A Review On Decision Support Methods For Hospital Based Nurse Practitioners

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Abstract: The aim of healthcare sector is to provide safe, efficient, and high- quality patient care in a cost-effective way. Thus, automated systems are in demand for clinical as well as administrative purposes. Clinical decision support system (CDSS) is such an automated application that analyses data, to help clinicians in making decisions for improving patient care. People know that, nurses are the assisted service providers to in-patients and emergency care units in every hospital or clinical department. In spite of a pretty big work and working hours, nurses have to take decisions some times during doctor's absence. Lack of nursing expertise during their preliminary career stages or physical tiredness due to overwork, many times wrong decisions would be made from nurse's end. As they are the direct contact point for every in-patient, development of specific decision support systems for nurses is highly relevant. Even though many CDSS have been created for doctors, now developed countries are promoting researchers for investigating and designing nurse's decision support system (NDSS). That awareness about the need and application of specific NDSS in India, is the motivation of our ongoing research work. Designing specific NDSS could improve the nurse's service, and thus socio economic importance. This paper mainly focuses on existing decision support system for nurses from previous 7 years, and to review about it. The research objective is to, solve specific barriers by investigating on advanced-applied intelligence techniques. Thus in the coming future, we would be able to develop specific NDSS on real data with the help of domain experts.

Keywords—CDSS; Nurse practitioners; Clinicians

I. INTRODUCTION

Now a day the main focus of health care industry is, to adopt modern technologies for providing best care to their patients or customers. One of the technologies is the clinical decision support system (cdss) which assist the clinicians in their work. Assistance may be in the form of : (1)confirming about the decisions that they have taken like asking to a second opinion, (2) giving steps to take a final clinical decisions, (3) alerting about a patient's state, (4) giving treatment recommendation, (5) survival analysis for giving specific medicines, etc. Assist systems are mostly made using artificial intelligence technology. Clinical decision support is a technology to find meaningful information for clinical decisions and distribute the best possible patient care to the patients. Cdss consist of a medical expert knowledge, patient data, inference engine and the case specific advice. The medical knowledge consists of some rules which is related to disease, symptoms, drugs, dosage etc. The patient data consist of the current details & history of patients i.e., the complete records of the patient. Using the medical knowledge, patient details are analysed and make a decision or future prediction drawing from the inference engine. In the case specific advice phase the system gives a suitable advice for the clinicians and which leads to possible patient care. Decision support can be paper-based, but computerised systems have the technological advancement of fast processing and can give useful information which maps to computerised decision rules or algorithms the cds systems and nurses play a vital role in the hospital settings and also it helps for giving better patient care. The nurse practitioners also use the cds system in the care of any emergency situations take place in the hospital, most of the time they take advice from the doctors through calls. But this may take long time and a lag occurs for giving care to the patients. For handling these emergency situations the cds system will help nurses. This research work focus on the nurses in the hospital for utilizing the clinical decision support system in the case of emergencies and eliminating the existing barriers of handling the cds system of the nurses[1][3][6][18].

II. Literature review

This section discusses various existing decision support systems based on review of literature. The survey is based on the studies conducted from 2011-2017 focusing on the nurses for using the cds systems. The researchers identified certain barriers for the nurses in the hospital for utilizing the cds system. Having accurate information including updated evidence-based practice guidelines, accurate clinical pathways, and existing clinical algorithms, were the most common barriers [18].

Smith and colleagues (2011)did a qualitative analysis to reduce gastrointestinal events caused by non-steroidal anti-inflammatory drugs using a risk assessment cds calculator. Their study focused on nurses and the healthcare cost and utilization

project inpatient database. The researchers examined the two barriers :missing information of patients in the electronic health record ,nurses cannot handle the risk assessment calcualator they donot have any awareness about that[16]. There was no study taken place in 2012 related to the cds system focusing on the nurses.

Stanik-hutt (2013) did a systematic review were that nurse practitioners deliver safe and effective care to the patients and the nurses use hospital technology along with cds systems to provide better care for the patients who is admitted in the hospital. This paper also discusses the pros and corns of using cds technology, its demand is effectively increasing in the health care industry [5].

