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Medical Documentation in Low- and Middle-income Countries: Lessons Learned from Implementing Specialized Charting Software

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Background: The implementation of electronic health record (EHR) software at healthcare facilities in low- and middle-income countries (LMICs) is limited by financial and technological constraints. Smile Train, the world's largest cleft charity, developed a cleft treatment EHR system, Smile Train Express (STX), and distributed it to their partnered institutions. The purpose of this study was to investigate trends in medical documentation practices amongst Smile Train-partner institutions to characterize the impact that specialized EHR software has on medical documentation practices at healthcare facilities in LMICs.

Methods: Surveys were administered electronically to 843 Smile Train-partnered institutions across 68 LMICs. The survey inquired about institutions' internet connection, documentation methods used during patient encounters, rationale for using said methods, and documentation methods for cloud-based storage of healthcare data. Institutions were grouped by economic and geographic subgroups for analysis.

Results: A total of 162 institutions (19.2%) responded to the survey. Most institutions employed paper charting (64.2%) or institutional EHR software (25.9%) for data entry during a patient encounter with the latter's use varying significantly across geographical subgroups ($P = 0.01$). STX was used by 18 institutions (11.1%) during a patient encounter. Workflow was the most frequently cited reason for institutions to employ their entry method during a patient encounter (51.4%).

Conclusions: The provision of STX to partnered institutions influenced medical documentation practices at several institutions; however, regulations and guidelines have likely limited its complete integration into clinical workflows. Further studies are needed to characterize trends in medical documentation in LMICs at a more granular level. *(Plast Reconstr Surg Glob Open 2021;9:e3651; doi: 10.1097/GOX.0000000000003651; Published online 22 June 2021.)*

INTRODUCTION

Electronic Health Record (EHR) systems have been adopted by numerous healthcare facilities worldwide due to their many benefits over conventional paper charts. EHR systems have been shown to improve the quality of patient care by reducing medical errors through standardizing medical documentation and improving communication across care teams.[1–3] Furthermore, EHR systems benefit institutions by consolidating patients' protected health information (PHI), reducing costs, and facilitating clinical research.[4–6] As a result, many healthcare facilities that practice paper charting have prioritized transitioning to electronic charting. Although EHR systems have been implemented in many healthcare facilities across high income countries, the same cannot be said for healthcare facilities within low- and middle-income countries (LMICs).[7–9] Healthcare facilities within LMICs frequently struggle to acquire EHR systems because of financial constraints or the lack of necessary technological infrastructure.[7–12] In the instance that institutions are able to procure EHR systems, many struggle to readily incorporate these

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systems into clinical practice because of steep learning curves and providers' limited access to EHR training.[12–14]

Smile Train, the world's largest cleft charity with over 20 years of experience partnering with healthcare facilities in LMICs, developed a cleft treatment EHR system and distributed it to their partnered institutions.[15] This system, Smile Train Express (STX), was designed to circumvent a number of barriers associated with EHR implementation by minimizing technological requirements for use and reducing the complexity of documenting patients' PHI.[15] The primary function of this EHR software is to keep track of cleft surgical data so that Smile Train and its partner institutions can work in tandem to develop quality improvement and safety action plans with the goals of improving and standardizing cleft surgical care. As a result, all Smile Train-partner institutions are required to log surgical cases into STX within 31 days of a procedure being performed and to participate in quality improvement and safety practices to receive funding for cleft surgeries. Case entry can be done both during a patient encounter or at a later date, as long as patients' healthcare data are uploaded to the STX cloud-based patient record database on a monthly basis. Despite being designed as a quality improvement tool, STX has also become the primary medium for medical documentation at some Smile Train-partner institutions.

Presently, few studies have investigated global trends in medical documentation practices at healthcare facilities located in LMICs.[16] Furthermore, no studies to date have investigated trends in medical documentation at these institutions following the provision of EHR software specifically designed to overcome obstacles that frequently impede the implementation of EHR systems. The purpose of this study is to investigate trends in medical documentation practices amongst Smile Train-partner institutions to characterize the impact that specialized EHR software has on medical documentation practices at healthcare facilities in LMICs.

