

WORLD HEALTH GRID ©

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As administrators and experts in information technology, we are exposed to a tremendous variety of technical problems and solutions. The problems we typically confront, or chose to confront, are those related to our professional responsibilities that are largely inherited from one generation to the next. Information technology is largely deployed in support of the academic mission at universities, an understandable circumstance. This may seem obvious to the point of being banal. But in so doing we have created an intellectual environment that has become redundant and often narrowly focused. The interesting and rather brave volume, *The Mirage of Continuity: Reconfiguring Academic Information Resources for the 21st Century*, argued for information resource specialist to take on a much broader orientation, calling for “a change in mindset.”¹ One goal of that change was to encourage the information resource specialists to eventually participate in the defining the 21st century institution of higher education, not just the 21st library. This call to a much invigorated purview spoke in part to the traditionally passive role information specialists tend to play at universities, but the horizons to which one is exhorted to expand remain intellectually close to home.

An increasing number of professional meetings involve faculty and academic administrators, but the communication between them and information resource specialists remains halting. Most conference and task force agendas in a given year are reasonably duplicative, with a relative few keynote speakers easily recognized from program to program. I have been struck by this for some time, and believe that this effect may be one of the prices paid for professionalism, organizational structure and efficiency, and the quiet comfort of familiarity in a period of genuine transition and disruptive change.

It was a passing statistic that moved me into a different mindset altogether, a brief fact mentioned in an economics article a year ago: twenty-seven thousand children aged five and under die from preventable causes each day. These deaths occur predominantly in poor and less developing countries. Stated another way, approximately 85 per cent of all the children who die in impoverished conditions could be saved through routine medical intervention. As I began to research these issues, I encountered recent publications from the World Health Organization that correlate an investment by wealthier nations to improve health conditions among the populations of poor and developing countries to significant economic gain for the world at large, as well as effecting the more obvious enhancements to quality of life, productivity, and strength of community. Of particular interest is *Macroeconomics and Health: Investing in Health for Economic Development*², an important work that defines a global program of contributing funds to improve the health of the less fortunate countries as a Global Public Good (GPG), defined as “public goods that are underprovided by local and national governments, since the benefits accrue beyond a country’s borders.”³ The fight against disease requires important investments in GPGs, beyond the means or incentives of any single government and beyond the sum total of national-level programs” (76).

¹ *The Mirage of Continuity*, eds. Hawkins and Battin, CLIR and AAU, 1998, chapter 16, “The Information Resources Specialist,” 270.

² *Macroeconomics and World Health: Investing in Health for Economic Development* can be found at http://www3.who.int/whosis/cmh/cmh_report/e/report.cfm?path=cmh,cmh_report&language=english

³ See also J. Sachs, “The Strategic Significance of Global Inequality,” *The Washington Quarterly*, Summer: 191.

In order to establish a sustained and systemic GPG for the reduction of poverty and improvement of health, policy changes at the national and international level are requisite, as well as the construction of an effective technology-based delivery infrastructure, with information, medicine, expertise, and food among those items needed most critically⁴.

This proposal speaks to one facet of such a GPG, the technical infrastructure needed to deliver information and expertise to remote and areas of the developing world, and concomitantly collect information from those remote sites that would aid in the understanding of disease prevention and promote a program of health maintenance⁵. As the Report notes,

“We need to harness the new information technologies to this cause as well. The internet now makes it possible to distribute medical and scientific journal articles and other information in a low-cost, rapid manner to all places with basic hardware and connectivity. Provisions of such equipment should be an important element of any donor-supported plan for improving health care based on modern information. The possibilities open up by the internet can overcome a traditional deficiency of medical research—the difficulty of delivering information to individuals in poor countries and those not associated with affluent institutions” (84).

Initial research showed that such a system is in fact possible to construct with existing technologies, and would be highly cost effective relative to the predicted economic return. The infrastructure entails three parts: a large scale, robust relational database of information essential for diagnosis and treatment of childhood disease and trauma; the organized data relating to pediatric field work sent back to the information repositories to update the existing records and for analysis of the effectiveness of treatments as well as providing descriptions of current health and environmental conditions; and a brief description of the technical specifications that would make this system possible. The term ‘grid’ is used in a more traditional sense—an organized system of distribution of resources—and as an evolving technological application that allows large scale, cost effective sharing of data, instrumentation, storage, computers, and visualization tools in support of this global project.⁶

1. Database Information to the Remote Site

Distributed, linked databases that can be queried easily and against which a variety of reports can be written are fundamental. This information could be maintained at different locations but would need a common platform and architecture to work effectively. While it is possible to access the Web and call up hundreds of thousands of sites relating to pediatrics, the World Health Grid requires that critical information be uniformly structured and relational to promote a comprehensive analysis of existing information pertinent to the patient or condition in question, i.e., a robust array of diagnostic tools. Rather than try to recreated or recode existing databases, an XML schema is proposed that would federate existing data and provide an easily

⁴ A brief overview of these problems is succinctly described by Jeffrey Sachs in “Helping the World’s Poorest,” <http://www.cid.harvard.edu/cidinthenews/articles/sf9108.html>

⁵ See “Unmet Needs in Public Health”, *Science* Vol 295 15 March 2002, 2035-2050.

