Healthcare Systems Process Reengineering for Developing Countries:
A Report to IMIA Working Group 9

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Abstract

To discover what kinds of health informatics the developing countries need, we look first to the underlying social structures that informatics is to support.

Developing countries face severe problems in their goal of assuring access to quality healthcare to their citizens. Nor is it comforting to look to the example of the developed countries, themselves uncomfortable with the tremendous commitment of resources that they use.

It seems clear that if developing countries are to succeed their systems for assuring health will need to achieve radical improvements over those currently employed by the developed countries. They need to build systems that are directed to the heart of the problems; they need to make the best use of their existing human and economic resources; and they need to do this while respecting the human potential and aspirations of their people.

Any such system will need to be built around planning, organizing and measuring the long-term, rather than episodic, health of citizens. In particular, health interventions need to be moved upstream where they are more effective and less expensive.

The job of health informatics is to provide the fundamental enabling infrastructure that would allow individuals to cooperate in the fluid, effective ways required.

We describe some of the requisites for such a system. Certainly, its construction will depend on the use of an open, standards-based distributed object software architecture.

Keywords:

Developing Countries; Medical Informatics; Healthcare Systems; Distributed Objects, Business Process Reengineering.

Introduction: Health Care and National Goals

In this paper we consider the role of health informatics from the viewpoint of developing countries trying to build healthcare systems appropriate to their national goals. In order to see the place of informatics, we need first to step back and look at healthcare systems.

Economic Importance of Effective Health Care

From the point of view of individual health providers, it is easiest to see illnesses as isolated episodes. However, from a national point of view, the national welfare and the national economy bear the sum total of all the costs of illness.

Illness has a tremendous social cost:

- It directly hurts quality of life of the citizens.

- There is a cost to the country's economy in days of work lost, in poor quality work, and in failure to realize human potential.

- It is almost always more expensive to get people well than to prevent them from getting sick (or sicker) in the first place.

From the national point of view, selectivity is impossible. The country has to provide for the *lifelong* wellness of *each* of its citizens. This goal might seem merely a liberal humanitarian nicety that, for a country with budget problems, might be an optional extra. This is wrong. The cost of illness to a country's economy is tremendous. Few things are more economically important than effective health care.

The Need for Order-of-Magnitude Improvements

"Yes," one might answer, "but, whether we need more or not, we are already doing as much as we can." Indeed, in almost all countries, developed or not, providers are already working at the limits of the resources given them and yet healthcare consumes too high a portion of the GNP.

The answer cannot be to ask counties to do more. *The only possibility is to find ways of enabling them to do better: to make more effective use of their existing resources.* The gap between what countries can do and what they must do is so wide that improvements in effectiveness must be order-of-magnitude. As far as informatics is concerned, merely offering to computerize existing processes is not sufficient.

Moving Health Interventions Upstream.

If a COPD patient comes to the emergency room, it is important that the hospital does its job well. It is more important to ask how the health care system could have staged previous care to have avoided, or at least predicted, hospitalization. It is still more important to have prevented the patient from smoking. *For each step that the intervention is moved upstream, it saves considerably more money for the economy as a whole and leaves the citizen healthier.* Moving interventions upstream implies a planning model whose basis is the longitudinal process of the individual citizens rather than functional specializations of the care providers.

The Need for Longitudinal Data.

There are many contexts in which the quality of care needs to be assessed.

- A care provider needs data on the quality of care in order to assess strategies for improvement.

- A purchaser of care—an individual purchasing care, an employer purchasing care for workers, or a government agency underwriting care—need to be able to make rational decisions.

- A government agency needs regulatory or planning data.

As the COPD example above makes clear, incident-based statistics that a specialized care provider might have in house are meaningless compared to longitudinal statistics. Even when a COPD patient might require emergency hospitalization, in-house measures of success (in-hospital mortality rate, length of stay, cost of care, or return to pre-hospitalization physiologic measurements) are insensitive and misleading compared to longitudinal statistics (survival time, length of time until re-hospitalization, length of time until further disability) unavailable to most hospitals.

A Patient-Oriented Comprehensive Healthcare Model.

There essentially is no way for a country to plan for or provide really effective care for its citizens outside of a model that can coordinate the delivery of comprehensive, longitudinal care for individuals and that can track its outcome.