Ariosto's (2014) did a quantitative analysis on cds alerts based on the opiate allergies in a medical centre. They did this study on in patients in the hospital. The researchers explained four barriers for effectively understanding the cds alerts: first, the unnecessary alerting of the cds was very high thus it leads to cause nuisance in the care unit and high overlapping alert rates, the second barrier is the existing cds system set up is not suitable for the opiate allergy alerts, the existing decision support algorithm cannot defined the opiate allergy alert., another barrier described was unnecessary data intake and inefficient patient information in the electronic health record[9]. Benson and colleagues conducted a quantitative study. Their study involves some nurse practitioners and they analysed how a nurse can handle the patients in hospital not for 1:1 ratio. This study takes place at a 350-bed teaching hospital. The study method was a pre and post implementation survey comparison focusing on cds database queries to identify sepsis[18]. The researchers identified two barriers to cds: the lack of information about the patients for doing their work in the records. The cds algorithm not supporting current evidence-based practice as outlined in the surviving sepsis guidelines [10].

Knoble and Bhusal(2015) coordinate a qualitative study based on CDS electronic algorithms by means of mobile technology. The sample targeted nurse practitioners in a multiple domain hospital setting in Nepal. The authors identified four barriers: During implementation software errors occur in the CDS algorithms, an application error, hardware technical issues in using some buttons in the system, unreliable battery life, which prevent the use of CDS system[15]. Miller and colleagues(2015) a meta synthesis qualitative studies focused nurse practitioners giving direct patient care in inpatient and outpatient settings. The authors examined the barriers of integrating CDS into clinical work. The meta synthesis identified five barriers: how to use the system, lack of knowledge integration between the electronic health record and the CDS system,CDS algorithm is not properly defined, lack of interoperability, Patient safety.[17].

Different experiment trial done by Eldredge (2016) involved 23 providers in an urban area, including seven nurse practitioners, which focused on effective use of CDS at the point of care. Many trial survey was developed for data collection. The output of these trial identified two barriers to adoption: lack of training with the CDS tool, lack of time to use the tool at the point of care[11]. Oh and colleagues conducted a trial to study to understand the CDS text-based electronic alerts based on acute kidney injury. The research occurred in the hospital setting and the blended sampling (98 participants) included nine midlevel practitioners. The researchers identified four barriers: alert error, delay for alerting caused lack of timeline, lack of ability to target alerts to specific groups.De Wit and colleagues (2016) conducted a qualitative, pharmacy-led study to examine drug-related and medication-error CDS alerts. The study took place in a dutch hospital setting with a blended sample that included nurse practitioners [14]. They found five barriers to cds-generated alerts: error in alert giving, cds content is not in a proper format, inaccuracy in cds , reliance on manual input of patient details, and inappropriate timing of the cds alert notifications

Based on the above nine studies Osheroff (2017) has provided the necessary framework to successfully design and implement CDS systems. Table 1 defines all the barriers of nurses for using CDS system, and the summarized form of all the reviews are shown in Table 2. The framework, also known as the CDS Five Right[18][19].

- Right information

- Right people

- Right format

- Right channel

- Right time

The CDS right information includes clinical knowledge, evidence-based practice guidelines, clinical pathways, and clinical algorithms. The CDS right people considers the people who need information for clinical decision making and consists of physicians, nurse practitioners, nurses, pharmacists, clinical staff, and patients. The CDS right format describes decision sup- port interventions, such as alerts, data, prompts, order sets, and informational buttons. The design and implementation of decision support through the CDS right channels incorporates the Internet, electronic health records, patient portals, workstations, and

mobile technology systems. Finally, the CDS right time pinpoints the timing of CDS in the workflow along with the right time to guide key decisions or actions. Use of the CDS Five Rights framework can assist in determining optimal CDS system utilization, as well as identifying barriers to use[6][18][19].

Identified Barriers
Unnecessary alerts/CDS alerts
Undefined Format
Unsupported CDS algorithms
Lack of patience information
Unfavorable timing of CDS
Unaware about the System
No knowledge about the System
Unsuitable CDS
Trust on manual input
Wrong CDS format
Problems in system hardware
Usability
Lack of interoperability

Table 1: common barriers of nurses for using cds system

III. WORK PLAN

This section explains the process concept of our proposed NDSS using advanced machine learning systems. Design and development of such system will be conducted in 5 different phases.