⁶ Relevant is D. Gwatkin, *Poverty and Inequalities in Health within Developing Countries: Filling the Information Gap*,” in D. Leon and G. Walt, eds. *Poverty, Inequality, and Health: An International Perspective*. Oxford: Oxford University Press, 2000. pp.217-246.

used access point that bridges various data sets and allows for searching across different information sources. Practitioners at remote areas of the globe could employ this common interface and query the data most pertinent to them at the time.

A list of databases of immediate value to the Grid would include:

- (1) Manuals of illness, diseases, symptoms, and diagnostic tools.
- (2) Global registry of specialists: names, contact information.
- (3) Health education programs and curricular materials.
- (4) Medicines: description, side effects, location, costs.
- (5) Online journals, abstracts, preprints
- (6) Environmental profiles by country/region:
 - (a) Locations of safe water supplies.
 - (b) Location of polluted sources (symptoms and treatment).
 - (c) Location of emergency food supplies.
 - (d) Location and description of health services.
 - (e) Location of disease outbreaks.
- (7) Changing environments: for instance,
 - (a) Areas of increased rainfall, marshlands=malarial hazard.
 - (b) Areas of receding vegetation=migrating rodent populations=disease spread.
 - (c) Areas of drought.
 - (d) Areas of expansive development and land management.
 - (e) Areas of deforestation.
- (8) Nutritional guides.
- (9) Geopolitical data: areas of conflict, war zones, disrupted food and water supplies.

2. Data: Information Flowing from the Remote Site

Given the difficulty of accessibility and heretofore poor communication means, much of the information pertaining to health conditions in remote locations has been difficult to gather and as difficult to contrast and compare across regions. The Macroeconomics and Health report states the need for remedy of this succinctly:

“There is still much to be learned about what actually works, and why or why not, in many low-income settings, especially where interventions have not been used or documented to date. Even when the basic technologies of disease control are clear and universally applicable, each local setting poses special problems of logistics, adherence, dosage, delivery, and drug formulations that must be uncovered through operational research at the local level.” The report supports the allocation of resources “to project-related operational research in order to examine efficacy, the optimization of treatment protocols, the economics of alternative interventions, and delivery modes and population/patient preferences.”

Similarly, the International Network for the continuous Demographic Evaluation of Populations and their Health (INDEPTH) has created a network of demographic surveillance systems (DSS) in 29 locations in 16 countries, most of them in sub-Saharan Africa. As the most recent INDEPTH publication notes, the “great void in population-based information constitutes a major and long-standing constraint on the articulation of effective policies and programs to improve the health of the poor and thus perpetuates profound inequities in health.”⁷ This project follows the example of INDEPTH, but requires a more detailed data profile for information gathering and assessment. The reference data model for INDEPTH tracks information on births, deaths, migration (characterized as ‘events’) and ‘episodes,’ including marriage, pregnancy, and change in membership of a social group. Pertinent to the Health Grid proposal, INDEPTH forms for Death of Children from Day 31 to Age 5 includes a list of nearly 50 symptoms that can be entered for data analysis.⁸

Each Grid site serves as a node for surveillance and ongoing information updating of local conditions. Sensors can automatically gather and send to the appropriate database local climate conditions; relevant information that could be entered routinely and merged with existing databases might include:

- (1) Mortality figures and cause of death
- (2) Local health problems, such as nutritional deficiencies
- (3) Records of interventions and their success or failure
- (4) Changes in political stability
- (5) Noteworthy environmental changes
- (6) Local ecosystem changes (occurrence of rodents, insects, non-native species)

The Health Grid will adopt the health Level 7 standard, using HL7 Reference Information Model, Templates for both simple and more elaborate diagnostic procedures, and the Messaging Standard developed for v. 3.0⁹

3. Satellite Delivery System

The satellite frequency bands most often used for telephony and data are C-band, Ku-band, and Ka-band. The table below provides a comparison of characteristics.

