Making Effective Referrals: A Knowledge-Management Approach

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Patients and physicians often choose specialty consultants with only limited knowledge of the available options. Access to information about specialists that was directly relevant to patient and clinician preferences could improve the effectiveness of the referral process. We have developed a prescriptive representation of the process of selecting consultants. This "referral map," based on decision theory, uses patient and provider preferences elicited through a literature review and interviews with physicians and provides a formal framework for representing referral knowledge and for evaluating referral options. Our method suggests that the goals and processes of selecting consultants can be managed more systematically using explicit repositories. Such systematic management promises to have a beneficial impact on the delivery of health care, as well as on patient satisfaction.

INTRODUCTION

In many cases, patients and physicians choose consultants on the basis of limited knowledge of the full range of available options. Referral decisions are often based on convenience, recent experience, and informal recommendations of colleagues. For example, after joining a new practice, a primary care physician might ask a more experienced colleague which orthopedist he or she uses for shoulder problems. If the experience is satisfactory, the physician is likely to continue referring to that orthopedist and may never become fully aware of other referral options, some of which might result in better referral outcomes. The informal knowledge and experience of a group of patients, physicians, and other clinicians, if taken together, would provide a formidable tool for making more informed, effective referrals.

We have developed a prescriptive representation for the process of selecting a consultant. This representation, a *referral map*, incorporates the knowledge and experiences that lead to choosing a consultant and can provide the basis for developing a computer-based repository of referral information. The underlying premise of this work is that systematic management of referral knowledge potentially promises to have a beneficial impact on the delivery of health care, as well as on patient satisfaction. In this paper, we discuss the theory underlying referral maps, explain how they can be used to build a repository of referral information, and address issues related to knowledge representation and repository design.

Background

There has been considerable interest in the impact of referrals on patient outcomes, especially in assessing the appropriateness of the decision to refer[1] as well as the role of inter-provider communication in referral effectiveness.[2] For the most part, however, interest in the process of selecting consultants has been motivated by health care marketing, with an emphasis on describing determinants of physician referral behavior in order to attract more referrals, as opposed to improving clinical effectiveness.

When making referral decisions, clinicians turn to a number of information sources, including fellow physicians, patients and their families, and to a lesser extent, referral directories.[3] Clinicians consider various factors when selecting consultants, including past personal experiences, perceived technical expertise, access, convenience, peer recommendations, and patient preference.[4,5] Other factors may be physician practice networks, hospital-physician ties, and use of computer networks for interprovider communication.[6] In this paper, we are interested in the prescriptive question: *In a particular referral situation, who, among the specialists available, is the best?*

Problems with usual way of referring

When selecting a consultant, physicians may consider only a small number of options, possibly overlooking more appropriate options for the patient's needs. Referral directories provide access to a broad array of choices, but do not represent the kinds of information that are central to referral decisions. For example, most referral directories will provide a list of gastroenterologists, but are less helpful in addressing a question such as: *who is a good gastroenterologist particularly suited for treating an anxious patient with Crohn's disease?* Traditionally, referral directories contain limited information, such as name, specialty, medical school, and insurance plans, although other types of information are beginning to be in-

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cluded, such as the physician's clinical interests.[7] There is also evidence that most clinicians do not use referral directories as a source of information for selecting consultants. In one study, only 2% of referring physicians cited a referral directory as an important source of information.[8]

Recently, online physician directories have appeared on the World Wide Web, offering the ability to find physicians by characteristics such as city, state, or specialty and providing links to short physician biographies or personal statements. However, none of these online resources provides a systematic approach to help the patient or referring clinician evaluate and select among alternatives.

Asking a colleague to suggest a specialist for the patient with Crohn's is an example of using *informal knowledge*. Informal knowledge can be thought of as information an experienced clinician who has practiced in one location for many years might know about his or her colleagues. Examples of informal knowledge pertaining to referrals include patient and clinician satisfaction with past referrals, consultant communication style, and specific consultant expertise (e.g., a gastroenterologist who is effective with an anxious patient with Crohn's disease). However, informal knowledge is limited and non-uniform. Geographically isolated rural providers, newly hired clinicians, and clinicians-in-training may have little basis to evaluate consultant choices. Moreover, in rapidly changing situations, such as after a merger of institutions, even experienced clinicians will not be familiar with the new consultants available to them.

