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A Historical Research Study of the Factors that Influence the adoption of Medical Decision Support Systems (MDSS)

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***Abstract*— Implementations of MDSSs have been shown to reduce practice variability and improve outcomes. Over the last few years, the evolution in decision-making systems is proceeding with an extension of knowledge and the decisional processes underlying this knowledge. Best practice must be an organizational and process oriented concept to achieve adoption and consequently outcome improvements. The first step in how decision support systems can be re-examined and improved may be with incorporating new and unambiguous knowledge with a clear scientific reference. Evaluating these improved systems implies evaluating physicians' adoption, compliance with guidelines, and impact on outcomes. A second important building block is to adopt clear medical concepts and classifications. Because the use of medical data for cooperative care is necessary to improve the quality of care, the patient-centered electronic health care documentation is needed. The study covered over 100 researches conducted in the field of Medical Decision Support system (MDSS). However, the research was not limited to simply MDSS. The field of MDSS has evolved out of Information technology and medical informatics. The key concepts relating to current MDSS systems were developed and presented in the literature prior 1976. But the most monumental research was conducted by Miller (1994) and his study acts as the foundational study for this research.**

***Index Terms*— Medical Decision Support system (MDSS), Historical evolution of MDSS, Computer Techniques in Medical Practice, Drug discovery.**

I. INTRODUCTION

This study employs the historical research to collect necessary information relating to developments in MDSS. The purpose of this study is mainly descriptive, aiming to understand some specific development in a particular period of time in a particular culture relating to MDSS. A historical investigation is conducted with objectivity and the desire to minimize bias, distortion and prejudice. Thus, it is similar to descriptive method of research in this aspect. As discussed in the previous chapter, there are four steps to historical research and they were adopted in this study as well. The study was initiated by first identifying MDSS as the key problem of investigation. A through literature review was conducted to understand the concept and its related issues. Based on the primary and secondary sources, key developments in MDSS are identified and evaluated. Then, the information is used to provide a summary of the developments as well as to present with further research possibilities.

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II. DATA ANALYSIS

The results of the study provide an insightful answer to the key research question. The research question of the study is: What are the factors that influence the adoption of medical Decision Support Systems (MDSS)?

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Medical Decision Support Systems, also known as clinical decision support systems have come a long way since its first use in the early 1950s. They have been hailed for their potential to significantly reduce medical errors and increase healthcare quality and efficiency. Medical decision support systems (MDSS) play an increasingly important role in medical practice. By assisting physicians with making clinical decisions, MDSS are expected to improve the quality of medical care. With introduction of probabilistic multi-dimensional techniques in Computer Science, the development of decision support systems in medical informatics field is common now (Moole & Korrapati, 2003, 2004). Computerized Artificial Intelligence Techniques have been discovered to assist in MDSS (Korrapati, 2000; Korrapati, 2005; Tadavarthi & Korrapati, 2017, Kapu & Korrapati, 2017).

Currently, most MDSS provide decision support for particular diagnostic or therapeutic tasks such as interpreting pulmonary function tests, analyzing electrocardiograms, or managing the use of anti-infective agents. MDSS can help physicians to organize, store, and apply the exploding amount of medical knowledge. They are expected to improve the quality of care by providing more accurate, effective, and reliable diagnoses and treatments, and by avoiding errors due to physicians' insufficient knowledge. Evaluation studies demonstrate that MDSS can have a positive effect on clinician performance and patient outcomes. In addition, MDSS can decrease healthcare costs by providing a more specific and faster diagnosis, by processing drug prescriptions more efficiently, and by reducing the need for specialist consultations. However, the performance of MDSS is subject to some important limitations and their inappropriate use or malfunctioning might adversely affect the well-being of the patient. Some MDSS fail to achieve the same level of diagnostic performance as human experts. This raises the ethical question: How can we design and use MDSS in a way

that maximizes the benefits and minimizes the risks for the patients?

While several authors have previously addressed ethical issues arising with the application of MDSS, there is still no consensus on the ethically appropriate use of these systems. Based on a review and synthesis of previous relevant work, I will propose a comprehensive, yet certainly not exhaustive, set of recommendations for the ethical development and use of MDSS.

The suggested recommendations will require further discussion and elaboration among computer specialists, vendors of MDSS, healthcare professionals, bioethicists, regulatory agencies, and the public. Professional societies should take the lead in this process, and the "Summary Recommendations for Responsible Monitoring and Regulation of Clinical Software Systems" is certainly one important step in the right direction. In addition, any set of ethical or policy recommendations will need continuous updating to keep pace with the technologic progress: New systems with new applications will pose new ethical concerns that will call for a modification or extension of the proposed recommendations.

