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RESEARCH ARTICLE

Artificial Intelligence and Creation of an Accessible Clinical Pharmacological Program for Test-takers

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ABSTRACT

A significant increase in approved drugs available for treatment during the past 25 years poses a challenge for medical education and associated testing including licensure exams. It is neither a practical nor responsible goal to have students memorize large volumes of static clinical pharmacologic information e.g., pharmacokinetic data, drug interactions. Provision of an electronic storage device not connected to the internet during formal evaluations is a process that can solve this problem; it also reflects the true matrix of modern medical decision-making regarding pharmacotherapy. Artificial intelligence is not required. Information provided herein proposes how to accomplish this advancement.

Aim: -To encourage support for medical education programs and licensing boards

-To provide test-takers with an electronic storage device containing clinical

-Pharmacological information that can be utilized to arrive at drug therapeutic decisions.

Scope: Healthcare professionals involved in the education of medical students and in their subsequent licensing certifications.

Introduction

A goal in my specialty is to help students learn how to analyze cases and create pharmacologic treatment plans. In this regard, I have recommended creation of a database accessible during medical school and licensure examinations[1-3]. The test-taker will still be required to think about and ultimately make drug therapeutic decisions but *sans* an Artificial Intelligence (AI) program. This would be a good initial phase toward understanding and working with AI-assisted medical decisions in clinical pharmacology.

Prior to delving into specifics of my proposal, I wish to discuss aspects of AI. An excellent review[4] touted its advantages in healthcare:

MEDICAL BENEFITS

- Predicting risks of diseases
- Prevention and control of diseases
- Improvement in data-driven decisions
- Improvement in surgery
- Greater support in mental health

ECONOMIC AND SOCIAL BENEFITS

- reduced post-treatment expenditures
- reduced expenditures by early diagnosis
- increased effective clinical trials
- greater patient empowerment
- relieving workload among medical practitioners

As is well known, major weaknesses of AI are its inadequate protection of personal health data and propensity to manufacture unrelated answers when it cannot find any correct ones (also known as 'AI Hallucinations').

Despite these negative issues, it is imperative to begin to start incorporating it into medical education. A primary reason is that AI utilization within medical practice is occurring at an unexpected rapid rate, becoming a significant aspect for some attendings in managing their patients. Justification is based on many clinical studies showing its clear advantage, e.g., AI identification of critical arrhythmias was determined to be 98.6% accurate compared to 80.3% for technicians[5]. Therefore, allowing our future doctors to consult an electronic storage device for assistance in determining the optimal course of drug therapy when in classroom learning and during exams is necessary for their entrance into the prescribing world. If they have not started, medical schools should begin to develop plans for integration of AI into didactic courses in the first and second years. Not only will this assist future doctors in arriving at the correct plan during this stage of their education, it will prepare them for their clinical rotations where AI is already employed.

At this point, I offer details of my proposal for providing a source of clinical pharmacological information available to test-takers during medical school and licensing exams.

Being involved in teaching health professionals for many decades, I have observed the significant increase in new drugs entering the United States market[1]. In my opinion, it is professional pedagogical malpractice to require medical students to memorize certain clinical pharmacologic data that can be retrieved quickly and accurately from a data source. Therefore, with respect to this topic, here are the data that should be provided:

Interactions

BIOTRANSFORMATION

There are many enzymes involved in drug biotransformation, and more than 100 drugs which are 'inducers' or 'inhibitors.' Certainly, students should know major ones (enzymes and drugs) but should also have a list that they can readily search.

PLASMA PROTEIN BINDING

Few drugs exhibit greater than 80% binding, considered the entry level at which displacement can significantly increase pharmacological actions, from efficacy to toxicity. For some involved in such interactions, e.g., oral anticoagulants, this event can be life-threatening.

HALF-LIVES

Fortunately for management of dosing, most drugs exhibit first-order kinetics (e.g., diazepam) as opposed to zero-order kinetics (e.g., ethanol). The former process allows greater ease and flexibility in adjusting doses, especially when the goal is to create a steady-state level. For chronic conditions such as a seizure disorder requiring 24-hour pharmacotherapy, easily-accessible knowledge of a T½ (e.g., phenytoin) is truly critical.

SPECIFIC POPULATIONS

Although most drugs are approved without restriction for those 18 years of age and older, any dosage changes required for various ages, e.g., geriatric patients, should be readily available.

PRE-EXISTING CONDITIONS

Due to a high rate of first-pass biotransformation, some drugs need to be reduced in dose in the presence of liver disease. For patients with kidney disease who are to receive a drug that is eliminated primarily through the renal system, those doses must be decreased.

ADVERSE REACTIONS

Information related to this aspect of drug therapy – from mild to deadly – should be discussed with patients. Having a ready source of those which are frequently-occurring and life-threatening (even if not very frequent) would be ideal.

GENETICS

This rapidly-emerging aspect of clinical pharmacology is becoming a necessity when planning pharmacotherapy.

How can this be accomplished? The best of source of information in the US is the Federal Drug Administration (FDA) label. This record contains all clinically relevant data submitted to the FDA by a pharmaceutical manufacturer to gain marketing approval for its product. Data can be extracted from such a document without cost. With cooperation from multiple sources, e.g., medical schools, professional societies, a storage system could be constructed. If there were 100 participating institutions

and organizations, each could prepare five drugs. Knowledge of the 500 most prescribed medications would come from such lists published in most countries. While there may be some differences, most clinical pharmacologic information does not differ around the globe, the most likely exception being genetic differences in biotransformation.

The concept would be to simply enter these drug data into the constructed program. Returned information would then include that necessary to allow the optimal decision. Could this be a place for AI beyond just providing targeted information? Yes. However, at this time, I am recommending only creation of a clinical pharmacologic database that will provide important information to the medical student learning how to develop a treatment plan, and when engaged in formal testing.

Whenever I discuss my electronic storage of clinical pharmacologic information proposal for exams and boards with our medical students, I always receive significant enthusiasm with requests to implement it *stat* if possible. It isn't. Curricular change, especially for the first two years of medical school, is designed to be a relatively slow deliberative process with potential input from any committee member, even those outside of the field in which changes are sought. There are only so many hours in the first half of this academic process, and other fields, e.g., immunology, also request increases in their respective teaching hours to cover new relevant material. However, my proposal does not require addition of any teaching hours.

To facilitate its acceptance in medical school, I decided to present my plan to John R. Gimpel, DO, Med, President & CEO, National Board of Osteopathic Medical Examiners (NBOME) for consideration. He approved creation of a 10-question board-style exam as a first step to evaluate this process, and asked Gretta Gross, DO, Med, Executive Vice President for Assessment and Chief Assessment Officer, NBOME, to participate. I sought volunteers at PCOM, and was quickly able to recruit a total of 10 Second- and Third-Year medical students. Accessibility to the targeted drugs would be on a separate drive that the test-takers could access during the procedure. Transitions would not be smooth because of the need to jump from one program (questions) to the other (database) but this is, after all, just the initial phase in development. When this exercise is complete, I will, at the invitation of Drs. Gimpel and Gross, present my results at the NBOME Innovative Workshop in Chicago in August of this year. Various other projects will be presented to this group which will then decide which ones to support for further development. Hopefully, I will receive approval to conduct a larger study which, if successful, could lead to the NBOME including my plan in its licensing exams. If that occurs, it should be possible to gain approval for inclusion in the PCOM curriculum.

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