1.   Knowledge acquisition-

The research work started with gathering of domain knowledge from medical experts including nurses. Individual meetings, group elicitation, literature review etc are the planned acquisition methods. Knowledge acquisition was done in Manak Hospital, Kerala. Doctors and nurses were interviewed after making them aware the need of such system in Kerala. Existing decision support methods will be reviewed and documented regularly, while one phase of reviews has already been over. Knowledge acquisition and Data collection helped the authors to select experimental data and departments (Gastroenterology and Urology) for the pilot study. Thus this phase has been completed.

2.   Dataset creation-

Based on the pilot study, attributes for the data collection will be fixed in consultation with medical domain experts. This would help to design the schema of dataset correctly. Then data will be collected to create a dataset for experiments. This will be cleaned after duplicate and null value deletion, noise removal, outlier detection, missing data identification and normalization. The cleaned data will be formatted based on the schema, which would be suitable for any machine learning algorithm.

3. Review of decision support systems –

 Advanced soft computing methods especially machine learning will be studied, as it has already proven its success in different domains. Suitable algorithms will be selected to make models of NDSS.

4. Training & Testing- An advanced soft computing based decision support system will be built based on the cross validation training on collected dataset. Hyper parameters will be tuned and best suitable model will be selected, to be used as decision support system for nurses for the above selected departments. Generalization testing will be done to confirm the performance stability of the system.

IV. CONCLUSION

Health information technology is increasing day by day due to vast number of ongoing research in that area .this work is mainly focused on applied artificial intelligence for nursing informatics in the hospital. During emergency cases, nurses need take necessary actions in the absence of doctors for a better patient care. In that situation, a system which assists the nurses by providing right information at right time will help them so the cds play a role at the point of patient care. The nurse practitioners faces some barriers for utilizing the existing cdss in hospital. The objective of this work is to solve all these barriers by making an efficient

cdss for nurse practitioners. The existing barriers can be solved by applying advanced soft computing methods or suitable machine learning algorithms.

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APPENDIX

YEAR	AUTHORS	STUDY	FINDINGS/BARRIERS
2011	Smith and Colleagues [16]	Qualitative analysis of an effort to minimize gastrointestinal events caused by non-steroidal anti-inflammatory drugs using a risk assessment CDS calculator. The study focused on nurse practitioners	• Incomplete patient information. • Nurse practitioner lack of knowledge about of the risk assessment calculator
2013	Stanik-Hutt [4]	The conclusions of a Systematic review for nurse practitioners	Nurse practitioners use hospital technology along with CDS systems to deliver high-quality, safe care during all phases of the patient's hospital stay.
2015	Ariosto's [9]	Quantitative analysis examined CDS alerts related to opiate allergies in an inpatient hospital academic medical centre. The sample include 15.4% nurse practitioners.	• High number of insignificant and inappropriate alerts . • Fully utilizing CDS was the incorrect system setup of allergy alerts in the electronic health record. • The decision support algorithm used to explain opiate allergies was improperly defined. • Inappropriate data intake and inaccurate patient information in the electronic health record
2015	Knoble and Bhusal [15]	Qualitative research studying CDS electronic algorithms by means of mobile technology. The study targeted nurse practitioners in a heterogeneous setting included in hospital.	• Software flaws in the CDS algorithms. • An application error. • Hardware technical challenges including inadequate touch technology.

			• Unreliable battery life, which obstructed use of the CDS system
2015	Miller and Colleagues [17]	Qualitative studies included nurse practitioners providing direct patient care in inpatient and outpatient settings	• Usability and user interface challenges • Lack of integration between the electronic health record and the CDS system, • Immature CDS algorithms • Lack of interoperability
2016	Eldredge [11]	A randomized controlled trial in an urban area including seven nurse practitioners. Study focused CDS utilization at the point of care	• Lack of training with the CDS tool • Lack of time to use the tool at the point of care
2016	Oh and Colleagues [12]	A randomized controlled trial to study CDS text-based electronic alerts focusing on acute kidney injury.	• Alert fatigue • Delayed alerting resulting in lack of timelines • Lack of ability to target alerts to specific groups
2016	De Wit and Colleagues [14]	A qualitative pharmacy led study to examine the drug related and medication error CDS alerts	• Alert fatigue • Incorrect CDS content • CDS inefficiencies • Reliance or manual input of patient details • Inappropriate timing of CDS alert notification

Table 2: Summary of review