

Short Communication

Artificial Intelligence Research in Primary Care Management

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ABSTRACT

Purpose: The purpose of this article is to review and integrate best research evidence in improving primary care and management with the assistance of artificial intelligence (AI) designed from a theoretically informed and empirically validated framework.

Methods: This is a review article to document the AI evolution in population health and management. The analytical framework is a transdisciplinary perspective. The processes for conducting a systematic review with meta-analysis are noted.

Results: The challenges in implementing and evaluating AI applications in primary care are identified from a systems approach, consisting of the contextual, design, performance and outcomes-of-care components.

Conclusion: The utility of applying transdisciplinary perspectives in AI research for primary care can be further demonstrated through innovative designs and applications of automation and artificial intelligence.

Keywords: Artificial intelligence research; Trans disciplinary approach; Meta-analysis; Population health management.

Introduction

Evidence-based practice (EBP) in population health has been well-articulated by the seminal work of Sackett et al. and Gray et al. [1,2]. To date management of population health or population health management is oriented toward patient-centric care in advocating self-efficacy or patient choice, particularly relevant to chronic conditions [3]. The purpose of this article is to review and integrate best research evidence in improving primary care and management with the assistance of Artificial Intelligence (AI) designed from a theoretically informed and empirically validated framework. More specifically, research strategies are needed to employ "big data", generate scientific knowledge, and guide decisions about personal care or policy formulations for promoting population health.

Evolution of artificial intelligence in healthcare

With the advancement in computer technology and knowledge management tools, healthcare professionals are able to develop and validate decision support systems to optimize the effectiveness and efficiency of the delivery system. The scope of AI applications in population health is evolving from employing the tabletop exercise software for identifying strengths and weaknesses in preparation and management of medical disasters [4] to reconfiguring care management protocols or strategies at the personal and/or population level [3]. The continuing growth of AI applications is unlimited with a projected estimate of more than $100 billion in the next two decades.

Careful review of the empirical work and development in healthcare AI reveals that there is a critical concern about the lack of substantive theories in supporting how meta data are analytically structured or used to generate consistent and replicable research evidence. For instance, it is well understood in the industrial engineering field that human factors are relevant and pertinent to improve functionalities of decision support system. In fact, human factors such as patient-centered care, perceptions of care rendered, and motivations to change health attitudes and behaviors emerge as dominant forces for shaping value-based payment strategies in the United States.

Challenges in adopting research strategies

To advance our theoretical and critical thinking in AI applications it is imperative to fine-tune theoretical foundations of each AI product used or to be developed in healthcare. For example, research in diabetes care could adopt a transdisciplinary perspective to postulate that care outcomes (O) are influenced by a multitude of personal factors such as the Knowledge (K), Motivation (M), Attitude (A), and Preventive practice (P) within the context of varying cultural and community influences. In short, this is called a KMAP-O model for diabetes control in varying communities [5].

Evidence-based practice is "doing the right thing right for the first time". In other words, we need to demonstrate "what's the proof" in adopting the right strategies for optimizing healthcare outcomes. Four challenges are noted as follows:

1. Identifying contextual or ecological correlates of health: We need to expand the conventional wisdom in defining health or wellbeing of the population by including environmental wellbeing. This is particularly important when healthy communities are being built.

2. Designing strategies responsive to human and organizational needs: Innovative care modalities or healthcare plans need to be designed that can fulfill human and organizational needs.

3. Employing performance appraisal or value-based assessment of care strategies or processes: In order to maximize patient and population health outcomes, one has to pay greater attention to performance evaluation. The evaluation criteria for organizational effectiveness in delivery primary care services should include a set of quantifiable standards such as the measures of personal care and technical quality, technical efficiency, and applicability to optimize population health.

4. Defining and specifying patient-centered care outcomes: Measurable patient care outcomes and their benchmarks should be used to assess the performance of primary care providers in terms to accessibility, quality, and cost. The Patient-Centered Outcomes Research Institute (PCORI) [6] plays a very important role in helping people make informed decisions and improving healthcare delivery and outcomes, by producing and promoting high-integrity, evidence-based information that comes from research guided by patients, caregivers, and the broader healthcare community.

Systematic review with meta-analysis

In the search for causal mechanisms for enhancing patient care outcomes, a systematic review with meta-analysis for diabetes care is suggested to document moderating effects of varying chronic care management principles involving with human factors influencing hospital readmission of diabetes with hypoglycemia (HG). The systematic review of care intervention strategies may include a broad range of intervention types aimed at reducing diabetes readmissions. The selected intervention components should include: personal choice, motivational therapy, education and assessment, rest and relaxation, exercise, interpersonal relationships, outlook, and dietary/nutritional recommendations. This systematic review and meta-analysis aim to generate empirical knowledge and research answers for following inquiries:

- Is there evidence that particular human-factor interventions may modify the care management effects on hospital readmission for diabetes with HG?
- Does a single human-factor intervention function more effectively than a combination of specific interventions in care management for diabetes patients with HG?
- How can the knowledge gained from the systematic review and meta-analysis be applied in population health management for diabetes?

Procedures for systematic review: Before launching meta-analysis of hospital readmissions for diabetes with HG, a systematic review of the current and past scientific trials on diabetes care should be performed in five steps to:

- Define the key words for the literature review;
- Formulate inclusion and exclusion criteria for the selection of high-quality research evidences;
- Assess the merits of each study selected;
- Specify the statistical rigor of analysis of results;
- Develop a clear standard of quantifying odds ratios or relative risk scores for each human-factor intervention; and
- Finalize the selection of empirical and clinical trial studies for performing meta-analysis.

Procedures for meta-analysis: Meta-analysis is commonly known as the generation of epidemiology of results. There is varying meta-analysis software available for use. Specific assumptions for modeling made by the investigator may include:

1) A fixed model;

2) A random model; and

3) A mixed model.

The comparability and homogeneity assumptions should be examined in performing statistical computations of odds ratios and their significance tests. It is highly recommended that Review Manager (a comprehensive meta-analysis website) be considered for meta-analysis. A detailed illustration of meta-analysis of human-factor interventions on heart failure readmissions can be found in Wan's Population health management for poly chronic conditions [3]. Furthermore, based on the systematic review and meta-analysis of results, we can attempt to develop a decision support system with the patient-centric orientation. This is similar to the development of an expert system for guiding diabetes patients with HG to avoid hospital readmissions. In other words, a graphic and user interfaced (GUI) decision support software can be developed from empirically validated statistical algorisms [7].

Concluding remarks

Primary care management is a central component of population health. By integrating principles in population health management, primary care providers could identify risk factors for preventive care intervention and chronic care management, deliver integrated and coordinated care, enhance patient engagement and self-care, and adopt functional decision support systems to optimize clinical practices and care outcomes. In conclusion, the utility of applying transdisciplinary perspectives to AI research in primary care can be further demonstrated through innovative designs and applications of automation and artificial intelligence.

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