- Other things being equal, delivering quality care depends on being able to coordinate a comprehensive long-term system of services to a citizen .

- Assessing the quality of care depends the availability of longitudinal data and analysis tools.

As many HMOs, despite their apparent comprehensiveness, have found, *without such planning and analysis tools they have no options for cost containment other than blindly denying care*.

This Point Doesn't Depend on a Country's Underlying Health Care Reimbursement System.

Comprehensive care can be delivered under a variety of socialized, private, or mixed care systems. Individual private providers could band together in voluntary organizations to achieve the requisite planning and analysis capabilities. The same capabilities could be achieved by private, but centralized HMOs. Equally, government agencies could supply part or all of these services. Provider organizations could be self-regulating, or could be monitored by employer or union organizations, or there could be government regulation, or any mixture of these.

What is essential is the underlying model—longitudinal, comprehensive service to individuals—rather than its implementation.

The Role of Health Informatics.

Patient-oriented comprehensive health care poses a difficult systems delivery problem.

- Whether all the providers are part of a voluntary organization, or are in a single, private HMO, or are part of a government bureaucracy, their services to an individual must be rationally (although not necessarily centrally) planned and coordinated.

- Conversely, as events occur their data have to become available for assembly and analysis.

The role of health informatics is to be the fundamental enabling infrastructure that makes such cooperation possible.

Without informatics, a country is locked into an equation that relates the amount of money spent on healthcare, the amount of work extracted from its providers, and the level of service that is provided to its citizens. In most countries the amount of money spent is already too large, the providers are already working as hard as they can, and the level of service provided is still not uniformly high enough.

Healthcare Systems Process Reengineering

While many providers take an idealistic view of their profession, it is clear that if healthcare systems are to be successful at providing health they need to be sensibly integrated into the larger economic life.

Thinking of healthcare in terms of business processes may seem strange when in many countries healthcare is partly or completely socialized. (We mean to address all these possibilities equally.) We need to remember that in any type of economy, resources consumed in providing healthcare are real resources. They may be in cash, in goods or in kind, or human resources. They are not cheaper for being spent in a good cause. They come at the cost of spending the same resources on other priorities. No matter how they are obtained or reimbursed, a country would want to be in a position to decide how to spend them and to prevent waste.

The Model: Business Process Reengineering (BPR).

In their classic book [1], Hammer and Champy set out the principles of Business Process Re-engineering (BPR).

The object is to achieve order of magnitude improvements in quality of service and in cost by identifying the basic process whereby a business provides added value to the consumer and then radically simplifying that process so that it is supervised by a case manager or small case team with incentives and responsibility for end-to-end delivery.

This is to replace the older, fragmented model we are familiar with, and in which nobody is really responsible for the whole chain of events that needs to take place in order to deliver goods and services to satisfied customers.

What BPR Shows Us.

In order to produce value for consumers (and therefore stable profitability for the business) each process that the customer sees needs to be placed under the control of a single *case manager* (or, exceptionally, a small case team) responsible to supervise that process from beginning to end.

In fragmented, task-oriented businesses, good performance statistics do not necessarily mean good customer satisfaction or even good profitability. These statistics only indicate how many cycles the staff goes through, not how much value is produced.

Similarly, the centralized, inflexible rules that these older organizations use to ensure accountability do not necessarily produce profit.

Reengineered organizations can allow individual case managers to make flexible, context-dependent decisions that maximize the joint benefit to the customers and the business. They can allow this freedom, while still ensuring accountability, by holding the case managers to overall, rather than case-by-case, measures of performance.

The way to ensure that both sets of goals, customer satisfaction and corporate accountability, are met is not by issuing rules but by directly reflecting them in the reward, reporting, and QA structures.

Informatics is a fundamental infrastructure allowing staff to cooperate in the ways needed.

The Commitment of Healthcare Professionals

The logical candidate to be an individual's case manager is the primary care provider, whether physician, nurse, or paraprofessional. Managed care has been correct in seeing the need for someone to provide oversight, but fatally incorrect in filling this role with people not having the education, the ability to deviate from corporate rules, or the motivation, to actively ensure that patients do well.

