

Effect of practice management softwares among physicians of developing countries with special reference to Indian scenario by Mixed Method Technique

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ABSTRACT

Introduction: Currently, many cheaper “practice management software” (PMS) are available in developing countries including India; despite their availability and benefits, its penetration and usage vary from low to moderate level, justifying the importance of this study area. **Materials and Methods:** First preferred reporting items for systematic-review and meta-analysis (2009) guidelines were considered; followed by an extensive systematic-review of available studies in literature related to developing countries, on key search term from main abstracting databases: PubMed, EMBASE, EBSCO, BIO-MED Central, Cochrane Library, world CAT-library till 15 June 2014; where any kind of article whether published or unpublished, in any sort or form or any language indicating the software usage were included. Thereafter, meta-analysis on Indian studies revealing the magnitude of usage in Indian scenario by Open Meta-(analyst) software using binary random effects (REs) model was done. Studies from developed countries were excluded in our study. **Results:** Of 57 studies included in a systematic review from developing countries, only 4 Indian studies were found eligible for meta-analysis. RE model revealed although not-significant results (total participants = 243,526; range: 100–226,228, overall odds ratio = 2.85, 95% confidence interval = $P < 0.05$ and tests for heterogeneity: $Q [df = 3] = 0.8$ Het. $P = 0.85$). The overall magnitude of usage of PMS on Indian physicians practice was however found between 10% and 45%. **Conclusion:** Although variable and nonsignificant effect of usage of PM software on practice of physicians in developing countries like India was found; there is a need to recognize the hidden potential of this system. Hence, more in-depth research in future needs to be done, in order to find a real impact of this system.

Keywords: Electronic medical records, general practice, India, meta-analysis, physicians, practice management software, systematic-review

Introduction

A gap in knowledge of physicians due to the information explosion and huge growth of knowledge in medicine can have a direct impact upon patient care. Computer technologies, information retrieval modes, can be a solution for this issue.^[1] Technology in the last two decades across the developing world has undoubtedly, revolutionized the health care delivery. Current computer technologies and the internet access have no doubt made an enormous resources available to physicians in the forms of “electronic mail to virtual patients” and this is

now impacting the physicians especially in developing countries in a great way.^[2] Emerging business model innovations in the health care delivery can also now generate significant benefits to all stakeholders, including patients and end users.^[3] In order to reduce the prevalence of clinical errors, effective use of clinical computer systems is now emerging as a one of the good strategy in clinical practice for physicians across the developing world.^[4]

The current demanding era of utilization, outcomes research, and cost efficiency requires an open-ended, time efficient physician practice management systems with the potential to improve patient care.^[5] Medical practice offices currently, therefore in developing countries; are experiencing a radical changes in their micro-processes, an essential norm for documenting and communicating patient care from the last decade.^[6]

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Medical informatics in developing countries is now ruled by two major kind of medical software such as PMS and electronic medical record (EMR). According to the “integrated care EMR,” as defined in International Standards Organization/DTR 20514, an “EMR is a repository of information regarding the health of a subject of care in computer-process able form that is able to be stored and transmitted securely, and is accessible by multiple authorized users.”^[7] However, medical practice management software (PMS’s) is a type of medical software which is used to manage the everyday activities in a hospital or nursing home or physicians’ clinic by dealing with the day-to-day operations of a medical practice at physician office.

Most PMS’s in India in the past had been used mainly for administrative and financial purposes. Most of the doctors had also relied upon E-mail or word processing services in last 2–3 decades, as a new entry of this kind of software had been quite low in past due to many factors such as more time consumption; expensiveness, complex system requirements, narrow capabilities, less-educated paramedical staff, portability issues, poor profits ultimately leading to poor popularity.^[8,9]

