Use Of Schema-Based Reasoning In Clinical Problem Solving Recommendations From The Patan Academy Of Health Sciences Kathmandu, Nepal

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Citation

B D Thomson. *Use Of Schema-Based Reasoning In Clinical Problem Solving Recommendations From The Patan Academy Of Health Sciences Kathmandu, Nepal*. The Internet Journal of Medical Education. 2014 Volume 4 Number 1.

Abstract

Terms of Reference

This report is in follow up to a Fulbright Specialist Grant to Nepal in 2013 funded by the Bureau of Educational Affairs and Cultural Affairs. The intended audience is professionals and health care organizations who desire to achieve higher diagnostic success in the care of their patients and in so doing possibly decrease patient costs. This audience would include medical students, nurse practitioners, residents, hospitalists, and administrators of Accountable Care Organizations (ACOs) being formed in the United States.

Abstract

Achieving diagnostic success is a core competency for all physicians. 1 How medical students are trained affects how they will practice, especially in their residencies and early clinical years. Young physicians must acquire, store, retrieve and finally apply large chunks of knowledge. To accomplish this goal it is best for these chunks of knowledge to be organized around clinical findings and concepts, case histories and stories. 2 All medical schools integrate clinical cases into the medical curricula of their students to promote the organization of medical content knowledge and to foster diagnostic success in clinical problems. But here medical schools differ. They employ different problem solving strategies for the same or similar cases. The two main reasoning strategies are hypothetical-deductive reasoning and schema-based reasoning. These two strategies are not the same and do not have equivalent outcomes in achieving diagnostic success. As discussed below, novice students tested on clinical cases using schema-based reasoning achieved higher diagnostic success than students given the same test cases who had been taught using hypothetical-deductive reasoning. 2 In the real world environment of limited resources and financial shift of risk to providers, this difference in diagnostic efficiency may prove to be a selective advantage. Health care organizations which provide patient care are continually reviewing the efficiency of their programs. Recommendations from the Patan Academy of Health Sciences (PAHS) in Kathmandu, Nepal, may help professionals evaluate and introduce schema-based reasoning into their clinical programs with the goal of achieving higher odds of diagnostic success.

INTRODUCTION

Published in 1910, the Flexner report precipitated the reorganization of medical education in the United States. 3 It "embraced scientific knowledge and its advancement as the defining ethos of a modern physician. Such an orientation had its origins in the enchantment with German medical education." 4 Medical schools developed a basic sciences first approach. They became standardized at four years with the first two years stressing the basic sciences and the last two years employing clinical rotations in hospitals and out-patient settings. Over time it was realized that the Flexner report had under emphasized the primary role of physicians as beneficial healers. 4 To correct this deficiency and to facilitate the grouping of large chunks of scientific knowledge, medical educators integrated clinical cases into the curricula of medical students' basic science years using either hypothetical-deductive reasoning or schema-based reasoning. This report is based on observations made at the Patan Academy of Health Sciences (PAHS) in Kathmandu, Nepal, in its transition of its medical students from one method of reasoning to the other.

DESCRIPTION OF SETTING AND PROGRAM

In 2013, I was awarded a Fulbright Specialist Grant to assist the Patan Academy of Health Sciences in the transition of its First Batch students during their initial clinical rotations from a hypothetical-deductive reasoning based curriculum to a schema-based reasoning curriculum.

Patan Hospital is located in the Kathmandu Valley of Nepal. It was established in the 1950s under the United Missions to Nepal (UMN) and remained so until its transition to Nepali government responsibility in the 2000s. It has approximately 450 medical-surgical beds and Nepal's only pediatric intensive care unit. In addition to emergency room visits, the staff provides care to almost 320,000 outpatients and 20,000 inpatients every year.

The Patan Academy of Health Sciences evolved out of Patan Hospital and is located on the same campus. All PAHS students are Nepali. Approximately 40 percent have financial support from their local villages in return for a two-year commitment to practice in that village upon completion of their training. The faculty is Nepali, all have Masters degrees, and some have been awarded a Ph.D. PAHS is also supported by a small number of UMN physicians and volunteer international basic scientists and clinicians.