Implementations of MDSSs have been shown to reduce practice variability and improve outcomes. Over the last few years, the evolution in decision-making systems is proceeding with an extension of knowledge and the decisional processes underlying this knowledge. Best practice must be an organizational and process oriented concept to achieve adoption and consequently outcome improvements. The first step in how decision support systems can be re-examined and improved may be with incorporating new and unambiguous knowledge with a clear scientific reference. Evaluating these improved systems implies evaluating physicians' adoption, compliance with guidelines, and impact on outcomes. A second important building block is to adopt clear medical concepts and classifications. Because the use of medical data for cooperative care is necessary to improve the quality of care, the patient-centered electronic health care documentation is needed.

III. RESULTS

Through this study, we concluded that there are a few factors that influence the adoption of medical decision support systems in today's medical practice.

1. Medical Knowledge and Decision-making Modeling

Modern medicine is under the influence of the 'evidence-based medicine (EBM)' and 'patient-centered medicine' paradigms. 'Evidence-based' practice is 'disease-' rather than 'patient-' oriented. Sweeney observed that evidence-based medicine is essentially a doctor-oriented approach because it focuses on the doctor's interpretation of the evidence (Sweeney et.al, 1998). Also, in this approach, the uniqueness of patients, their individual needs and preferences are ignored as relevant decision-making factors.

2. Role of Evidence-Based Medicine (EBM) in development of MDSS

The evidence based medicine paradigm leaves little room for tacit, personal, background-related and difficult to formalize knowledge (Nonaka, 1994). The development of a 'quantitative' medicine beyond decision-making support systems demonstrates that this tacit knowledge is being ignored and this is a serious problem because this knowledge, after a suitable assessment, could require a formalization to be easily shared. This knowledge comes from personal experience in using, adapting and evaluating explicit knowledge, which is being used in practice. This is an important point in the knowledge creation process underlined by Nonaka (1994).

Numerous decision support systems are based on knowledge provided by human experts. This includes clinical research knowledge as well as empirical knowledge translating the experience of experts. However, this knowledge and the manner by which it has been acquired is not clearly identified or expressed in those systems. As a result, the 'gold standard' is poorly defined and experts' opinions remain the reference.

The EBM paradigm opened a fundamental debate regarding medical practice and decision. It raised questions regarding the validity of the evidence applied to qualify knowledge in the decisions being made. Consequently, EBM is becoming an essential source of knowledge for the development of medical decision support systems because

- It is the proper type of information and knowledge, how it is expressed and sought. Expert knowledge is not the most significant type of knowledge in this paradigm.
- It answers the search for a gold standard that is lacking to validate expert systems' knowledge and opinions. The literature, the results it provides and the associated meta-analyses are erected as standards and generate good practice guidelines.
- It has the ability to explain decision-making systems in a way that is accepted by physicians (Teach and Shortliffe, 1981).

3. Clinical Practice Guidelines (CPGs)

Clinical Practice Guidelines (CPGs) are more likely to be evidence-based. They aim at improving clinical medicine as quality assurance instruments. The objectivity being sought by CPGs also induces normative approaches that need to be controlled, otherwise ethics will change, physician-patients relations will be altered, and undesirable results may be produced. The number of CPGs has been increasing dramatically worldwide since the nineties. The methodology required for implementation and use of guidelines must be discussed. The quality of a decision is dependent upon the appreciation of the correctness of those actions undertaken by the decision-maker from a given model and in accordance with reality as he/she sees it. Decision analysis allows for rational and critical discussions, in particular, the dogmatic application of intuition.

4. Collaborative medical practice

Furthermore, improving the quality as well as the continuity and coordination of care is requiring networking medical practice, which has the favors of governments and social security agencies. The resulting organizational environments are both more complex and global. Internet technologies are available to provide those environments

including group support systems and computer-mediated communication systems.

5. Shared decision-making: End-users involvement

Health professionals should be aware of the fact that their patients' expectations are changing. Patient's choices and assessments of the 'usefulness' of a given therapy also need to be taken into account. What is considered as a satisfactory or acceptable situation by some may well be intolerable to others. Physicians must be increasingly careful about integrating patient preferences into medical decision processes. Accessing medical decision support system tools on the Internet (e.g., individual risk assessments, search for drug interactions, prognosis computations) can help patient better understand their condition or formalize their expectations.

IV. SUMMARY

The challenge for the future is to use information technologies that bring together these separate, "evidence-based medicine" and "patient-centered medicine" approaches. Ensuring that a decision support system meets the physician's needs means understanding the environment into which this system operates and the factors making up this environment. Future decision support systems should boost this integration-enhancing knowledge access and management and making care more patient-centered. Further research possibilities to include developing Decision Support Systems using newest techniques such as Machine Learning and Artificial Neural Networks.

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