been required to use EMRs since 2016. The population size of each municipality based on 2020 census was extracted from the official provincial website.[20]

Data obtained until March 10, 2020 were classified as pre-pandemic while data beyond March 11, 2020 covered the pandemic period.[21] There is one user account per clinic, usually assigned to the clinic's physician. The EMR system used in this study was an open-source system developed by an academe in partnership with a private company and validated by DOH.

Total EMR time, the total duration of all EMR actions performed by each user per day during scheduled work hours (8 am to 5 pm, Monday to Friday) was estimated and averaged for the two periods: pre-pandemic and during pandemic. Variance ratio tests were done to test for equality of variances in EMR time before and during the pandemic. Based on these results, unpaired t-tests for samples with equal or unequal variances were done to determine statistical differences ($p<0.05$) in total EMR time before and during the pandemic using STATA/SE version 15.1.

These RHUs were also classified as having basic, advanced, or complete adoption based on types of actions or EMR features used in 2020. Basic usage refers to features used to digitize health records such as creating, adding, and editing patient records. Advanced usage includes use of the basic features related to encoding information as well as other features such as views, searches, and referrals. Complete usage means full adoption of the system including editing records, managing extensions and plug-ins, and syncing data for submission and back up.[16] The specific EMR feature most frequently performed was also identified for RHUs which significantly differ in duration of average daily EMR use at pre- and during-pandemic periods.

The study was given ethical clearance by the University Research Ethics Office (UREO) of the Ateneo de Manila University. Data on EMR users were anonymized and facilities were de-identified using unique identifier codes. As usage logs only track relevant information about the system and user actions, no other RHU characteristics nor patient information were accessible to the authors.

RESULTS

Table 1 shows the average total EMR use of facilities during daily work hours before and during the pandemic. The population size in the municipalities of the RHUs is also presented. There was no clear pattern observed between the duration of use of EMR and population size.

Users in three RHUs (RHUs 1, 2 and 3) interacted with EMRs for about 1.5 hours or less daily before and during

Table 1. Average daily duration ± standard deviation of EMR time (in hours) during work hours by facility, 2020

Primary health clinic	Population size*	Pre-pandemic	During pandemic	T-test (*p*-value)
RHU 1	33,376	0.68 ± 0.03	0.86 ± 0.67	-0.83 (0.429)
RHU 2	58,176	1.06 ± 0.46	0.02 ± 0.00	3.17 (0.087)
RHU 3	72,637	1.53 ± 0.63	0.43 ± 0.34	1.86 (0.189)
RHU 4	34,597	4.89 ± 0.47	2.95 ± 0.93	**4.89 (<0.001)****
RHU 5	34,725	8.10 ± 3.87	3.31 ± 1.22	2.11 (0.155)
RHU 6	27,305	3.94 ± 0.89	8.89 ± 4.16	**-3.64 (0.004)****

* *based on 2020 census*
** *statistically significant at p-value<0.05*

the pandemic. A user in RHU 2 barely interacted with the EMR during the pandemic. On the other hand, users in RHUs 4, 5 and 6 interacted with EMRs from 3.9 to 8.1 hours daily before the pandemic and from 3.0 to 8.9 hours daily during the pandemic.

The usage logs showed that all six RHUs had complete adoption of the EMRs. This means that users could edit records, manage extensions and plug-ins, and sync data for submission and back up. Variance ratio tests indicated unequal variances before and during the pandemic. Thus, unpaired t-tests for samples with unequal variances were performed. Results of analyses showed that EMR use was significantly different between the pre-pandemic and during the pandemic in two RHUs. In the period covering the pandemic, RHU 4 had statistically significant shorter EMR use while RHU 6 had statistically significant longer EMR use (Table 1).

The features commonly performed in RHUs with statistically significant differences in EMR use before and during the pandemic are shown in Table 2. Examining the EMR features performed by users in RHUs 4 and 6 showed that while there was complete adoption of the EMRs, users did not utilize the advanced features frequently and instead used mostly basic features that pertain to digital patient profiling. There was also no evidence of features used related to referrals.

DISCUSSION

Usage logs showed that before the pandemic, RHUs had varying duration of use of EMR, ranging from less than one hour to eight hours. During the pandemic, a user in RHU 2 barely interacted with the EMR while others used the EMRs from 3 to 9 hours daily. Two RHUs had significantly different duration of EMR use between the two time periods studied. One RHU had significantly shorter EMR use while another RHU had statistically significant longer EMR use during the pandemic, compared to before the pandemic. While all RHUs had complete adoption of the EMRs, advanced features were not used frequently. There was also no evidence of features used related to referrals.

