Systematic Inventive Thinking: A New Tool for the Analysis of Complex Problems in Medical Management

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Abstract

The complexity of medical problems is a well-recognized phenomenon. In the presence of economic and cultural restrictions, medical decision-making can be particularly challenging. This paper outlines a system of analysis and decision-making for solving such problems, and briefly describes a case study in which the method was used to analyze the case of antibiotic overprescribing in a large health maintenance organization. The purpose of the study was to determine if a technique for problem-solving in the field of engineering could be applied to the complex problems facing primary care. The method is designated Systematic Inventive Thinking and consists of a three-step procedure: problem reformulation, general search-strategy selection, and an application of idea-provoking techniques. The problem examined is the over-prescribing of antibiotics by general practitioners working in Maccabi Healthcare Services, an HMO serving one and a half million patients in Israel. The group of healthcare professionals involved in the discussions generated 117 ideas for improving antibiotic use. Six of these ideas were then implemented in a national campaign in the winter of 2000/1 and 2001/2. During this period, a significant reduction in per-visit antibiotic purchasing was observed for influenza visits (from 79.2 per 1,000 to 58.1 per 1,000, $P < 0.0001$), but not for other categories of visits. The SIT methodology is a useful technique for problem-solving and idea generation within the medical framework.

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The Systematic Inventive Thinking methodology [1] is a structured method for idea generation that is different from other methods such as brainstorming, in which free association is used to generate the ideas. We used this method for tackling the problem of antibiotic overprescribing. The SIT methodology originates in the seminal work of Genrich Altschuler [2]. Altschuler examined thousands of inventions from which he extracted some properties that characterize creative solutions. His main finding was that the solution always incorporates an elimination of a conflict in the problem state. A conflict is a state in which changing one parameter of the problem, in order to gain some benefit, causes deterioration in another parameter. An example of this conflict could be that in order to improve patient satisfaction a physician may give his mobile phone number. This may result in a satisfied patient but a frustrated physician. Altschuler [2] found that conflicts can be indexed according to the type of elements involved and thus was able to assign strategies for overcoming the different problems. The elements in the above problem may include accessibility of the physician, cost of a mobile phone, other forms of comunication such as e-mail, the number of patients, availability of another healthcare professional, etc. SIT methodology overcomes these conflicts by applying specific conditions that allow the problem to be reformulated and permit the testing of a candidate solution. In the above example one could generate ideas for solving the problem of patient satisfaction without addressing telephone use. It has been shown that certain creative patterns are identifiable, widely applicable, and learnable [3]. These patterns, called templates, can serve as facilitative tools that channel the ideation process, enabling the individual or group to be more productive and focused. This paradigm has been shown to be superior in the field of ideation for new products than other widely used ideation methods [4]. The first stage in applying SIT in a problem-solving context entails constructing a matrix of the problem variables in order to identify potential new relationships between them.

The overuse of antibiotics [5] is a well-recognized problem that is responsible for increasing antibiotic resistance [6,7] and raising healthcare costs, and serves as a poor health behavior model for patients [8,9].

Method and description of idea generation

A group consisting of two specialists in family medicine, two pediatricians, an infectious disease specialist, a dispensing pharmacist, a clinical psychologist, a pharmaceutical company executive and a marketing expert gathered to address the problem of antibiotic overuse. The analysis and group discussion continued for 16 hours over 4 sessions. The last meeting was devoted to determining criteria for the adoption or rejection of ideas.

In the case of antibiotic utilization the following variables were

HMO = health maintenance organization
SIT = systemic inventive thinking

identified. The key players are the patient, physician, insurer, and pharmaceutical companies. The behavior of each player is influenced by a variety of factors such as knowledge, health beliefs, antibiotic beliefs, illness outcome, expectations and other external influences including financial. From these variables one can build a table where every cell describes each influence on each key player. An example of physician factors are the level of financial security, professionalism, age, specialization, knowledge, colleague support, awareness of antibiotic resistance, degree of satisfaction with the health maintenance organization, concern about litigation, current antibiotic utilization, and patient profile. Each of these factors is a cell in the physicians' row of the table. After building the table one can analyze each cell using Altschuler's templates, thus generating a variety of solutions. Each template is used to address a problem from a different angle. An example of such a template is the removal of an essential component from the problem. For instance, by applying this template to the "Physician/Prescription" cell, one removes the component of the antibiotic and thus allows for the generation of ideas such as a "Viral prescription" for advice and symptom-reducing medication or the need for encouraging vaccination. Further examples using the different templates are presented in Table 1.

The ideas generated were used to create a national campaign during the winter of 2000/1 and 2001/2 to reduce antibiotic use.

Results

The group of healthcare professionals generated 117 different ideas for addressing the problem. The following criteria were examined:

- High probability of success
- Proven track record
- Novelty
- Specific suitability for Maccabi Healthcare Services
- Usefulness in other utilization contexts
- Ideas that can be tested as a pilot.

The analysis of each of the main variables was undertaken separately:

The patient

The patient is eager for a speedy recovery from illness and wants to be sure that he or she will not become seriously ill. The patient, feeling a need for a tangible expression of treatment, believes in antibiotics as the appropriate treatment for any and all infections including viral, although a minority of patients is beginning to look for alternative treatment strategies. There may also be a perception that the newer antibiotics are better.