Today, healthcare industry in India is rapidly growing in the private sector, and they are participating and investing on a large scale.^[8] Maintaining integrity, confidentiality, and availability of patient health information is also appearing to be a technological challenge for practicing private physicians in India.^[9] The penetration rate of EMR and PMS among Indian private doctors reveals that they are slowly recognizing the importance of EMR as well as budding PMS’s available in the market. Only few famous examples such as that of Dr. Mohans Diabetes Specialty Center in Chennai where diabetes EMRs (DEMRS) of 140,000 appointments and 87,000 follow-ups had been done through such system, are elucidation the utility of such system in Indian scenario.^[10]

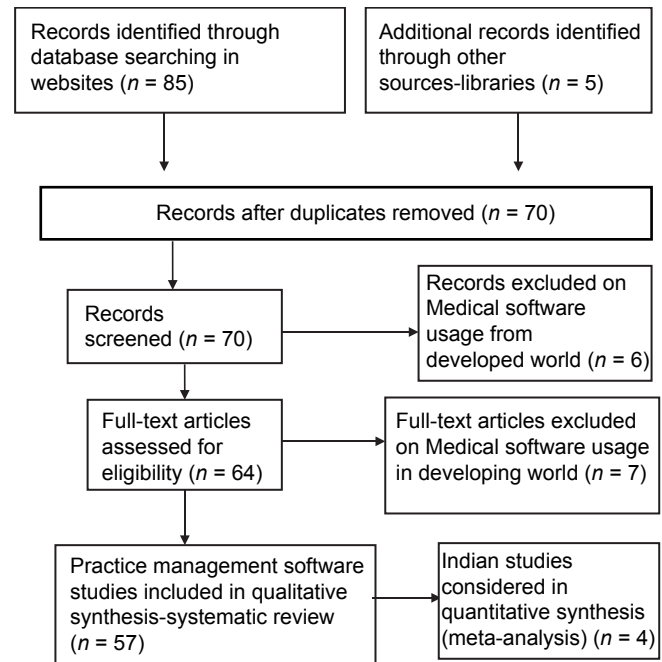
Currently, in international markets good PMS’s system such as Benchmark, Kareo, MediTouch, WRS Health, Medios, Centricity, EMA-Modernizing Medicine, WebPT, ChiroTouch, and NueMed which are available; but they have not yet made a proper entry in Indian physicians’ office. Although Indian market currently is also dominated by more than 380 PMS and EMR makers (e.g., MedClick, MedPrctice, Easy Clinic, Doctor Sahab, general practitioner (GP) plus, BirlaMedisoft, Lekhisoft, Doctors Desktop, ClinicEQ, Clinic-1, Docs Engage, Drager, Dragon and Swastin etc.), even their usage is very little. Majority of these PMS system focus primarily on practice management along with support in revenue management. The famous PRACTO software-one of the most popular in Indian setups due to its many positive features is still not used up to the satisfactory mark. Studies focusing on the content of EMRs and PMS are also needed on priority basis in developing countries, especially studies on nursing documentation and patient self-documentation.^[8,9] With this problem in mind, authors therefore, have researched this area by studying the usage by Indian Physicians as well as by a rest of the developing world physicians in area of PMS, in

order to come out with a usage analysis of these software via mixed method approach of systematic-review and meta-analysis.

Materials and Methods

An extensive systematic-review followed by meta-analysis as per preferred reporting items for systematic-review and meta-analysis (2009) guidelines was done on key search terms: “PMS” from key abstracting databases PubMed, EBSCO, EMBASE, BIO-MED Central Cochrane Library, world CAT-library till 15 June 2014, where any kind of article whether published or unpublished article, in any sort or form or language was included in context of only developing countries including India. Comparative usage analysis in Indian scenario was finally done by meta-analysis technique, in order to get the final picture of usage analysis. Meta-analysis on Indian studies revealing the magnitude of usage in Indian scenario was completed by Open Meta-(analyst) software using binary random effects (REs) model. The method of selection of studies is explained in the flow chart given below:

Flow chart of study selection process



Results

57 eligible studies from developing countries were retrieved and they revealed that a wide variety of PMS and EMR systems are used, with their variable effects ranging from good to little [Table 1].

Many categories of PMS are available in India for helping Indian physicians [Tables 1 and 2].