EMR use in some of our facilities was comparable to pre-pandemic estimates of previous studies which showed that primary care physicians used EMR for an average total of about six hours per weekday.[22,23] These studies identified that total EMR time was divided between direct patient care and actual computer use doing clerical tasks and inbox management. Since our study did not directly identify the exact activities associated with these blocks of time, we can only assume that the physicians, depending on patient volume, also divided their time reasonably for face-to-face patient care and EMR record management before the pandemic. During the early phase of the pandemic, when restrictions and social distancing measures were imposed by governments, a study observed initial reductions in EMR time, although some clinical specialties recorded longer EMR use.[24] In our study, population size supposedly served by the RHUs was not an indicator of patient volume as those RHUs with larger populations actually had shorter time spent on EMR during work hours before the pandemic compared to RHUs with greater population size in their respective municipalities. EMR time even decreased at the time of the pandemic in these RHUs. Thus, physicians may have either low patient volume or performed other tasks that did not require EMR use. The opposite picture could be assumed for RHUs with increased EMR interactions during the pandemic. Those RHUs whose total EMR time did not change probably engaged in telemedicine and spent the same amount of time on tasks related to patient care and EMR records.

Table 2. Percentage of performed EMR features during work hours based on usage, facility and timing of pandemic, 2020

EMR Features	Percent use in RHU 4		Percent use in RHU 6	
	pre (n=13,622)	during (n=34,115)	pre (n=11,474)	during (n=92,603)
Basic				
Edit Health Record	38.23	40.98	26.68	14.78
Create Health Record	5.96	6.00	9.36	6.53
Add Patient	0.22	0.08	0.04	0.10
Advanced				
View List Records	5.21	3.09	18.77	16.66
Search Records	1.12	2.88	6.11	11.73
Update Patient Profile	5.25	2.20	4.20	5.66
View Patient Profile	1.70	0.71	2.47	3.71
Check Patient Philhealth ID	0.00	0.00	0.00	0.60
Complete				
View Dashboard	17.46	16.67	1.13	3.32
View Eclaims Forms	0.10	0.66	0.00	0.82
View Eclaims Page	0.14	0.28	0.01	0.90
View Profile	0.01	0.00	0.02	0.00

Estimates using time duration require several assumptions and may not be able to account for gaps in time which occur during idle activities.[17] RHUs which recorded average daily EMR use that exceeded the 8-hour work period could have included these idle times wherein user remains logged in the system but not actively interacting with it. Additionally, the same system, using one account, may have been running over several devices during workdays. This may have occurred when a user logged in, but provided clinical care first then used the EMR post-clinical work, like the practice shared by health care workers in a local study.[25] As workflow measures were not mapped, it was not possible to allocate time spent per feature used, from log in to log out in the system. This could have provided information on activities which when altered, could affect efficiency in health practice.[18] Ideally, measures of duration should be validated with direct observation data[17,22] such as in time-motion studies.

Our results suggest that despite increased interactions with the EMR, in terms of time and type of activities, complete adoption of the system four years after implementation, has been slow and may have been brought about mainly by financial implications from PhilHealth as well as reporting requirements of DOH. Indeed, these findings support the need for laws and policies as well as institutional oversight that would drive adoption of EMR as well as use of eHealth technologies in general.

As indicated in the framework, one of the critical inputs to EMR use is the user or human resource. Indeed, user feedback could provide information on satisfaction with and appreciation of the system. A qualitative study pointed out the lack of appreciation of some health care workers as they likened EMRs to "electronic cash registers in supermarkets that manage the flow of money towards or outside the health facility."[25] We also did not see evidence of features used related to referrals which imply that electronic data exchange between facilities did not yet occur in our study. Indeed, interoperability, which should facilitate easier data transfer across health facilities is still a strategic challenge for the government and other key sectors.[8] The pandemic has also affected the EMR interactions of RHUs differently and may have further delayed progress in adoption of some users. Based on the Taiwan experience, where inter-institution exchange following EMR implementation took ten years, a strong incentive mechanism must be present for successful digitization of healthcare facilities.[26]

Most analyses of usage logs were done using information systems of private hospitals. Locally, this was a pilot analysis of EMR usage logs in public, primary care settings, which cover a public health emergency, thus, offering rich data implications in terms of assessing quality domains of a health service system. Limitations include lack of information about other contextual factors such as technological capability of the users, patient volume, service delivery configuration, changes in facility characteristics including human resources over the years and more importantly, during the pandemic, as these could have affected adoption of EMRs.