PAHS follows the British model of graduate medical education. Medical students enter after high school for five and one-half years of study. An individual class is called a Batch and is designated by the year in which the group enters medical school rather than the year of graduation. PAHS admitted its First Batch of fifty-five students in 2010. These students received two years of basic sciences education and analyzed clinical cases in small groups using hypothetical-inductive reasoning. The time allocated for these small group sessions was three hours two times per week. In November 2012, in their third year, these students transitioned to the use of scheme-based reasoning in accord with the Clinical Presentation (CP) curriculum that had been developed at the University of Calgary Medical School. All future students at PAHS will follow the same route of transitioning during their third and fourth years.

Dr. Arjun Karki, MD, Vice-Chancellor, explains the reasoning for employing both reasoning methods:

"We saw the worthiness of both approaches and unlike many medical educators we do not consider them as mutually exclusive. We see them complementary to each other. Hence, chose to include both of the methods. In other words, given the inherent culture of our educational system to excessively emphasize on the value of 'memorizing facts' rather than the 'logical reasoning,' we chose PBL (Problem Based Learning, see below) as an antidote to this problem.

On the other hand, CP Curriculum gives the students an insightful perspective as to how to approach patients clinical problems in a more holistic and systematic way. In my opinion, regardless of our resource base, each of these teaching methods brings unique advantages to the educational programs." 5

As discussed below, a major factor not stated by Dr. Karki, MD necessitating this decision was the number of MDs available to teach within the Patan Hospital medical community.

For the purposes of this report I have defined the terms Experts and Beginners as follows. Experts are health care professionals who possess significant medical content knowledge and schema- based reasoning processes. Beginners are health care professionals who possess various degrees of medical content knowledge and who are transitioning to schema-based reasoning. Others have defined "Experts" as qualified specialists practicing their specialty for more than five years and "non-experts" (Beginners) as final year clinical clerks. 6

OBJECTIVE AND STUDY QUESTIONS

The objective of this paper is to answer four questions:

How does hypothetical-deductive reasoning compare with schema-based reasoning as they are used within medical schools'
curricula?

How is the term "scheme" defined within the content of the CP Curriculum?
Does the use of schema increase the odds of achieving diagnostic success?
What are the recommendations for programs to initiate schema-based reasoning in clinical problem solving?

To answer these questions, I evaluated the medical education programs of four medical schools. I have had academic positions at three of the medical schools and visited the fourth, the University of Calgary. (See Appendix)

ANSWERING OF STUDY QUESTIONS

How does hypothetical-deductive reasoning and schema-based reasoning differ as used in various medical school curricula?

There are two major differences between the two approaches; objectives are handled differently and clinical cases are analyzed
differently.

Objectives are handled
differently

In a hypothetical-deductive reasoning curriculum, a basic scientist or physician introduces a single clinical case to a small group of medical students applying the chief complaint, history of the present illness, review of systems, physical examination, laboratory, etc. format. Throughout the presentation of the case the students are asked, "What are your differential diagnoses at this time?" Eventually, there remains a single diagnosis or a set of correct diagnoses. At the initial meeting, students develop learning objectives based on the case, but they are not given the learning objectives developed by the faculty. The facilitator assures that the students' objectives include all of the ones developed by the faculty. Over the next several days the students receive lectures, podcasts, laboratories, etc. explaining and examining the learning objectives. At the conclusion of the week the students give presentations back to the group based on the objectives.

Various curricula employing hypothetical-deductive reasoning evolved and were given names to include Systems Based Curriculum (Case-Western Reserve , Cleveland, Ohio, 1950s), Case Based Instruction (CBI) and Problem Based Learning (PBL, McMaster University, Hamilton, Canada, 1970s). With the introduction of PBL, the philosophy of medical education changed. Knowing factual material was considered of secondary importance, and the ability to solve medical problems became the primary goal of medical education.

As discussed below, in a response to have Beginners think more like Experts, schema-based reasoning was introduced at the University of Calgary Medical School in 1994. A physician expert presents to the whole class one of the 124 schemes. The learning objectives for the week are discussed and given to the students. Over the next several days the students receive lectures, podcasts, laboratories, etc. explaining and examining the learning objectives. At the conclusion of the week, multiple cases are presented to small groups of eight students who discuss and explore the multiple pathways of that scheme.