Meta-analysis

On applying binary REs model on 4 Indian eligible studies ($P = 0.29$, 95% confidence interval = 0.40–20.3, overall odds ratio = 2.85) and tests for heterogeneity: $\text{Tau}^2 = 0.0$ $Q [df = 3]$

Table 1: Themes synthesis from studies of developing countries for systematic review

Name of the first author of studies with year and reference citation	Countries of studies	Study methodologies	Key findings of studies	Themes synthesized from studies
Hamadeh ^[11]	Lebanon	Exploratory	Practice management-automation	PMS usage types across developing countries
Ferrara ^[12]	Europe	Report,	Standard “HIS architecture”	
Higashi <i>et al.</i> ^[13]	Japan,	Evaluation	Hospital-cancer registry	
Nitsuwat and Paoin ^[14]	Thailand	Research,	ICD-10 coding software	
Some <i>et al.</i> ^[15]	Burkina Faso	RCT	Qualitative data management software	
Yu <i>et al.</i> (2009) ^[16]	Australia	Review,	eSTEP software-PDA based data collection	
Marchal and Kegels ^[17]	SEAR	Exploratory,	HRM software development	
Ali <i>et al.</i> ^[18]	Pakistan	Review,	Model data management structure software	
Hovenga <i>et al.</i> ^[19]	SEAR	Research,	EHRs-nursing constraint models	
Hussain <i>et al.</i> ^[20]	Jambia	Exploratory,	Epi-software usage in sleep apnea and MCH care	
Maimbolwa <i>et al.</i> ^[21]	China	Review	GIS software for estimating floods	
Liu and Liu ^[22]	Korea	Exploratory	Software for telemedicine	
Kurec ^[23]	Japan	Report	Medical E-prescribing software	
Niinimäki and Forsström ^[24]	Italy	Evaluation	Computer assisted PAP-test software	
Della Palma P <i>et al.</i> ^[25]	China	Exploratory	Wound management software	
Liu <i>et al.</i> ^[26]	China	Review	Software for acute pain management	
Pawlik <i>et al.</i> ^[27]	Germany	Exploratory	Digital image management software in dermatology	
Rubegni <i>et al.</i> ^[28]	SEAR	Research	EMR-physician satisfaction study	
Ganesh and Al-Mujaini ^[29]	Oman	Research		
Malhotra and Chakraborty ^[30]	India	Exploratory research-based studies	Tele-psychiatry application software project	
Tejaswi <i>et al.</i> ^[31]			Cloud-computing software for physicians	
Rajasekar <i>et al.</i> ^[32]			Image registration software in radiotherapy	
Kumar and Indrayan ^[33]			ROC analysis software for medical research	
Malaviya and Gogia ^[34]			Rheumatology specific EMR	
Jayshree <i>et al.</i> (2006) ^[35] and Kumar <i>et al.</i> ^[36]			Laboratory information management software	
Aggarwal <i>et al.</i> ^[37]			Computer software for fiber optic bronchoscopy data	
Bhambani <i>et al.</i> ^[38]			Prosthodontics-digitalization	
Indian Doctors Guide ^[9]				
India Mart study ^[8]	India	Internet-based research	Types of medical software availability in India	
Patkar ^[39]	India	Internet-based research	Why Indian doctors do not like PMS's	Key medical software category available in India Key issues of medical software nonpopularity in India

PMS: Practice management software; HIS: Hardware intrinsic security; PDA: Personal digital assistant; HRM: Human resource management; EHR: Electronic health records; EMR: Electronic medical record; ROC: Receiver operating characteristic; RCT: Randomized clinical trial; MCH: Maternal and child health; GIS: Geographic information system; PAP: Pap smear; eSTEP: estep software

= 0.8 Het. $P = 0.85$, $I^2 = 0.0$); although the results were not statistically significant but the magnitude of effect of PMS usage on Indian physicians ranged between 10% and 45% as per meta-analysis results, indicating the hidden potential of PMS usage on Indian physicians [Table 3, Figures 1 and 2].