Referral maps

Referral maps are intended to address the limitations of the current ways of selecting consultants by helping referring clinicians and patients use informal knowledge when making referrals. The referral map itself consists of a set of criteria reflecting patient and provider preferences for selecting specialty consultants and a decision theoretic framework for using those criteria to evaluate and select specialists. The goals of referral maps are the following:

- *Capture informal referral knowledge in an organized way within a formally justifiable framework*
- *Formalize informal knowledge about referrals*
- *Apply this knowledge across a universe of consultants to select a good fit for a given patient, clinician, and clinical situation.*

METHODS AND DESCRIPTION

Assessment of patient and provider preferences

We reviewed the literature to generate a list of criteria relevant to selecting consultants. Interviews with a convenience sample of staff and resident physicians at Beth Israel Deaconess Medical Center were used to refine this list, which provided the basis for developing the referral map's model.

Construction of decision model

We constructed a decision model for selecting a consultant based on multiattribute value theory (MVT). MVT is the branch of decision theory concerned with evaluating alternatives characterized by multiple attributes.[9] MVT takes a set of *alternatives* (in our case, specialists) and a set of *objectives,* or reasons to choose one alternative over another, and assigns a measure of value to each alternative on the basis of how well it satisfies the objectives. The underlying principle is that a complex objective, such as "Choose the best specialist," can be expressed as a combination of simpler objectives. This principle is facilitated by creating an *objectives hierarchy* or *value tree*, which makes explicit the progressive decomposition of objectives.

The referral map's objectives hierarchy has as its top-level objective *Choose the best specialist from the available alternatives.* This top-level objective is broken down into six subordinate objectives:

- *Maximize match between the reason for referral and specialist expertise*
- *Maximize match between the referring clinician's preferences and the specialist's philosophy of care*
- *Maximize match between the referring clinician's preferences and the specialist's demographic characteristics*
- *Maximize communication practices by the specialist with the referring clinician and patient, as well as service orientation toward the patient*
- *Maximize access to appointments, as well as convenience of getting to and being seen by specialist*
- *Minimize indirect costs (to referring clinician) and out-of-pocket costs to patient.*

Each of these six objectives is broken down further until unambiguous *primitive objectives* are reached. In Figure 1 the *Access and Convenience* branch of the referral map's objectives hierarchy has been expanded to illustrate the relationship of objectives, subordinate objectives, and primitive objectives.

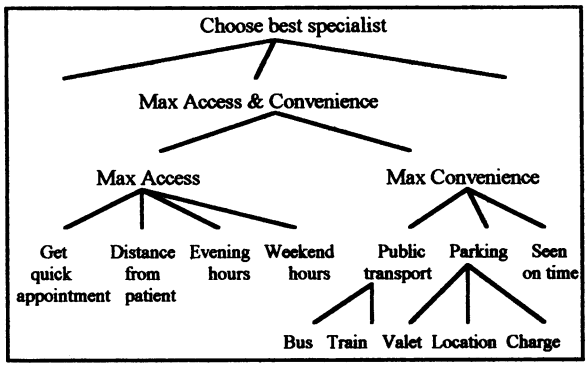

Figure 1. Portion of referral maps objectives hierarchy

At the bottom of the objectives hierarchy, *attributes*, or measurable qualities, can be associated with the *primitive objectives*. *Value functions* map each attribute measurement to a value between 0 and 1, reflecting the degree to which the primitive objective has been satisfied. Table 1 provides an example of the value function for the attribute *#days until next available appointment.* This attribute corresponds to the primitive objective *Get quick appointment.*

Table 1. Mapping attribute to value

Attribute Measurement (# days to next available appointment)	***Value***
>28 days	0
15-28 days	0.2
8-14 days	0.4
4-7 days	0.6
1-3 days	0.8
Can be seen the same day	1.0