METHODS

Data Source

A survey was developed by author ER to identify trends in medical documentation and to assess the implementation of STX at 843 Smile Train-partnered institutions across 68 LMICs. Questionnaires were administered through STX (Smile Train Inc., New York, N.Y.) between November 7, 2019 and December 2, 2019 and were completed by individuals responsible for entering or supervising the entry of cleft surgical data into the application and uploading the data to the STX patient record database via an internet connection. Each partner institution was only allowed to submit one survey response. The identity of respondents remained anonymous; however, institutions remained identifiable as survey responses were utilized as a quality improvement tool at each institution. Survey questions inquired about the reliability of an institution's internet connection, the methods institutions employed to record healthcare data during a patient encounter, the rationale for using said methods, and whether or not an institution employed a second EHR system in conjunction with STX for cloud-based storage of healthcare data (Table 1). Questions were either asked in multiple choice or free response format. All multiple-choice answers had an associated comment section to further clarify the rationale behind each answer selection. If there was discordance between the multiple choice and free response answers, the free response answer was favored. Questions left blank were considered nonresponses and did not count toward the total response count for that question.

Measurements

Institutions were classified by their geographic and economic characteristics according to the United Nations' M49 geographic classification system and the World Bank's Income Classification System, respectively.[17–19] Internet connectivity was based on respondents' anecdotal experience with their internet connection. Data entry methods for logging patients' PHI during a patient encounter were grouped into four categories: paper charting, offline data entry tools, STX (online), and institutional EHR software. Offline data entry tools, such as Microsoft Excel (Microsoft Inc., Redmond, Washington) and STX's offline toolset, were defined as any application used to store PHI without an internet connection. Institutional EHR software was defined as EHR software, excluding STX's online toolset, that required an internet connection to access and modify patients' PHI. Respondents were allowed to select

Table 1. Survey Questions

Questions
1. What is the status of the internet connectivity at your treatment center? • We don't have internet access • We have limited or unreliable internet access • We have good internet access some of the time but not at all times • We have good internet access in all areas of the treatment center at all times
2. How do you create patient and treatment records during a patient encounter?* • We fill out a printed paper form and later copy data into a treatment record • We enter data directly into an offline application record without paper form • We enter data directly into a Smile Train Express online patient record without a paper form and without an offline application • We enter data into our own medical record system and then copy data into Smile Train record
3. Please tell us why these methods work best for your team?†
4. Is Smile Train Express the only electronic, cloud-based patient database used by your treatment center? • Yes, we only use Smile Train Express • No, we also use our treatment center's patient database

*May select more than 1 answer.

†Free response question.

multiple answers regarding the use of data entry methods for logging PHI during a patient encounter, as many institutions employ a variety of methods across different settings of care.[4]

Respondents' reasoning behind using their selected data entry method was answered in a free response format. These responses were stratified into four different categories by authors AF, MD, and ER: data reliability, double-checking of data, infrastructure, and workflow. Data reliability was defined as desiring a backup copy of patient information due to the belief that other methodologies were relatively unreliable to store patients' PHI. Double-checking of data was defined as wanting to ensure that data were logged correctly before being transcribed into cloud-based storage systems online. Infrastructure was defined as lacking the necessary equipment to use other methods of data entry. Workflow was defined as using a data entry method to maximize the efficiency of clinical activities. If a free response answer listed more than one reason for using a particular method, the response was counted as an individual datapoint for each category. To isolate respondents' reasoning for employing either paper or electronic entry methods during a patient encounter, responses from Smile Train-partner institutions who employed both paper and electronic entry methods during a patient encounter, a practice known as double-charting, were excluded from this analysis.

Analysis

Geographic and economic subgroups were analyzed separately. The mean of each response along with its percent value was calculated. Multi-sample *t*-tests were conducted to compare variables across geographic and economic subgroups. All *P*-values were calculated using the Wilcoxon rank sum test, with statistical significance defined as a *P* value less than 0.05. All statistical analyses were conducted using STATA (StataCorp., College Station, Tex.).

RESULTS

Of the 843 Smile Train-partnered institutions invited to participate in this cross-sectional study, 162 (19.2%) responded to the survey (Tables 2–4). We observed no statistically significant differences in reported internet connectivity across geographic and economic subgroups ($P = 0.33$ and $P = 0.36$, respectively). The majority of responding institutions reported that their internet connectivity was "good sometimes" (48.1%), with only 14.4% and 3.1% of institutions reporting limited or no internet connectivity, respectively.