Often, the healthcare community has been merely reactive to cost-driven changes. They need to take responsibility. They need to discard the old "We'll do it all within a narrow sector" attitude. They need to provide *leadership* in a cooperative model that includes individuals, employers, and government agencies as part of the team and whose goal is to positively assure long-term health for individuals.

HSPR

We propose [2] Healthcare Systems Process Reengineering (HSPR). The goals are like those often stated by proponents of Managed Care. We emphasize

- prevention and wellness,

- a high quality of clinical care,

- and containment of costs.

We propose methods that are quite different, that we argue are more likely to deliver on promises while leaving the social fabric of providers and of patients more intact.

- Where Managed Care manages cases using centralized rules administered by clerks with little discretionary power, we propose case management by the responsible primary care providers using professional judgment.

- Where Managed Care enables system control by applying requirements inflexibly to each and every case, we propose to control outcome and cost by applying requirements (determined by provider peer groups and formulated in terms of the goals rather than the methods of treatment) to groups of similar cases, leaving peer groups the latitude to resolve the vagaries of each problem.

- We propose using valid statistical principles to allow for the effect of random variability in the outcome of the small number of cases seen by providers in disease groups that are narrow enough to be reasonably homogeneous.

- We propose using information technology to allow providers meaningful longitudinal follow–up and to enable collaborative specialty referrals. The database that evolves from this activity will also

underly a set of decision support tools and documented quality assurance by peer review.

HSPR Informatics Services

Where others have proposed defining treatment by guidelines and clinical pathways, we recognize

- that these are applicable only to a limited number of cases with simple structure,

- that their empirical support and their acceptance among providers are limited,

- and that variation by individual practitioners is the only possible source of correcting current mistakes and making progress.

Enforcing such rules universally is counterproductive.

It is easier for providers to agree on standards for diagnosis and for goals of therapy than on methods of therapy. Thus, it is best to use informatics to support diagnostic procedures and therapeutic reasoning.

We propose to provide a comprehensive variety of techniques for supporting the health care provider, techniques that are permissive and enabling, rather than confrontational and disabling. We should offer providers CME, tools for decision support, statistical analysis software, physiologic calculations and models, and intelligent search tools for literature references and a library of past cases.

A dynamic model of informatics

We need to avoid the idea that we are increasing the quantity of information, of data. A critic, thinking of overworked medical personnel, burdened with requirements to maintain already bulging archives of records, might see us as merely adding to the problem. "What? Now they not only have to do the record keeping, they have to enter it into computers!" *We are not building static repositories of data but helping people to interact dynamically.*

The first reality of clinical practice is that it is complex and contains many different realities. Diseases differ.

- A disease like tonsillitis suggests a simple model of clinical practice in which there are three neatly separated phases — diagnosis, treatment, and afterwards —, each with uniquely correct answers.

- Other diseases are more complex. Chronic Obstructive Pulmonary Disease has no afterwards. Its standards of possible success are different: we can only hope to make the patient more comfortable and to prevent or delay further degeneration.

A patient presents with a set of symptoms. He also presents with a history that colors our interpretation of the symptoms and limits our choice of therapy. We may diagnose more than one chief complaint. We may not be able to settle on a definitive diagnosis before we need to initiate ther-

apy. Rather we have a differential diagnosis from which we progressively rule out possibilities, as disease, testing and treatment evolve; and perhaps it is only afterwards that we are able to rule out all the possibilities but one. In parallel, we may also be treating symptomatically and trying to maintain homeostasis in the light of physiologic law.

Suppose we saw the information in an electronic version of a medical textbook as a field of data meant not to be read but to be searched by multiple, semi-independent criteria. Suppose we saw each of the steps in the differential diagnosis as a set of keys for searching this data. Expand this program to include physiologic calculations. When the patient is admitted the physician has partial data and the program helps with the first stage of refining the differential diagnosis and ordering provisional therapy. These results can be passed on to the staff on the next shift (or shared with nurses and specialty services) as a live, interactive document in which assumptions and data can be added to or modified to get to the next stage of treatment. And so on.

The object is not to store information, but to help diverse providers share productively in the care of a patient.

Individual and Community Involvement

It is a corollary of our point of view that wellness is primary: the moment a consumer becomes ill, the system loses. A further corollary then is that *individuals, communities and community agencies have to be enlisted as active partners rather than as passive recipients.*

The old model of health applies poorly to the real world.