Band	Frequency Used	Dish Size
C	4/6 GHz	8-20 M
Ku	11-12/14 GHz	<2.5 M
Ka	17-31 GHz	<2M

The lower frequency C-band requires a large and expensive earth terminal, with bandwidth more restrictive at higher frequencies. The C-band is most often used for television feeds between companies and distribution to cable operators. It is also used for telephony primarily by

⁷ Population and Health in Developing Countries. Vol.1. Population, Health, and Survival at INDEPTH Sites. International Development Research Center, 2002. 1

⁸ Ibid., 318-319.

⁹ See <http://www.hl7.org>

common carriers. The transponder cost compares favorably with Ku-band, but the earth terminal cost and large size makes it impractical for most grid applications.¹⁰

The Ka- and Ku-bands feature low-cost, very small aperture terminals (VSATs), and ultra-small aperture terminals (USATs). The only disadvantage for the higher frequencies is that they are subject to more rain-fade in areas that have heavy downpours such as the tropical zones. The Ku or Ka-bands economically meet the requirements for the health grid. Ka-band satellites utilize “spot beams,” which result in smaller, lower power terminals.¹¹ Systems providing high-speed Internet access TCP/IP protocol in the Ku-band and especially the Ka-band may be more economical and more easily integrated with terrestrial options and other applications¹². Security and privacy issues can be addressed by creating a VPN.

A new communications system exists that support simultaneous LAN and ISDN interconnections as well as isochronous services such as videoconferencing. The system, called “Local Network Interconnection via Satellite Systems,” has been specifically tailored for optimizing applications on top of TCP/IP. High-speed Internet access via satellite and novel multicast applications can be provided efficiently. The system has been successfully tested for distributed business applications (multipoint videoconferencing, applications sharing) and telemedicine trails. Videoconferencing, Web browsing, application sharing and ISDN telephony have been demonstrated using this technology.¹³ The health grid requires de facto a cost effective, easily deployed, and easily replicable base station model. The small size, relatively low costs, and portability of a ka band solution running TCP/IP protocol with data collected using HL7 templates seems a reasonably sound approach.

Policy

The technical, policy, and humanistic issues surrounding this project are complex and interrelated¹⁴. Only the intersection of scientists, technologists, policy makers, and humanists can effectively bring about the desired ends¹⁵. If the technical infrastructure proves to be functional, then a major focus on policy changes necessary to establish a world grid for improving children’s health in impoverished nations becomes paramount. These policies would include laws and regulations for multinational broadcast, economic policy to fund the grid, intellectual property policy for the timely dissemination of scholarly information, and assumable risk.¹⁶ With so much at stake, and especially in light of the technical feasibility of successful implementation, the next appropriate steps would be to find funding to construct a database prototype with extensible properties and field test methods of satellite information delivery. Concomitantly, it is

¹⁰ The Health Grid is a Web based solution; this project should not be confused with Satellife, an admirable project also dedicated to the remote delivery of health information via email. See <http://www.satellife.org/index2.php>

¹¹ Helpful research for this section was conducted by Technology Futures, Incorporated (TFI), L. Vanston and D. Smith. <http://www.tfi.com>

¹² Some background can be found at: <http://www.adec.edu/nsf/tcpip-performance.pdf>

¹³ A synopsis can be found at <http://students.cs.byu/~curtis/460.proj.writeup.html>

¹⁴ Excellent background to these issues is *Challenging Inequities in Health: From Ethics to Action*. Eds. T. Evans, M. Whitehead, F. Diderichson, et al. New York: Oxford University Press, 2001. Reviewed at <http://jama.ama-assn.org/issues/v287n6/ffull/jbk0213-1.html>

¹⁵ See A. Sen, *Development as Freedom*. New York: Alfred Knopf, 1999.

¹⁶ See Joseph Nye’s, “The new Rome and the new barbarians,” in *The Economist* 21 March 2002:

http://www.economist.com/displaystory.cfm?story_ID.1045181. Also, Nye’s *The Paradox of American Power: Why the World’s Only Superpower Can’t Go It Alone*. New York: Oxford University Press, 2002.

essential to gain support for recommending key policy changes that could bring this project to life.¹⁷

If indeed this project comes to fruition, it will have begun as an application of existing information technology economically deployed for a global public good. The Health Grid is, in essence, a digital library project, and has elements of content creation, management, searching, analysis, federation of disparate data sources, and network topology that are common to discussions around the coffee machine in research libraries today.

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¹⁷ M. Kenner, "Public Policies to Stimulate Development of Vaccines and Drugs for Neglected Diseases," CMH, July 2001.