The majority of participating institutions employed paper charting (64.2%) or institutional EHR software (25.9%) for data entry during a patient encounter. The frequency of paper charting during a patient encounter was inversely correlated with the gross national income (GNI) of the country in which the partnered institution was located (Table 4); however, this finding was not statistically significant ($P = 0.08$). We observed statistically significant differences in respondents' institutional EHR software use during a patient visit across geographic subgroups ($P = 0.01$), with institutions in the Latin America & Caribbean and North Africa & West Asia subgroups employing paper charting most frequently (Table 3).

Table 2. Geographic and Economic Characteristics of Responding Institutions

Geographic Subgroup	n (%)	Economic Subgroup	n (%)
Central and South Asia	49 (30.3%)	Upper middle income	56 (34.6%)
East and Southeast Asia	42 (25.9%)	Lower middle income	93 (57.4%)
Europe and North America	2 (1.2%)	Low income	13 (8.0%)
Latin America and the Caribbean	28 (17.3%)		
North Africa and West Asia	5 (3.1%)		
Sub-Saharan Africa	36 (22.2%)		

Table 3. Trends in Medical Documentation Practices across Geographic Subgroups*

	Total	Central & South Asia	East & South-east Asia	Latin America & Caribbean	North Africa & West Asia	Sub-Saharan Africa	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	*P*
Internet connectivity (n = 160)							0.33
Good most of the time	55 (34.4%)	21 (42.9%)	11 (26.8%)	10 (35.7%)	4 (80.0%)	8 (22.9%)	
Good sometimes	77 (48.1%)	22 (44.9%)	22 (53.7%)	14 (50.0%)	1 (20.0%)	17 (48.6%)	
Limited/unreliable	23 (14.4%)	4 (8.2%)	6 (14.6%)	3 (10.7%)	0 (0%)	10 (28.6%)	
No access	5 (3.1%)	2 (4.1%)	2 (4.9%)	1 (3.6%)	0 (0%)	0 (0%)	
Entry method: during patient encounter (n = 162)†							
Paper	104 (64.2%)	34 (69.4%)	23 (54.8%)	18 (64.3%)	1 (20.0%)	26 (72.2%)	0.13
Offline software	14 (8.6%)	4 (8.2%)	5 (11.9%)	2 (7.1%)	0 (0%)	3 (8.3%)	0.93
STX (online)	18 (11.1%)	2 (4.1%)	6 (14.3%)	3 (10.7%)	0 (0%)	7 (19.4%)	0.28
Institutional HER	42 (25.9%)	13 (26.5%)	12 (28.6%)	10 (35.7%)	4 (80.0%)	3 (8.3%)	0.01
Entry method: cloud-based storage (n = 160)†							0.02
STX	95 (59.4%)	29 (59.2%)	30 (73.2%)	12 (42.9%)	1 (20%)	23 (65.7%)	
STX + Other EHR	65 (40.6%)	20 (40.8%)	11 (26.8%)	16 (57.1%)	4 (80%)	12 (34.3%)	

* The Europe & North American (n=2) subgroup is not shown due to low sample size; however, it was included in statistical analysis.
†Only responses stating that an institution used the selected entry method are shown. STX = Smile Train Express.

Table 4. Trends in Medical Documentation Practices across Economic Subgroups

	Total	Upper-middle Income	Lower-middle Income	Low Income	
	n (%)	n (%)	n (%)	n (%)	*P*
Internet connectivity (n = 160)					0.36
Good most of the time	55 (34.4%)	18 (32.7%)	35 (38.0%)	2 (15.4%)	
Good sometimes	77 (48.1%)	28 (50.9%)	42 (45.7%)	7 (53.8%)	
Limited/unreliable	23 (14.4%)	6 (10.9%)	13 (14.1%)	4 (30.8%)	
No access	5 (3.1%)	3 (5.5%)	2 (2.2%)	0 (0%)	
Entry method: during patient encounter (n = 162)*					
Paper	104 (64.2%)	33 (58.9%)	59 (63.4%)	12 (92.3%)	0.08
Offline software	14 (8.6%)	6 (10.7%)	7 (7.5%)	1 (7.7%)	0.79
STX (online)	18 (11.1%)	6 (10.7%)	9 (9.7%)	3 (23.1%)	0.35
Institutional EHR	42 (25.9%)	18 (32.1%)	23 (24.7%)	1 (7.7%)	0.18
Entry method: cloud-based storage (n = 160)*					0.28
STX	95 (59.4%)	28 (50.9%)	59 (64.1%)	8 (61.5%)	
STX + other EHR	65 (40.6%)	27 (49.1%)	33 (35.9%)	5 (38.5%)	

*Only responses stating that an institution used the selected entry method are shown.