The values associated with each attribute are combined into a global measure of value, reflecting how well the alternative satisfies the top-level objective. The alternative with the highest value measurement is selected. The appropriate form of the function used to combine the individual value measurements depends on the relationship among the objectives; the form that has been most often employed in practical applications, and the form we have chosen, is the *Additive Multiattribute Value Function (AMVF)*, which is a weighted sum of the individual attribute valuations, where the *weights* indicate the relative importance of each attribute within attribute ranges:

$$v(a) = v(a_1,\ldots,a_n) = \sum_{i=1}^{n} w_i v_i(a_i), \text{ where}$$

- $v(a)$ is the AMVF,
- a refers to an alternative (specialist),
- a_1 - a_n are the attribute measurements for a,
- w_i is the weight for the i^{th} attribute,
- $v_i(a_i)$ is the value function valuation for the i^{th} attribute.

Example

To illustrate our use of MVT, consider the case of an avid bicyclist who develops knee pain that interferes with her ability to ride. A referral to an orthopedist results in a recommendation of surgery; however, she feels that her concerns have not been adequately addressed and requests a new referral to a different orthopedist who will be more open to non-surgical treatment. She prefers that the orthopedist be female and have evening hours.

The referral map evaluates each potential orthopedist, weighing the attributes that correspond to the above preferences— female, non-aggressive, evening hours, expert in knee injuries, sensitive to bicyclist's concerns— more heavily than factors to which the patient and clinician are less sensitive. The output is an ordered list of orthopedists. The one with the highest value will best satisfy the specified preferences.

DISCUSSION

Outside of health care, it has been recognized that the collective informal knowledge and experiences of employees are valuable assets.[10] Referral maps provide a decision-theoretic framework for representing important referral knowledge and using that knowledge to help clinicians make effective referrals. However, there are challenges to employing MVT for referral maps, and there are aspects of the referral process that fall outside the problem domain addressed by MVT. Our approaches to these issues are addressed in the following sections.

Sources of information

A comprehensive implementation of referral maps would need to draw upon many disparate information sources, including medical records, claims data, physician profiles, referral directories, managed care data, patient satisfaction data, and physician schedules. Adapting these sources for use in referral maps requires validating information, adjusting for case mix, and providing appropriate incentives for clinicians and patients to furnish information about their referral experiences.

MVT and knowledge representation

Selecting a consultant is a classic problem of choosing among alternatives based on multiple criteria— exactly the problem that MVT addresses. MVT has a

track record of successful application in other industries. It offers the potential of justifying the selection of one alternative over another, and since value functions are defined a priori across the entire range of possible attribute values, it provides predictable behavior.[11]

In an MVT-based model, some objectives may suggest natural measurement scales, as illustrated in Table 1. In other cases, however, a natural measurement scale may not be practical, e.g., a procedure rate adjusted for case-mix may have limited validity as a measure of "aggressiveness" or may inadequately capture the intent of the objective *Maximize aggressiveness*. In this case, a value scale may be used. Attributes that which minimally and maximally satisfy the objective are defined and are assigned values of 0 and 1, respectively (Table 2). Intermediate values are assigned subjectively for each alternative.

Table 2. Value function for *Maximize Aggressiveness*

Attribute Measurement	*Value*
Never does procedure (even when most colleagues would)	0
... ...	... ...
Always does procedure (even when most colleagues would not)	1.0

Point of view

There are at least four potential customers for referral maps: referring clinicians, specialists, patients, and health care organizations. Like all MVT models, however, referral maps reflect the point of view of one decision maker; in our case, this is the primary care (referring) clinician. Potentially conflicting priorities among customers could be reflected in the objectives hierarchy. For instance, compared with referring clinicians and patients, managers and payers might put greater emphasis on minimizing cost. Thus, if the referral map were constructed from the point of view of the organization, a greater weight might be assigned to the *Minimize cost* branch of the objectives hierarchy. This example points to the need for clinicians and patients to understand the basis for recommendations made by the referral map.

Our approach has been to adopt the point of view of the referring clinician, while trying to accommodate preferences of other stakeholders. Patient preferences, for instance, are represented in the referral maps objectives hierarchy, although they are conveyed through the point of view of the referring clinician. An alternative representation based on the patient's point of view would also be valid and might have advantages in certain settings, e.g., for helping a patient to select a primary care provider.