Clinical cases are analyzed
differently

Hypothetical-deductive reasoning is a process whereby clinicians formulate and test hypotheses in a sequential fashion, listing all of the possibilities and eliminating each one in turn by history, physical, laboratory, imaging studies, incidence rates, etc.7

Schema-based reasoning is an inductive reasoning process in which key clinical features are used to include or exclude sets of possibilities. This method of reasoning was combined with patho-physiological principles and organized into diagnostic schemes to form the basis of the Clinical Presentation (CP) Curriculum.
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How is the term "scheme" applied within the content of the CP Curriculum?

In the 1980s, Dr. Henry Mandin M.D. posed a simple question, "How can we teach Beginners to think like Experts?" In answering this question, Dr. Mandin developed 124 schemes based on patho-physiological concepts representing the multiple ways in which a patient, family, or community presents to a physician. These schemes form the core of the CP Curriculum. In describing a scheme, Dr. Mandin wrote,

"A scheme is a mental categorization of knowledge which contains a particular organized way of understanding and responding to a complex situation. Schemes are created by Experts and are considered to have two functions; firstly, to serve as frameworks around which students could learn new information and secondly to provide an approach to clinical problem solving."9

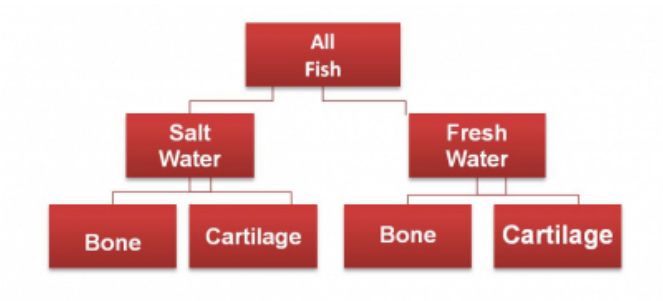
All 124 schemes originated with Dr. Mandin and have been compiled into The Calgary Black Book: Approaches to

Medical Presentations.8

For his outstanding, lifelong contribution to medical education Dr. Mandin received the 2011 Duncan Graham Award from the Royal College of Physicians and Surgeons of Canada.

Figure 1

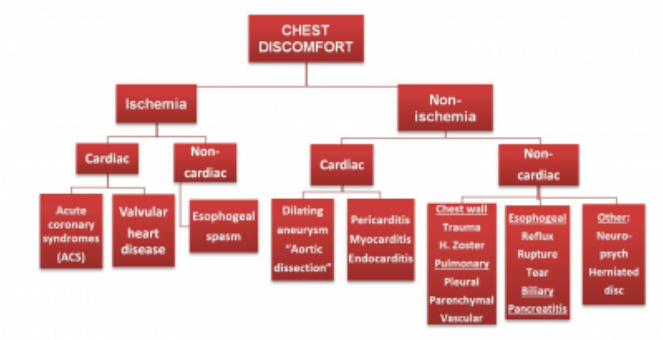
Example of a scheme using the study of fish



If one wished to study a species of fish, it is not helpful to divide fish species as to whether or not a particular species lives in water. All fish live in water. However it can be helpful to divide fish into those that live in salt water from those that live in fresh water. One can then further divide fish into those that have bony structures from those that have cartilage. Thus, in asking and answering two questions based on physiology and anatomy, one can both eliminate thousands of fish species and markedly narrow down the number of species to study.

Figure 2

Chest Discomfort scheme from the Calgary Black Book



The first branch point between the top and second rows requires the answer to a physiology question. What is the basis of ischemic pain and is it present? The second set of branch points between the second and the third rows are based on anatomy. Thus by asking and answering two questions based on physiology and anatomy one can eliminate multiple causes of CHEST DISCOMFORT and markedly narrow the number of diagnostic possibilities. The bottom row lists diagnoses based on the patho-physiological concepts above. A clinical expert provides examples as to how decisions are made at each branching point.

Steps in introducing individual schema for the CP Curriculum

1. Introduce the scheme so that the entire domain can be viewed on one slide. The clinician can then ask questions about the scheme; this reveals to the students that in order to understand the logic of the scheme, they need to learn a lot of factual material.

2. Explore each branching point and identify the basic concepts essential for understanding how the clinical decision is made at that step.

3. Design learning opportunities for students to learn all of these listed basic science concepts: lectures, labs, team based learning, etc.