CONCLUSION

The COVID-19 pandemic has brought digital transformation to many organizations, with the health sector notably at the center due to the need for real-time data to inform daily decisions to manage the pandemic. Our study presented a unique perspective on the use of eHealth systems in rural settings. While adoption has been slow in the country, the pandemic has shown an uptake of use in some primary health facilities, highlighting an appreciation for technology. More importantly, the flexibility of the system to accommodate other tasks could have increased its use and relevance to the user. Our study emphasizes the need for societal as well as technical inputs to accelerate adoption of the system. Understanding adoption includes understanding the behavior of users as well as identifying their needs to enhance their technological capability. Training and continuous technical support should form part of any new introduction of EMR technology. It is recommended that analyses of usage logs be supplemented with facility-level information as well as views and opinions of key stakeholders of the system. Future research directions should explore other mechanisms which affect user behavior and encourage full adoption of technology such as use of games or non-monetary incentives.

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Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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REFERENCES

1. Department of Health, Philippines eHealth Strategic Framework and Plan 2014-2020 [Internet]. 2014 [cited 2023 Sep]. Available from: https://ehealth.doh.gov.ph/#openModal11.
2. Department of Health, National eHealth Context (Overview) [Internet]. 2020 [cited 2023 Sep]. Available from: http://ehealth.doh.gov.ph/#openModal9.
3. An Act Instituting Universal Health Care for all Filipinos, Prescribing Reforms in the Health Care System, and Appropriating