Discussion

Ever since the world entered the information technology (IT) revolution, almost all the health and its related sectors are using the services of IT in both developed and developing countries. Many developing countries currently use many IT programs such as electronic health records (EHR) Infrastructure, AORTA in The Netherlands, EMR Exchange in Singapore, and National Patient Summary (NPO) in Sweden.^[40] Among the 2 major categories of medical software, EMR system is different from PMS system. EMR system is mainly used for the assisting the practicing physicians in a clinical area, whereas PMS is used

primarily for administrative and financial matters. The integration of the EMR and PMS is the most challenging aspects of the medical PMS implementation.

Theme 1: Practice management software usage type across developing countries

Both private and government physicians are now requiring more support for their practice activities. In developing countries, various types of medical software had been employed by private physicians to address their practice challenges [Table 1]. But for their successful scalability, what is required is better sustainable sources of funding, greater support for the adoption of new technologies and better ways of evaluating impact as found in developed countries.^[47] Hardware intrinsic security (HIS) technology has been developed in developing countries more for transactional purposes on mini and mainframe platforms. The recent HIS technology have the advantage of PC technology,

client-server models and telecommunications to achieve integration.^[48] In the absence of governmental version of primary care software in many developing countries, there is a tendency of family physicians using too many software with different quality, which are often not compatible with each other.^[49] Some of the most popular examples of medical PMS available in developing countries are Care2X, OpenEMR, MirrorMed, Open Dental, and Technology Assisted Practice Application Suite.^[41] Our systematic-review of 57 studies found that a wide variety of PMS and EMR systems are used in developing countries; with their overall effects although not so excellent, but the trends were on positive side on the practice of physicians.

Key examples of successful practice management software implementation

Studies in literature reveal many types of PMS system in developing countries spanning eastern to the western part of the globe as seen from studies considered in our systematic-review [Table 1].

- On Clinical practice analysis data; study of Hamadeh found that, there was a good impact of automation on patient care, missing medical records, appointment scheduling, referral rates, and repeat prescriptions after using such technology^[11]
- Study of Ferrara had also found that; an open architecture (based on the introduction of a middleware of common health care-specific services) can not only reduce the effort necessary for allowing existing systems to interwork, but also it established a functional and information basis for the whole health organization^[12]
- Study by Higashi *et al.* in the area of hospital-based cancer registry in Japan by applying medical software found that this type of database can not only provide an infrastructure for future clinical and health services research, but also it can support quality measurement and improvement of cancer care^[13]
- Study of Nitsuwat and Paoin in Thailand had found that International Classification of Diseases-10 (ICD-10) ontology in the ICD coding software can facilitate successful implementation of ICD in developing countries without any adequate number of competent ICD coders^[14]
- Qualitative study of Some *et al.* on women's perceptions of home births in two medical districts of Burkina Faso using QSR International (A qualitative research software developer based in Melbourne, Australia, with offices in the United Kingdom, the United States and Japan), qualitative data management software for managing their interviews were positive^[15]
- In their study of a generic personal digital assistant (PDA)-based data collection software-eSTEP by Yu *et al.* it was found that this software directly interfaced with EpiData and also it significantly reduced errors in data entry. This eSTEPS field trial proved that, PDA was more efficient than paper for public health survey data collection^[16]
- Study of Marchal and Kegels on HRM software found that they could identify conditions for successful high commitment management of health service managers; appropriate decision spaces for healthcare managers and a pool of reasonable well-trained health workers for hospital sector after using this technology^[17]
- Study of Ali *et al.* had found that Information from the model data management structure software helped others to construct reliable databases for large-scale epidemiological studies in less developed countries^[18]
- The study of Hovenga has found that the nursing profession must develop its domain knowledge constraint models (archetypes open EHR) collaboratively in an international context^[19]
- Study of Hussain *et al.* found after using SPSS software in his study that; a significant number of doctors were not aware that obstructive sleep apnea could occur in nonobese individuals (33%), women (42%), and children (39%)^[20]
- Study of Maimbolwa *et al.* used EPI INFO, an epidemiological statistical software package, to analyze the quantitative data and they found that midwives had an opportunity to ensure that care given during childbirth is clinically safe and culturally sensitive^[21]
- Study of Liu and Liu on usage of geographic information systems based software had shown that this kind of approach had practical significance to flood fighting and control in developing countries like China^[22]
- Improved technology of computer hardware and software coupled with less cost and better access to this technology is now establishing telemedicine as an acceptable standard practice as found in the study of Kurec, creating a good scope of PMS^[23]
- Study of Niinimäki and Forsström found that voluntary evaluation practice can be an invaluable source of information in terms of developing new software in medical e-prescribing^[24]
- Automated computer-software-assisted Pap test ability to reduce human resource costs and its adoption in a model using only biologists and pathologists for screening was found to be more economically advantageous as found in the study of Della Palma *et al.*^[25]
- The study by Liu *et al.* found that standardized wound information management by standardized techniques of acquisition, transmission, and storage of wound information after using wound management software can be used widely in hospitals, primary medical institutions, surgical clinics of China^[26]
- Study by Pawlik *et al.* revealed that only few commercial software met the needs of an acute pain service, hence they developed and implemented a program-Schmerzvisite, Medlinq, Hamburg, Germany in the acute pain service of a University Hospital with positive results^[27]
- In the study of Rubegni *et al.* (2009) they designed a reliable hardware structure for future scaling. This software facilitated the classification by pathology, patient and visit, with an advanced search option allowing access to all images and the possibility of comparing two or more digital images^[28]
- A study in Oman which evaluated physician satisfaction with the EMR system, found both positive impact in areas of communication, data entry and retrieval, patient