In contrast to paper charting, the frequency of institutional EHR software use during a patient encounter was positively correlated with a country's GNI (Table 4), though this observation also was not statistically significant ($P = 0.18$). STX (online) was used during a patient encounter by 18 (11.1%) of respondents, with 11 (6.8%) using the software as their sole method for documenting patients' PHI. Of these 11 institutions, six (54.5%) were cleft specialty centers, one (9.1%) was a general pediatric plastic surgery center, and four (36.4%) were all-purpose hospitals.

A total of 82 respondents (50.6%) provided responses detailing their institutions' reasoning for selecting their data entry methods employed during a patient encounter with 70 (43.2%) reporting that they solely used paper or electronic methods (Table 5). The a majority of responses (51.4%), regardless of data entry method used during a patient encounter, stated that improving the workflow of their clinical activities was their primary motivation for institutions to employ their selected entry method(s). More specifically, respondents who employed paper charting during a patient encounter explained in the free response section that lack of technologically savvy staff in conjunction with high clinical volume experienced at their institution was the greatest problem posed by the implementation of EHR software in regard to clinical workflow. Conversely, participating institutions who employed electronic charting methods during a patient encounter reported that electronic charting methods allowed them to improve clinical workflow by increasing the speed of documentation and easing access and transfer of patients' PHI across care teams. Data reliability was the second most frequently cited reason for institutions to employ paper charting during a patient encounter (23.4%). In contrast, double-checking of data was the second most frequently cited reason for institutions to employ electronic charting methods during a patient encounter (21.7%).

STX was used as the sole EHR software for cloud-based storage of patients' PHI at 59.4% of all participating institutions. We observed statistically significant differences in the use of EHR software for cloud-based storage of healthcare data across geographic regions ($P = 0.02$); however, there were no statistically significant differences observed based on the GNI of the country in which partnered institutions were located ($P = 0.28$).

Table 5. Rationale for Using Selected Data Entry Method during a Patient Encounter

	Total (n = 70)	Paper (n = 47)	Electronic (n = 23)
Rationale*	n (%)	n (%)	n (%)
Data reliability	14 (20.0%)	11 (23.4%)	3 (13.0%)
Double check	12 (17.1%)	7 (14.9%)	5 (21.7%)
Infrastructure	8 (11.4%)	6 (12.8%)	2 (8.7%)
Workflow	36 (51.4%)	23 (48.9%)	13 (56.5%)

*Data-reliability = desiring a backup copy of patient information due to the belief that other methodologies were relatively unreliable to store patients' healthcare data; Double check = wanting to ensure that data were logged correctly before being transcribed into cloud-based storage systems online; Infrastructure = lacking the necessary equipment to use other methods of data entry; Workflow = using a data entry method to maximize the efficiency of clinical activities.

DISCUSSION

In this cross-sectional study, we analyzed survey responses provided by 162 Smile Train-partner institutions to characterize the impact that specialized EHR software has on medical documentation practices at healthcare facilities in LMICs. We observed that paper charting was the most frequently employed method for primary PHI documentation during a patient encounter. The detrimental effects that EHR systems were perceived to have on clinical workflow, primarily due to lack of computer literate staff and exacerbated by high clinical volume, were the primary reasons for employing paper charting in these settings.

These findings are consistent with observations described in previous studies that investigated EHR implementation in healthcare facilities residing in both LMICs and high-income countries (HICs).[20–23] It is likely that incorporation of readily accessible EHR software training modules following the acquisition of EHR systems would benefit institutions that exclusively use paper charting during a patient encounter. This is supported by our observation that institutions that exclusively employed electronic charting during the patient

encounter improved clinical workflow once they had learned to use their EHR software. While few studies have investigated the effects of EHR software training on clinical workflow at healthcare facilities within LMICs, training experiences at healthcare facilities within HICs have been shown to be effective and associated with minimal financial burden.[13,14,24] We anticipate similar results would likely be observed following the implementation of EHR software training experiences in LMICs.