Eligibility criteria

When a specialist is selected, there may be criteria, such as insurance plan, provider gender, or translation services, that must be satisfied for the specialist to be considered, so-called *eligibility criteria*. Managing such preferences, which determine the inclusion or exclusion of an alternative, falls outside the MVT paradigm, which ranks one alternative as more or less desirable than another. The referral maps model addresses this issue by dividing the specialist selection process into two stages (Figure 2), first using eligibility criteria to establish the set of eligible specialists and then using MVT to identify desirable specialists. In the prototype input screen in Figure 3, the user is able to indicate whether an attribute is *essential*, i.e., that its absence should disqualify an alternative from consideration.

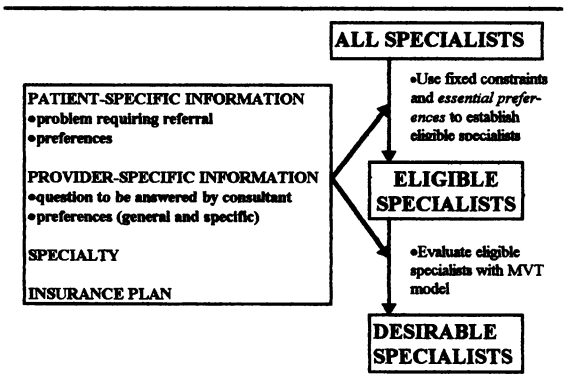

Figure 2. Eligibility and desirability

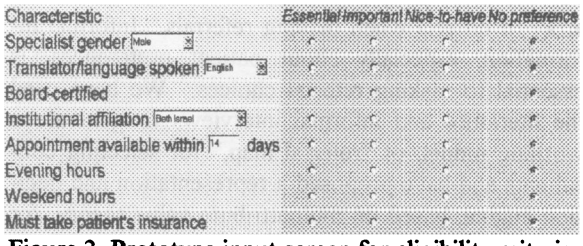

Figure 3. Prototype input screen for eligibility criteria

Managing dynamic preferences

Referral preferences are use-specific, i.e., selection criteria change on the basis of specialty, referring clinician, patient, and reason for referral. For example, a referring clinician may apply different criteria when referring a patient for evaluation of an uncertain diagnosis as opposed to a known diagnosis. Similarly,

patients' preferences vary. For example, in certain situations, some patients may be willing to make a higher co-payment to see an out-of-network specialist. Thus, referral maps must accommodate dynamic preferences.

Our approach to modeling dynamic preferences is to permit the clinician to change or specify preferences at the time of referral. These preferences can then be represented in the referral map in two ways: by modifying the weights assigned to objectives or by changing the organization of the objectives hierarchy. We are currently exploring to what degree customization of referral maps should occur at the specialty level (e.g., cardiology referral map versus orthopedics referral map), at the level of the individual decision maker (e.g., each user has a unique preference profile), and/or at run-time.

Sensitive information

Like other clinical information systems, referral maps make explicit processes of care and decision-making criteria. Some criteria, such as clinician age or race or number of medical malpractice suits, may be sensitive and thus difficult to acknowledge openly and formalize in a referral database. This problem can be addressed by omitting potentially sensitive criteria from the referral map, at the loss of some comprehensiveness, or by acknowledging the relevance of sensitive criteria and providing organizational backing and support for their inclusion. Managing sensitive information is not a problem unique to referral maps and must be addressed at the organizational level.

CONCLUSION

For the most part, physicians do not consider a full array of criteria when making referrals. Informal information, especially about patient preferences, is essential to making referral choices. We have used the literature and informal interviews to generate a working model, or "referral map," for selecting consultants and have proposed a representation and decision engine, based on multiattribute value theory, for evaluating alternatives.

We conclude that applying a knowledge management approach to referrals has promise. Our method suggests that the goals and processes of selecting consultants can be managed more systematically with explicit repositories. Such systematic management promises to have a beneficial impact on the delivery of health care, as well as on patient satisfaction.

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