Table 2: Key medical software category available in India for practicing physicians

Categories of medical software available	Utility for Indian physicians
Simple Medical software ^[9,40-43]	They can be used to fulfill the different requirements of medical practice such as payroll solutions, web-based HR solutions, customized software solutions for hospitals at affordable prices Helps large healthcare software and service providers to design, build and maintain a variety of hospital, physician, and clinics
Hospital Management System software ^[9,40-43]	Practicing doctors can automate medical as well as administrative aspects of clinic operational aspects It can manage patient's information, appointments, prescriptions, insurance, hospitalization record such as admission Decision support system for the hospital authorities Useful in electronic management in a hospital or nursing home Gives cost cutting and efficient management
Medical Imaging software ^[9,40-43]	Crisp and clearly detailed images Live video Compare pre- and post-treatment New generation image analysis software help scientist to do analysis X-ray fluorescence software-enables to achieve the maximum analytical performance from the energy and wavelength dispersive X-ray Endoscopy software-used in medical applications for quick and reliable video capture and imaging Useful for nuclear, CT scan, laparoscopes, endoscopes, colposcopes, C-arm, and ultrasound systems Tele-radiology software-solution for hospitals can be networked, and images can be exchanged between physicians' office and tertiary care center
Central Nursing Station software ^[9]	For nursing management in ICUs and CCUs, etc.
Medical Software for Microscope ^[9]	Helps microscopic analysis of images, pathology specimens, biochemical results
SGS 3-dimensional Airway software ^[9]	The is an updated method for analyzing data gathered with the Eccovision Acoustic Pharyngometer
Medical Representative Reporting System ^[9]	Available at competitive prices for management of MRs at physician's clinic
Medical Retail software ^[9]	Interactive for reporting findings along with comments to patient consulting physician
Medical Practice Management System ^[9]	All aspects of medical practice can be managed
Voice therapy software ^[9]	Voice therapy involves exercises related to the use of voice
Medical Certificate software ^[9]	Useful for laboratories
Medical Store Billing software ^[9]	Customized as per the client's specific need for various data management
E-OPD-Software and Medical Clinic Management Systems ^[9]	To make registration work in OPD easier It can give healthcare organizations-automation and messaging systems efficiently
Medical Coding software ^[9]	It saves not only time of coders but also help them in improving the efficiency of coding
Lab Management software ^[9]	For a physician and dental labs in hospitals
Disease Specific software ^[9]	Endocrine and diabetes, gastroenterologists, laproscopic surgeons, ENT surgeons, cardiology, and Obs-Gyn
Diagnostic Management software ^[9]	It can help in administration of the day to day activity of pathologists, from the patient test registration to the report submission
Medical Record Management software ^[9]	This type of clinical medical record management software is designed for medical practices who find problem with maintaining their patient's past medical record in their successive visits in both medical and dental practice
Medical Stores and Pharmacy software ^[9]	A complete pharmacy accounting software for stock, financial accounting, expiry, and batch check availability
Medical Instrumentation and Devices software ^[9]	For M2M interactions and their smooth operations