4. Review the scheme by an Expert using case examples as to how clinical decisions are actually made at the branching points.

5. Practice with prepared written cases and apply to actual cases in clinical situations. 10

Does the use of schema increase the odds of diagnostic success?

"We are all Experts, we are all Beginners." 11

In our everyday worlds, knowingly or not, all of us employ efficient step-wise strategies to make daily decisions and to solve new problems. These strategies include pattern recognition, hypothetico-deductive reasoning and schema-based reasoning. Over the past one hundred years medical educators have applied these three strategies to help develop medical education curricula.

The first strategy is pattern recognition. Sir William Osler M.D. (1849-1919) noted that pattern recognition forms a critical part of the diagnostic process and that the clinician draws on his knowledge base to refine a possible diagnosis from "triggers." 12 More recently, Bowen wrote that, "expert clinicians store and recall knowledge as diseases, conditions, or syndromes — 'illness scripts' — that are

connected to problem representations. These representations trigger clinical memory, permitting the related knowledge to become accessible for reasoning." 13 Both authors note the importance of "patterns" or "scripts" in reaching a diagnosis.

The second strategy is hypothetico-deductive reasoning. This is a process whereby hypotheses are formulated and tested in a sequential fashion. This method was known and employed by the Greeks, used by a majority of physicians at the turn of the last century, and evaluated by Elstein in 1978. He wrote, "The utilization of a hypothetical-deductive method seems to be a nearly universal characteristic of human thinking in complex, poorly defined environments." 5

The third strategy employs series of questions and answers based on patho-physiological principles to include or exclude sets of possibilities. Dr. Mandin combined this method of reasoning with diagnostic schema to create the CP Curriculum. The University of Calgary adopted this curriculum in 1994, and is still used today.

Experts have available to themselves the use of all three diagnostic reasoning strategies and do so in an organized manner. But Beginners are not yet Experts. They can only employ hypothetico-deductive and scheme-based reasoning. 2 Medical schools have available these same two strategies to teach Beginners. Some medical schools use the schema-based reasoning within the CP Curriculum, while the majority of medical schools in the United States employ hypothetico-deductive reasoning. This disparity in the choice of teaching methods is due to the impact of the Flexner Report, the rather recent development of the CP curriculum and to the number and availability of Ph.Ds and MDs within a medical community. In areas such as Nepal where MDs are scarce, the basic scientists teach the majority of the lectures in the PBL curriculum and mentor all of the clinical cases employing hypothetical-deductive reasoning. Under the CP Curriculum only clinical Experts mentor the clinical cases.

But the question remains; does the use of schema- based reasoning increase the odds of diagnostic success by Beginners?

In 1986, Patel and Groen questioned whether hypothetical-deductive reasoning achieved higher diagnostic success. They determined that experts who accurately diagnosed complex clinical problems used forward reasoning (schema-based reasoning, data to hypothesis) in contrast to novice subjects who used backward reasoning (hypothetical-deductive reasoning, hypothesis to data). The novices more often misdiagnosed or only partially diagnosed the same presenting problems. 14

Mylopoulos studied the qualities of renowned clinicians as judged by their colleagues. He found that these Experts were noted for their ability to gather meaningful patient stories (illness scripts) through a series of questions and answers (scheme- based reasoning). 15

Over a period of 20 years, four independent studies from the University of Calgary showed the benefits of the CP Curriculum on the retention of experts' long term knowledge as well as on the retention of basic scientific knowledge and diagnostic success by beginners. 6, 16 ,17, 18 Most recently, a 2012 prospective randomized study from the University of Toronto Medical School showed that medical students receiving schema-based reasoning instruction versus hypothetical-inductive reasoning had a 38% higher diagnostic success. 2

The evolving answer to the question proposed is yes. More studies are needed and welcomed.

Recommendations for initiating a schema-based reasoning program

1. Select appropriate schemes

The University of Calgary Medical School and A.T. Still Osteopathic Medical School, Meas, Arizona introduce patho-physiological principles, scheme concepts and the 124 schemes to the medical students over their first two years. At PAHS the first and second year medical students analyze cases using hypothetical-deductive reasoning within a PBL curriculum. Schemes are not used during these two years. In November 2012, PAHS transitioned its First Batch medical students to analyzing all prepared and real cases on the wards in the use of schema-based reasoning within the CP curriculum. Two schemes are introduced each week to the First Batch students as they rotate through five clinical departments. Due to delays from religious holidays and civil strikes this entire process will be accomplished over approximately two
years.