- The distinction between "what happens before you're sick" and "what we can do after you're sick" does not correspond to any boundary useful to the consumer.

- Within health care, although specialization is important in providing depth of knowledge and resources, and independence among providers is important in preserving individual responsibility, these have to operate within a model that views the world seamlessly through the consumer's eyes.

This means that individuals and community groups will need tools corresponding to, and integrated with, those for healthcare providers. They will need systems that provide health information, intersectoral applications, and analytic tools. They would enable them to cooperate effectively with healthcare providers once disease is diagnosed. They would also allow all of the partners to cooperate in planning the individual, social and environmental preconditions of health: in moving healthcare interventions upstream.

System

Opportunities for developing countries

Developing countries have opportunities now, not only because technology has advanced to provide more cost-effective solutions but also because technology has been widely enough deployed to provide historical precedents and guidance for cost-effective adoption strategies.

Although high technology is seductive and although it is important to keep an eye on long-term goals, we perhaps should look first at low and medium tech solutions. The technology is not nearly as important as its suitability to the social structure it is intended to serve or as the capability and dedication of the people using it.

Developing countries have opportunities in several ways.

- The ROI curve for health informatics technology is not exponential, but sigmoid. People may think that the greatest return is gotten with the highest and most expensive technology. This is not true.

- There are some high tech, and very useful, projects that can be done without major investment a national telecommunications infrastructure

- Countries that are behind may have opportunities to skip a step and move to higher technology that more developed countries can't get to because of commitments to existing infrastructure.

Standardization

The inability of systems to interoperate would be a decisive hindrance. It often appears that "standardization" would be a means to ensure interoperability. However, it is surely not always the best means. Some forms of standardization are both undesirable and effectively unattainable.

Many standardization committees that have been formed in recent years have failed to come to useful agreement. A main cause of such failures is that there are often good reasons why different manufacturers, or different medical specialties, or different localities have variant implementations of similar concepts. Monolithic standardization, crushing such legitimate differences, may be positively undesirable.

We should not be requiring the diverse components of a country's health care system to adhere to an arbitrary standard taking perhaps years to arrive. *We should regard it as an obligation to develop technology to allow each group to operate in the way natural to it and yet still interoperate with others.* Examples like the multi-vendor CORBAnet Interoperability Showcase show that this can be done.

Distributed Objects

The software [3] should enable the following.

- Consumers, community groups, health care providers, health payers, and government agencies, at different geographic levels, have to be supplied

- with information, with intersectoral applications, and with structural forms of communication

- enabling them to work collaboratively, in ways that foster inherent community dynamics, using data that might be textual, numerical, graphical or multimedia,

- on an integrated system of problems the old model used to include separately under health care, community health, environmental, and social.

Even the simplest prototype subset of the HSPR software, to be persuasive, would have to allow a selection of choices from this menu that would pose a very difficult programming problem. Certainly, tackling any large fraction of the problem by monolithic, top-down architecture, even one using OO techniques, would be impossible.

Yet this seems unreasonable. So many of the tasks to be done in different contexts are so similar. Is there much difference between enabling physicians to meet on the Web discuss a patient and enabling a community group to discuss an environmental problem? The back end is similar, but the complexity of the front end increases geometrically with the number of kinds of players and of problem types.

The solution must be an OO architecture that is, instead, bottom-up. The programs have to be fragmented into independent, distributed components, each containing only a few objects. The data and document components exist first, in the sense that they are operated on by program components that can be interchanged and recombined in a great variety of ways. Data and components are synthesized into executable programs by agents, some nothing more than scripts but many being highly intelligent and directed programs. The resulting macrocomponents can, in turn, be synthesized into still larger scale components, eventually resulting in a software analog of VLSI.

It is important that this componentization exist at the document level as well as at the program level. A user needs to be able to assemble and view, in real time, pages that combine results of diverse programs, according to current needs and context.

The only possible software paradigm is an open, standards-based architecture using *Distributed Objects.*

We believe that the success will depend on making good use of Distributed Object Technology and that the implications of this decision—the engineering possibilities that it opens up— will profoundly influence the health informatics community's vision of what we can offer. It is this that would allow us to implement a vision of governments, community groups, diverse providers, and individual citizens cooperating dynamically to build healthy societies.

References

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