HR: Human resource; CT: Computed tomography; ICUs: Intensive Care Units; CCU: Critical care unit; ENT: Ears nose and throat Obs-Gyn: Obstetrics and gynecology

Table 3: Findings showing effect of PMS on practice of Indian physicians from meta-analysis

Name of study with reference-citation (first author)	Population in study (n)	Number of participants on which PMS was used (n)	Estimated-OR	95% CI		Weights (in %)	SE	P
				Low	High			
Singh <i>et al.</i> 1997 ^[44]	100	80	1.24	0.02	63.61	24.91	2.00	NA
Chudasma <i>et al.</i> , 2008 ^[45]	235	206	1.14	0.02	57.73	24.99	1.4	0.90
Pradeepa <i>et al.</i> , 2011 ^[10]	226,228	44,295	5.10	0.10	257.39	25.05	1.1	0.56
Anand <i>et al.</i> , 2012 ^[46]	16,963	1866	9.08	0.18	458.16	25.04	1.0	0.29
Total	243,526	46,447	2.85	0.40	20.3			

Binary random-effects model: P=0.29; 95% CI=0.40-20.3; Overall OR=2.85. Tests for heterogeneity: Tau²=0.0 (df=3)=0.8 Het. P=0.85; I²=0.0. CI: Confidence interval; OR: Odds ratio; SE: Standard error; PMS: Practice management software

care, and reduction of medical errors as well as negative aspects, such as loss of confidentiality of information and software-related problems, which needs to be solved for their better applicability.^[29]

Theme 2: Indian scenario of practice management software system usage

Our meta-analysis found that the magnitude of effect of PMS usage on Indian physicians ranges between 10% and 45% as

per meta-analysis results [Table 3, Figures 1 and 2]; which is somewhat higher than the reports by major physician office software company in India like PRACTO, which reported that only 40,000 doctors out of total 840,000 registered physicians used this software despite its good publicity, revealing a low usage prevalence of PMS nearly 5%.^[42] Our systematic-review has also found that Indian scenario is very heterogeneous with patchy efforts in the direction of PMS system implementation, with some impinging key issues and examples as given below:

- Many experts now feel that in India “online consultation and e-prescription” can become a routine way of health consultation, as around 80% Indian physicians are using Internet via tablets and mobiles.^[40] This can be an indicator for possibility of faster penetration of PMS system in Indian physicians’ office so, online and digital health care programs built on latest technology and supported by experienced health experts and engineers can dent Indian health care status in a positive way^[9,40-42]
- Demand for PMS in India is predominantly driven from the major metro-cities and penetration of these kind of software in smaller cities/town/rural areas has remained low due to lack of the affordability, accessibility, awareness and availability of GPs and even physicians.^[9,40-42] hat is required and suggested in India is provision of structured computer and IT training for medical (MBBS) students; which can equip them with skills they need as future physicians, as an essential strategy for improving the quality of medical and health care as per study suggestions of Chudasama *et al*^[45]
- Although “there are inevitable difficulties associated with the introduction of new systems and technologies,” according to Sathyamurthy, which has also been suggested by Bagchi in India, where it has been found that even new computer systems introduction had difficulties, these need to be overcome on urgent basis in their study on telemedicine.^[50] But there is no need to lose hope as new emerging technologies such as-cloud computing can also be an answer, with which the doctors can keep their information

about their critical diseases, critical cases and sophisticated problem they phase as per the study of Tejaswi *et al*.^[31] Studies now indicate that the even medical libraries in India such as in Karnataka have used different kind of software Packages in mainly from the commercial market packages^[51]