Recommendations:

Medical schools transitioning their third and fourth year medical students to schema-based reasoning introduce all schemes to their medical students as they rotate through the appropriate clinical departments.
Health care programs initiating schema-based reasoning to their physicians and ancillary providers select schemes appropriate to the clinical presentations of their patients. Thus, a Department of Medicine will choose different schemes than a Department of Pediatrics.

2. Integrate schema with the basic sciences

Individual boxes within a row are distinguished by their differences while an individual row is united by one of the basic sciences. Most schema break down to:

Define the Clinical Presentation (History)
Understand the Physiology
Identify the Anatomy
Integrate abnormal physiology and anatomy into diagnoses (Pathology)

Recommendations:

Experts review existing schemes and amend if needed or author new ones.

Experts guide Beginners through the scheme branch points from the top down applying physiology, anatomy, pathology principles and knowledge.
Beginners explain the physiologic or anatomic principle within a row and differentiate the distinctions before proceeding to the next row.

3. Review the Basic Sciences

At PAHS, the objectives rarely reinforced the basic sciences. In the case presentations, physician mentors lightly explored physiology and anatomy principles and early on would ask, "What are your differential diagnoses at this time?" This quick reversion to hypothetical–deductive reasoning did not allow the students sufficient time to apply the schemes and reason to correct diagnoses.

Recommendation:

Objectives for each clinical case should review the basic sciences: Anatomy, Bacteriology, Biochemistry, Pathology, Physiology, and Pharmacology as well as Public Health, Behavioral Health, Ethics and Humanism which are demonstrated in the case.

4. Annotate the branch points

At first the schemes at Calgary were basic connecting boxes and lines. Later, the faculty added annotations. Over time, more and more annotations were added which masked the simplicity of the schemes. Consequently, booklets called Process Work Sheets (PWSs) were written and the annotations were removed from the scheme pages. As the PWSs grew more extensive, they became less focused on the decision making required at individual branch points. In the Chronic Dyspnea PWS, the first branch point of the scheme lists 9 questions to "Ask About", 15 items to "Look For", and 11 "Investigations". Of these 35 items, only four support the key physiology question; what is the limiting factor to exercise in a normal person compared to a pulmonary patient at sea level and at altitude?

Recommendations:

Experts annotate the branch points to guide Beginners as to how the Experts would decide at each branch point. Annotations should be brief and apply appropriate physiology, anatomy, or pathology concepts and knowledge.

Experts may provide PWSs that can be used for exploration, thought provocation and discussion to match the medical knowledge of a particular group.
Beginning medical students require more content knowledge. Graduate physicians may only need annotations.

5. Develop multiple cases to explore the multiple branch points of a scheme

All medical schools examine clinical cases. There are three levels of cases:

"A" cases are real cases of actual patients known to the authors. The histories, physicals, laboratories, imaging

studies, outcomes etc. all fit because they are true. Authors can adapt the information to the level of the beginners.
"B" cases are taken from journals such as the New England Journal of Medicine. These cases are published because they are of rare diseases or unusual presentations of common diseases. The histories, physicals, laboratories, imaging studies, outcomes, etc. all fit because they are true. But these cases are usually more advanced and not suitable for beginners.
"C" cases are cases usually authored by basic scientists. The author starts with a theme and a diagnosis, i.e., emphysema; then writes objectives and works backwards creating a composite case. These cases frequently contain inherent clinical inconsistencies such as a female's chest x-ray in a case of a male with emphysema or the present of clubbing due to emphysema; it is not.
19

Recommendations:

Use cases of actual patients known to the authors. Maintain a library of actual cases for additional learning material.

6. Provide appropriate educational materials for the Beginners

University of Calgary Medical School has written and revised The Calgary Black Book: Approaches to Medical Presentations. This compendium contains all the schemes. The book is pocket-sized and widely used at Calgary and at A.T. Still. The students use the box and line schemes individually and in small groups guided by physician Experts. PWSs are available. The extent of their use by students varies.