Other potential reasons for the high usage of paper charting during a patient encounter include the significant disparities in healthcare coordination and funding across countries. Many countries' governments have facilitated EHR software implementation through financial incentivization.[25–27] These initiatives resulted in rapid EHR software integration at healthcare facilities within HICs; however, their use within LMICs has not been as successful.[25,28] One study based in India found that funding provided for incentives by governing bodies in LMICs was frequently exclusive to public healthcare facilities, resulting in limited implementation of EHR systems across private healthcare facilities.[25] It can be surmised that countries with lower GNI are less likely to successfully incentivize the adoption of EHR software into all healthcare facilities. This phenomenon may help explain why we observed that paper charting and institutional EHR use during a patient visit were respectively negatively and positively correlated with the GNI of the country in which the partnered institution was located.

While the use of paper charting during a patient encounter was not found to be statistically significant across all geographic and economic subgroups, institutional EHR software use was found to vary significantly across geographic subgroups. In regard to the Latin America & Caribbean subgroup, we postulate that this finding is due, at least in part, to variation in governments' creation of national EHR systems and incentives for implementing nongovernmental EHR systems. For example, the Ministry of Health of Brazil, a country that accounted for 46.4% of participating institutions within the Latin America & Caribbean subgroup, provided national EHR systems to healthcare facilities starting in August 2013.[29] The provision of national EHR systems, in addition to incentives provided by local and regional governments for the implementation of proprietary EHR software, has resulted in 45% of publicly-funded healthcare institutions employing EHRs.[29,30]

We observed that a small subset of participating institutions employed STX (online) as their sole documentation method both during the patient encounter and for cloud-based storage of patients' PHI. This finding suggests that the provision of EHR software alone, even software specifically designed to circumvent multiple barriers to EHR system implementation within LMICs, does not fully address the challenges of online medical documentation in LMICs. Although highly effective as an EHR software, STX's design may not meet the requirements for EHR software established by partnered institutions' governing bodies.[8,31] Regulations from national governments may also prohibit the use of STX exclusively; for example, healthcare facilities in South Africa are legally required by the national government to have hard copies of all medical records, regardless of the reliability of their EHR software.[32] As a result, many partner institutions residing within countries with similarly restrictive national requirements frequently enter patients' PHI into STX at a later date to avoid decreasing the efficiency of their clinical workflow secondary to double- or triple-charting during a patient encounter.[33]

We observed that 59.4% of participating institutions employed STX as the sole method for entering patients' PHI into cloud-based storage. As previously discussed, it is possible that institutional EHR systems are required to be used in conjunction with STX for cloud-based storage of healthcare data because of restrictive policies issued by partnered institutions and national governments.[8,31] We also observed statistically significant differences in use of entry methods based on an institution's geographic location, though we did not observe significant differences based on the GNI of the country where the institution was located. It should be noted, however, that Smile Train partner institutions who employed institutional EHR software may have automatically uploaded patients' healthcare information to cloud-based storage during the patient encounter. As such, we believe that methods used for entry of healthcare data into cloud-based storage are highly dependent on the use of institutional EHR software during a patient encounter.

Our study has several limitations. First, our subgroup analysis was limited by our survey response rate; a larger sample size would have allowed for improved detection of statistical significance across geographic and economic subgroups. Second, the generalizability of our study is limited by the fact that our sample may not be representative of all healthcare facilities within each geographic and economic subgroup, especially given the unique structure of different cleft care delivery models within LMICs.[34] Third, it is possible that questionnaire responses were influenced by Smile Train's relationship with a respondent's institution. Fourth, due to the cross-sectional design of this study, we were only able to outline general trends in medical documentation practices at Smile Train-partnered institutions. Lastly, although governmental initiatives and data security have both been shown to significantly influence EHR software implementation, these factors were not directly investigated in this study.[25,31,35,36]

CONCLUSIONS

The implementation of EHR systems in healthcare facilities in low- and middle-income countries continues to be a significant challenge due to financial constraints, lack of necessary technological infrastructure, and limited access to software training. Although the provision of Smile Train Express at partnered institutions did impact medical documentation practices at several institutions, regulations and guidelines established by governing bodies have likely limited its complete integration into clinical workflows at the majority of

partnered institutions. Our findings suggest that organizations with the goals of implementing EHR software at healthcare facilities within LMICs must take a highly individualized approach given the significant variability in hospital and governmental policy. Further studies are needed to characterize trends in medical documentation in LMICs at a more granular level and to develop protocols for improving EHR software implementation in these settings.

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