- Most GPs in India want software to make better the quality of practice in both clinical and administrative areas. But most of the medical software available in India follow the western module pattern. The following benefits are clearly evident as per EHR Indian committee (2013) reports and many other studies:^[9,40-42]
 - It makes the patient’s health information available when and where it is needed
 - It enables clinicians secure access to information needed to support high quality and efficient care
 - It can give a patient’s total health information together to support better health care decisions, and coordinated care.

Some key Indian examples

- The DEMR is appearing to be an effective information management tool in Indian setups; with the potential to improve diabetes care and research, as it was found to help well in tracking diabetes care as per study suggestions of Pradeepa *et al.* in Chennai (India)^[10]
- Project Study of Malhotra *et al.* in Chandigarh, India reveals that telepsychiatry application project software has reliability and validity in diagnostic processes in adults, with future hope of promising results, opening a new paradigm in health care delivery in area of psychiatry^[30]
- Study of Anand *et al.* on child health improvement through computer automation – a pediatric clinical decision support system has found that; by automating the process of screening and alerting the physician to those who screened positive, had significantly decreased the burden of identifying relevant guidelines and screening of patient families in physician clinics^[46]

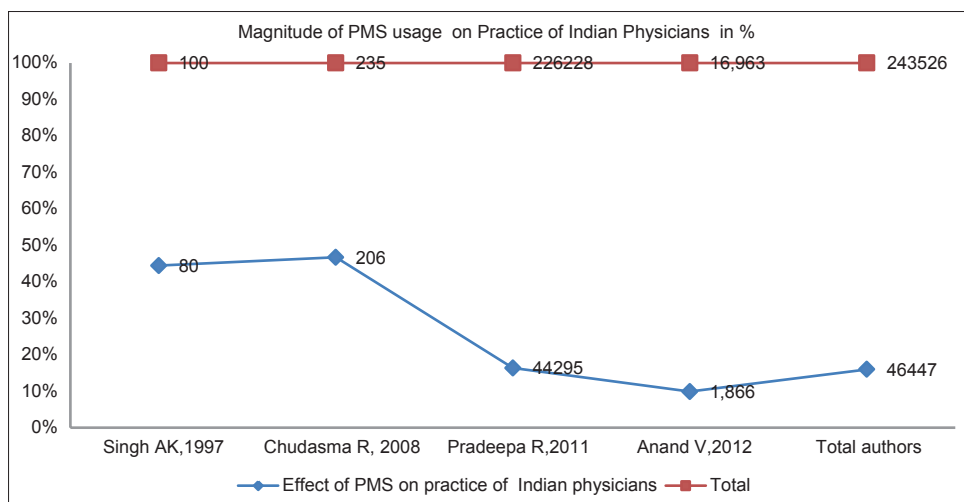


Figure 1: Studies revealing magnitude of practice management software usage on practice of Indian physicians

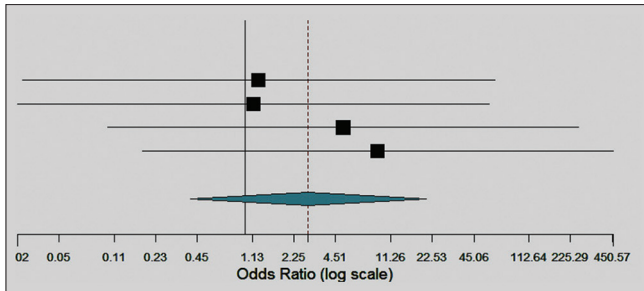


Figure 2: Forest plot showing pooled effect size of practice management software usage on Indians physicians practice