At PAHS, the schemes and the PWSs for each clinical rotation are combined into a booklet and provided to the students as they rotate through the disciplines of Medicine, Emergency Room, Pediatrics, Ob-Gyn and Surgery. The schemes and PWSs are universally used by individual students and also reviewed in the small groups. In Nepal, with its limited resources and lack of textbooks PWSs are essential.

Recommendations:

Medical schools employing schema-based reasoning in a CP curriculum provide a pocket sized book containing all the schemes as well as electronic or paper versions of the PWSs. Clinical care programs that initiate schema-based reasoning provide an annotated pocket-sized book containing all the schemes.
The providing of PWSs is dependent upon the level of medical content knowledge of a group; third year medical students versus resident physicians.

7. Utilize the strengths of the basic scientists and the physicians within the CP Curriculum

The goal in the training of young physicians is to integrate cutting edge research with bedside patient care to graduate physicians as beneficial healers. Steps 1, 2, 4, and 5 in the CP curriculum are clinical. The time requirement for these four steps is approximately 20% of a student's week. Step 3 includes lectures, podcasts, laboratories, team based learning, etc. The time requirement for all components of this one step is approximately 80% of a student's week.

Recommendations:

Select basic scientists for the basic sciences. The basic scientists can best interface between cutting edge research and the teaching of the basic sciences.
Select physicians for the clinical components. Physicians can best interface between the teaching of the basic sciences and their application to patient-centered care.

8. Train Experts in schema-based reasoning

Initial training sessions at PAHS for the faculty started in August 2012 and have continued after the "go live" date on November 27, 2012. Continued training is concentrated on the processes and medical knowledge content required to guide Beginners through individual schemes.

Recommendation:

Train Experts in the concepts and processes of schemes and schema-based reasoning through initial and ongoing faculty sessions.

9. Foster 360 degree learning through use of the Objectives

The University of Arizona Medical School-Phoenix employs hypothetical-deductive reasoning within a CBI curriculum. The objectives are written by the faculty and are not given to the students. The students develop their "own" group objectives guided by the facilitators. Individual students pick one of the objectives to explore. At the end of the week each student presents the findings of his/her objective to the

group. The result is that the students become experts in their assigned objective, but less so in the objectives researched by other members of the group.

Recommendations:

Experts develop, present, and discuss objectives with beginners.
Beginners explore all objectives with the faculty and fellow students.
Beginners propose, develop and explore additional objectives of interest. This allows Beginners to enrich both themselves and the Experts.

10. Vertical Integration of schema-based reasoning

PASH is introducing two schemes per week to the First Batch for a total of 124 schemes. The house staff at Patan Hospital was not participating in the schema-based reasoning training and the schemes were not available to them.

Recommendations:

Schema-based reasoning training needs to include the house staff and hospitalists who write the vast number of orders and who guide medical students on a daily basis.
The number of schemes presented to house staff/hospitalists could be one per week.

DISCUSSION

For thousands of years expert physicians have passed on to younger generations the qualities needed to become beneficial healers. During this time content has progressed from fear of evil humors to knowledge of the genetic code. On the other hand, while the technologies used to facilitate learning have markedly evolved, the core methods to encourage critical thinking remain few. Of these methods, two major ones are hypothetical-deductive reasoning and schema-based reasoning. As stated above, both methods equally prepare students for the medical knowledge content portions of the board examinations and encourage critical thinking. But the academic pursuit of critical thinking must recognize the real world environment of limited resources. This is as true in the United States as it is in Nepal. How do these two methods compare using a Strengths, Weaknesses, Opportunities, Threats analysis?

Hypothetical-deductive reasoning's major strength is also its weakness. It's strength is that it encourages learners to explore multiple possibilities and diagnoses. In the classroom this method is effective and accrues no cost. But its weakness is that is that when applied at the bedside it creates a need to rule out these multiple possibilities and diagnoses by ordering multiple tests with accrued costs and patient risk. In the case of "Acute Abdomen" presented at the University of Arizona, the Facilitators' Guide lists seventy-five differential diagnoses in alphabetical order for the students to consider and rule out. 20

Schema-based reasoning's strength is that it applies patho-physiologic principles to clinical decision branch points and results in higher diagnostic success. This method of reasoning can be taught to Beginners in the classroom, reinforced in the clinical clerkship years, and carried over after graduation to the hospital bedside and clinical practice. While not yet rigidly analyzed, clinical experience and business acumen would lead one to conclude that achieving the correct diagnosis by combining schema-based reasoning with patho-physiological principles would result in fewer tests, time, risk, and cost. Its potential weakness is that it requires sufficient expert clinician involvement for the training of beginners in clinical problem solving.