The doctor

For the doctor, who works as an independent contractor, patient satisfaction is of the utmost importance. Furthermore, it is not in the doctor's financial interest for the patient to return to him or her during the same illness episode. Despite numerous articles on antibiotic resistance, the doctor is unperturbed and is sure that the pharmaceutical companies will find a solution to antibiotic resistance. From the perspective of the doctor's daily routine, antibiotic resistance does not seem to be a problem. Like the patients, the doctor feels that broad-spectrum, newer antibiotics are "stronger" and may lead to a better clinical outcome. The doctor may believe that the patient might interpret the advice given without tangible medicine for his/her ailment as being the easy way out and not in accordance with the classic biological model of "disease-drug-cure."

The pharmaceutical companies

Pharmaceutical companies are seen by the doctors as reliable suppliers of information with regard to their specific product, but are judged to be less concerned how the product is used. The companies want the doctor to choose their antibiotic rather than another.

The health maintenance organization

The HMO is interested in providing good medical treatment in a cost-effective way, but cooperation by its physicians cannot always be guaranteed. In addition, efforts to reduce the use of antibiotics

Table 1. Examples of the use of different templates

Type of analysis	Example
Removes an essential component from the problem.	• "Viral prescriptions" – Remove the antibiotics from the prescription and prescribe only symptom-reducing medications. • Recommending vaccinations for high risk populations.
Introduces an environmental component to the problem or makes use of an existing component in a new and additional manner.	• Screening by nurse practitioner. • The drug company marketing materials, in addition to trying to sell their product, will include information on the proper use of their drug.
Reorganizes one or more components in time or in space	• All physicians in a specific geographic area will receive the same guidelines for prescribing drugs. Thus, the patient will not be able to locate a physician who will prescribe antibiotics if the first physician did not. • Prescriptions will be split in two: One to be filled immediately, prescribing drugs that reduce the severity of symptoms – nose drops, lozenges, etc. The second, to be filled only if symptoms persist 24 hours later, is the prescription for antibiotics.
Adding a component of the same type as an existing one, with the new component exhibiting a qualitative change from the original.	Clinical visit followed by phone call: • Follow-up by the doctor. • The client calls later in the day or the following day to find out whether or not to take the antibiotics.
Creation of, or undoing a link between two variables	Part of the diagnosis process is delegated to the child's parents who are taught to recognize symptoms other than fever.

may be construed by patients as cost-cutting by the HMO at their expense.

Undoubtedly, due to the complexity of the subject it is likely that not one leading idea should be chosen but that a number of different approaches be used. Each member of the group graded the ideas, and a cumulative score was obtained for each idea. The successful ideas were divided into three main groups. Some examples follow:

***Pertaining to the doctors*:**

- Teaching consultation techniques that allow the doctor to actively listen to the patient, show empathy and manage the consultation time
- Providing doctors with accurate feedback regarding their prescription patterns
- Conducting small-group learning sessions with an infectious disease specialist
- Offering the doctor a "Viral prescription" with which to end the consultation
- Encouraging influenza vaccination among highest risk patients
- Making the doctor or nurse available for telephone advice.

***Pertaining to the patient*:**

- Launching a media campaign discouraging the use of antibiotics for viral illnesses (with the backing of other HMOs)
- Including information on the correct use of antibiotics as part of routine baby checkups
- Offering the patient a follow-up telephone consultation at a specific hour after the clinic visit to provide reassurance
- Incorporating the problem of antibiotic resistance into school curricula.

***Pertaining to treatment*:**

- Encouraging self-treatment with over-the-counter remedies.

The ideas were then implemented in a national campaign in the winter of 2000/1 and 2001/2 using mass media as well as specific intervention with physicians and patients. There was a cumulative reduction in the proportion of respondents who reported that they would request antibiotics for the treatment of 'flu' subsequent to the two consecutive campaigns. A significant reduction in per-visit antibiotic purchasing was observed for influenza visits (from 79.2 per 1,000 to 58.1 per 1,000, $P < 0.0001$), but not for other categories of visits.

Discussion

Antibiotic over-prescribing is one of the main causes for the increase in resistance of common microorganisms to antimicrobial drugs. In the United States about 65% of all antibiotic use is for upper respiratory tract infections [5,10]. At least 50% of these prescriptions are probably unnecessary if judged from the biomedical model of disease, but when judged using the biopsychosocial model one can understand the reasons for the high utilization. The challenge is to analyze and influence the psychosocial aspects of the practitioner-client interaction in order to reduce utilization.

It is extensively documented and well known that inappropriate antibiotic utilization is a complex problem. The medical literature, while describing some successful interventions, can only offer hints as to how to tackle the problem in a comprehensive way. The technique offered by Systematic Inventive Thinking triggered the generation of a wide variety of potential solutions, some of which may be unique to a particular organization or system. The solutions adopted by Maccabi Healthcare Services to tackle the problem of antibiotic utilization are based on the ideas generated by the SIT technique. The use of this technique allowed decisions to be made over a wide range of options – old and new – as opposed to exploring the medical literature which may have just come up with the tried and tested options. Since medical organizations are particularly complex and differ from each other, this system of analysis can be particularly useful, allowing the development of tailor-made solutions for each case.

Conclusion

We describe a new way of medical problem-solving that has enabled us to define the confounding elements in a complex issue and generate tailor-made solutions. When implemented on a national scale, these ideas led to a change in behavior in the specific problem of antibiotic overprescribing

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