- The data from multiple imaging modalities for radiotherapy planning can be well-achieved by image registration software and these can be easily implemented as well as easy to use for image processing suitable for radiotherapy planning as found in study by Rajasekar *et al.*^[32]
- Receiver operating characteristic curve is a kind of plot which shows the compromise between the sensitivity and (1-specificity) across a series of cut-off points when the diagnostic test is continuous or on ordinal scale and this has been performed well by medical software as noted in study by Kumar and Indrayan^[33]
- Health workers and doctors with knowledge of computers and software need interaction and learning with software engineers for the workflow and clinical evaluation processes for development of efficient rheumatology-specific EMR application, as found in the study by Malaviya and Gogia^[34]
- Computerized medical practice is now becoming a new trend in India through new software such as doctors desktop^[52]
- In genetics-in order to efficiently handle the large amounts of genotypic data generated and to maintain quality control, study of Jayashree *et al.* revealed that laboratory information management system can be useful in the management of microsatellite genotype data in a moderately high throughput genotyping laboratory.^[35] Another study on creation of a complete database of simple sequence repeats present in the expressed sequence tags of human genome; various bioinformatics tools, databases, and software were developed by Kumar *et al.* and found that database can provide comprehensive information of human genome^[36]
- Aggarwal *et al.* had developed a user-friendly software for uniform and complete data entry for fiberoptic bronchoscopic procedures. They observed that this database component evaluated in 1000 consecutive records entered in 1 year 2 months with no discrepancies^[37]
- Information generated by the MCHS software for primary health care system; as found in study of Singh *et al.* was found to act as a catalyst for behavioral change in the community from indifferent users to active users of the health care services.^[44] In economic terms, another study by same author in 1992 earlier had already found that costs for a fully immunized child are reduced with reduction of dropouts; thus, the computer system contributes to quality assurance and cost effectiveness in delivery of care^[53]

- Study of Bhambhani *et al.* has found that there is endless scope of digitization and technology in prosthodontics areas such as stereo lithography, rapid prototyping, use of virtual articulators and digital face bows, digital radiographs, or in the field of training, education and research by the use of virtual patient programs, dental software^[38]
- The medical record keeping practice needs to develop into a proper process in the large number of smaller clinics and hospitals that cater to a large section of the people in India and for this PMS can be a good answer, which can maintain all kinds of records in a better way.^[54]

Theme 3: Categories of medical software available in India

Medical informatics actually has now emerged as a solution to the practical problems of clinics, nursing homes and hospitals for which following key drivers in India are operating, such as: (a) EHR/EMR; (b) Medical PMS.^[9] From our systematic-review, we found that many categories of medical software in India are available with wide choices. [Table 2] For the efficient management of physician practice, there are nearly 375 medical software suppliers from India, and most of them focus on better patient care as their principal objective.^[9,40-43]

Theme 4: Issues of nonpopularity of medical software in India

Developing nations like India despite facing the acute shortage of doctors in rural areas, have an opportunity of medical diagnostic software availability as a surrogate for qualified medical-practitioners as per the study findings of Arora.^[55] The medical software in India however needs to be more physician friendly and customizable.^[56] Many IT experts and doctors have found some of the key issues for slow penetration of this industry in India despite their potential benefits as seen in our systematic-review as given below:^[9,40-42,55-57]

- Physicians are less IT savvy-so not willing to invest in buying and learning new technology
- Most physicians are old fashioned-not like to invest in computer software.

Conclusion

In the current era of paper-based medical records in developing world, often invaluable data are not available at the right time for physicians to permit better quality health care. Medical PMS can improve doctor's clinical workflow efficiency. The current market for PMS and EMR for doctors is on the verge of explosion in India. It is now possible with such kind of PMS systems in to ensure the availability of the right information at the right time for better and improved clinical decisions; provided barriers in their usage are well taken care off, especially in developing countries like India as compared to physicians of other developing word where its application needs further momentum. Hence, authors suggest that more in-depth studies in the future with larger sample sizes in this field especially in

developing countries; on this upcoming health care technologies, for better patient outcomes.

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