An opportunity exists for health care providers in applying schema-based reasoning. In third world countries any decrease in the use of precious resources is welcomed. In the United States with the passage of Affordable Care Act and the advent of Accountable Care Organizations (ACOs) financial risk is being transferred to the providers. Patients will move from being revenue centers to being cost centers. Some savings in patient costs may be achieved by out-patient preventive care. But the vast amount of patient costs will continue to be generated in hospitals. Consequently, those physicians who write most of the orders within hospitals- residents, fellows and hospitalists will need to become more cost efficient, to achieve maximum productivity with minimum wasted effort or expense. But a weakness is that the majority of these physicians are graduates of medical schools which used one of the hypothetical-deductive teaching methods. This approach to clinical problems remains their primary method in their formative years as they gain clinical experiences and expertise. Herein lies an opportunity for ACOs and other health care providers to evaluate and employ schema-based reasoning in approaching the clinical presentations of their

patients.

CONCLUSION

Achieving diagnostic success is a core competency for all physicians. How medical students are trained affects how they will practice, especially in their residencies and early clinical years. Medical schools use various reasoning methods to evaluate clinical cases. All of these methods encourage the pursuit of critical thinking, but the use of schema-based reasoning is proving to achieve higher odds of diagnostic success. In the real world environment of patient needs, limited resources, and financial risks this difference may prove to be a selective advantage.

The story of PAHS and the lessons learned there may help health care professionals evaluate and introduce schema-based reasoning to improve diagnostic success with the twin goals of maintaining quality medical care while lowering patient care costs.

ABOUT THE AUTHOR

Brendan D. Thomson M.D., MBA, is Board Certified in Internal Medicine and Pulmonary Diseases and a member of the Society of Critical Care Medicine. He holds a MBA from Arizona State University, Carey School of Business. Dr. Thomson was in the private practice of pulmonary medicine for twenty-five years prior to becoming the medical director for a health care company which specializes in the care of geriatric patients. He was Chief of Staff for two Phoenix area hospitals and is past president of the Samaritan Health Plan. In 1991 he was awarded the Public Service Award by the Maricopa County Medical Society. In 2013 he received a Fulbright Specialist Grant to assist the Patan Academy of Health Sciences in Kathmandu, Nepal, transition from hypothetical-deductive reasoning to schema-based reasoning. He is an Assistant Professor of Medicine at the University of Arizona-Phoenix, and the Medical Director of Hacienda, a not-for-profit facility for developmentally delayed persons.

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Acknowledgements

This work was an outcome of a Fulbright Specialist Grant to Nepal, funded by the Bureau of Educational Affairs and Cultural Affairs. The opinions are those of the author alone.

Dr. Henry Mandin M.D., Professor Emeritus, University of Calgary Medical School, Calgary, Alberta, Canada. Medical Educator of the Year, Canada, 2011.

John Bertram, Ph.D, Professor of Anatomy, University of Calgary Medical School, Calgary, Alberta, Canada.

Arjun Karki, M.D., past Vice Provost, Patan Academy of Health Sciences, Director of the ICU, Grand Hospital, Kathmandu, Nepal.

Paul Standley Ph.D, Assistant Dean – Curricular Affairs and Professor; University of Arizona College of Medicine – Phoenix.

Kathleen Carlson, MLS, AHIP, Education Librarian, Phoenix Biomedical Campus Library, Phoenix.

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The author does not have a URL.

Appendix: Medical Schools studied for the Report
1. The University of Calgary Medical School, Alberta, Canada, which initiated the Clinical Presentation Curriculum in 1994.
2. A.T. Still Osteopathic Medical School, Mesa, Arizona, which has used the Clinical Presentation Curriculum since its inception in 2007.
3. Patan Academy of Health Sciences in Kathmandu, Nepal, which is transitioning from hypothetical-deductive reasoning to schema-based reasoning.
4. The University of Arizona- Phoenix, which uses hypothetical-deductive reasoning CBI method.

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