Funds Therefore. Tran. Senate and House of Representatives of the Philippines. Republic Act ed [Internet]. 2019 [cited 2023 Sep]. Available from: https://www.doh.gov.ph/sites/default/files/health_magazine/RANo11223_UHC.pdf
4. Joint DOH-DOST-DICT Department Memorandum No.2017-0003. Reorganization of eHealth Experts Groups and Teams [Internet]. 2017 [cited 2023 Sep]. Available from: http://ehealth.doh.gov.ph/index.php/98-reorganizationofehealthexpertsgroups/90-reorganizationofehealthexpertsgroups
5. Philippine Health Insurance Corporation. Advisories 2016: Electronic Medical Record System [Internet]. 2016 [cited 2023 Sep]. Available from: https://www.philhealth.gov.ph/advisories/2016/adv2016-0040.pdf
6. Department of Health. eHealth Strategies and Activities [Internet]. 2020 [cited 2023 Sep]. Available from: http://ehealth.doh.gov.ph/index.php/phie/strategies-and-investment/43-strategies-and-activities
7. Lu JL, Marcelo PGF. Assessment of the context for eHealth development in the Philippines: a work in progress from 1997 to 2020. Acta Med Philipp. 2021;55(6):681-92. doi:10.47895/amp.v55i6.3208.
8. Sylim PG, Lu JL, Marcelo PGF. Discoursing terminology standards and interoperability in relation to the Philippine eHealth strategy. Acta Med Philipp. 2022;56(1):106-17. doi:10.47895/amp.v56i1.3937
9. Dayrit M, Lagrada L, Picazo O, Pons M, Villaverde M. Organization and Governance [Internet]. World Health Organization; 2018:21-71. [cited 2023 Sep]. Available from: http://www.jstor.org/stable/resrep28462.9
10. Pulmano CE, Estuar MRJE. Towards developing an intelligent agent to assist in patient diagnosis using neural networks on unstructured patient clinical notes: initial analysis and models. Procedia Comput Sci. 2016;100:263-70. doi: 10.1016/j.procs.2016.09.153.
11. Lal A, Ashworth HC, Dada S, Hoemeke L, Tambo E. Optimizing pandemic preparedness and response through health information systems: lessons learned from Ebola to COVID-19. Disaster Med Public Health Prep. 2022 Feb;16(1):333-40. doi:10.1017/dmp.2020.361. PMID: 33004102; PMCID: PMC7642496.
12. Dornan L, Pinyopornpanish K, Jiraporncharoen W, Hashmi A, Dejkriengkraikul N, Angkurawaranon C. Utilisation of electronic health records for public health in Asia: a review of success factors and potential challenges. Lopalco L, ed. BioMed Res Int. 2019 Jul 8:2019:7341841. doi:10.1155/2019/7341841. PMID: 31360723; PMCID: PMC6644215.
13. Chan YYY, Ngai EWT. Conceptualising electronic word of mouth activity: An input-process-output perspective. Mark Intell Plan. 2011; 29(5):488-516. doi:10.1108/02634501111153692.
14. Cordova R Jr, Gloria E, Ygaña J. Knowledge, Attitudes, and Practices of Selected Regions in the Philippines on Electronic Medical Record System. Accepted for poster presentation during the 17th National Health Research for Action Forum at Shangri-la Hotel [Internet]. 2018 [cited 2023 Sep]. Available from: https://doh.gov.ph/sites/default/files/publications/17th-National-Health-Research-Forum-for-Action.pdf
15. Cortez J, Ishii J, Ongkiko A, Ortega C, Malang B, Vigonte F. Health Information System Users in Public Health Facilities: A Descriptive Analytics. IJMABER [Internet]. 2023 [cited 2023 Sep]. Available from: https://ijmaberjournal.org/index.php/ijmaber/article/view/692.
16. Villamor DAR, Pulmano CE, Estuar MRJE. Understanding adoption of electronic medical records: application of process mining for health worker behavior analysis. Proceedings of the 4th International Conference on Medical and Health Informatics. 2020;98-104. doi:10.1145/3418094.3418109.
17. Rule A, Chiang MF, Hribar MR. Using electronic health record audit logs to study clinical activity: a systematic review of aims, measures, and methods. J Am Med Inform Assoc. 2020 Mar 1;27(3):480-90. doi:10.1093/jamia/ocz196. PMID: 31750912; PMCID: PMC7025338.
18. Adler-Milstein J, Adelman JS, Tai-Seale M, Patel VL, Dymek C. EHR audit logs: A new goldmine for health services research? J Biomed Inform. 2020 Jan;101:103343. doi:10.1016/j.jbi.2019.103343. PMID: 31821887.
19. Sinsky CA, Rule A, Cohen G, Ardnt BG, Shanafelt TD, Sharp CD, et al. Metrics for assessing physician activity using electronic health record log data. J Am Med Inform Assoc. 2020 Apr 1;27(4):639-43. doi:10.1093/jamia/ocz223. PMID: 32027360; PMCID: PMC7075531.
20. Province of Iloilo. Official website of the provincial government of Iloilo [Internet]. 2021-2022 [cited 2023 Nov]. Available from: https://iloilo.gov.ph/en/municipal-directory
21. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020 [Internet]. 2020 [cited 2023 Sep]. Available from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020
22. Arndt BG, Beasley JW, Watkinson MD, Temte JL, Tuan W, Sinsky CA, et al. Tethered to the EHR: Primary care physician workload assessment using EHR event log data and time-motion observations. Ann Fam Med. 2017 Sep;15(5):419-26. doi:10.1370/afm.2121. PMID: 28893811; PMCID: PMC5593724.
23. Tai-Seale M, Olson CW, Li J, Chan AS, Morikawa C, Durbin M, et al. Electronic health record logs indicate that physicians split time evenly between seeing patients and desktop medicine. Health Aff (Millwood). 2017 Apr 1;36(4):655-62. doi:10.1377/hlthaff.2016.0811. PMID: 28373331; PMCID: PMC5546411.
24. Tsai T, Boazak M, McPeek Hinz ER. Increased clinician time using electronic health records during COVID-19 pandemic. AMIA Annu Symp Proc. 2022 Feb 21;2021:1159-68. PMID: 35308951; PMCID: PMC8861678.
25. Macabasag RLA, Mallari EU, Pascual PJC, Fernandez-Marcelo PGH. Catching up with rapid technology implementation: mobilities, electronic medical records, and primary care work in the Philippines. Appl Mobilities. 2023;8(2):97-112. doi:10.1080/23800127.2022.2087014.
26. Li YJ, Yen J, Chiu W, Jian W, Syed-Abdul S, Hsu M. Building a national electronic medical record exchange system – experiences in Taiwan. Comput Methods Programs Biomed. 2015 Aug;121(1):14-20. doi: 10.1016/j.cmpb.2015.04.013. PMID: 26001420.