Perspective: Archimedes

Archimedes: A Bold Step Into The Future

A promising new model for improving care, which deserves a solid policy foundation as it moves into use.

by John R. Lumpkin

ABSTRACT: The increasing adoption of electronic health records (EHRs) enables the development of new tools to guide clinical research, clinical protocol development, and national policy formulation. Archimedes is an example of a new generation of tools that go beyond identifying past problems with medical devices and pharmaceuticals or failures with health care delivery to predicting potential problems and identifying new treatments and approaches that can improve care. Although the arrival of this new generation of tools raises some concerns, the tools’ great potential for improving care must be carefully considered.

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The world of health information technology (IT) has changed dramatically in the past five years. Electronic health records (EHRs) and the associated support systems have catapulted from obscurity into the stratosphere of presidential attention. Although adoption rates among individual physicians remain low, EHRs’ ability to reduce errors and improve quality, coupled with the high priority placed on adoption by national leaders, can be expected to lead to increasing adoption over the next few years.1

EHRs along with the redesign of care delivery can have a big impact on quality through the implementation of decision support. This technology enables the EHR to provide situational knowledge to the clinician in the form of reminders or suggested diagnostic or therapeutic steps.

Current uses of health data. In the nineteenth century, pioneers such as John Snow and Florence Nightingale demonstrated the power of using data derived from individual health experiences to answer health questions affecting large groups. Snow used the data to identify the cause of an outbreak of cholera, and Nightingale used the data to drive improvements in military hospitals. Large-scale longitudinal studies, such as the Framingham Heart Study, have demonstrated the power of large databases to identify health risks and demonstrate the effectiveness of interventions.2 Yet despite their proven effectiveness, the construction of these large databases has been restricted by their very large costs. The collection of data from paper-based clinical records is labor-intensive, time-consuming, and expensive.

To serve their primary function, EHRs accumulate large quantities of data in a readily accessible electronic format. In an interoperable environment, data that are stored in many

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locations are assembled as needed to aid clinical decision making by the patients and their clinicians. Just as clinical data in a paper-based world can drive public health interventions, quality improvement, and research, the data in EHRs can be used for a number of similar secondary purposes.

Several papers in this collection note how large amounts of clinical data made accessible by electronic health information systems can enable rapid assessment of drug and treatment protocol effectiveness as well as identification of unsuspected adverse outcomes. The important work reflected in these papers shows how current tools can be improved with access to more data in a timely fashion.

 ■ Promise of Archimedes model. In contrast, David Eddy’s development of the Archimedes simulation model represents the beginning of a new phase of rapid learning enabled by the health information revolution. Traditional studies use data to determine what happened at some point in the past. In the case of a_n adverse side effect of a pharmaceutical, analysis of large volumes of clinical data can rapidly identify findings that might not be apparent with relatively small clinical trials. Analysis of large clinical data sets can also determine trends in patterns of care that result from the adoption of treatment protocols or policy changes. In each instance, the data analysis determines what happened in the past to guide actions in the future. The patients affected are real people who must live with real consequences. The key innovation in the development of simulation models like Archimedes is that alternative approaches to care and health care policies can be tested before they are implemented. Clinical trials can be performed in an electronic environment indicating usefulness of new techniques and treatments. The important difference with the simulation model is that deaths and injuries or failed improvements are happening to virtual people, not real ones.

As such, Archimedes is to health IT what the first amphibian that crawled out of the primordial swamp was to evolution of human beings: an important evolutionary step and one that foreshadows future wonders. In 1969, the ARPANET was just a tool that a bunch of geeks at four universities used to share research data. Few, if any, could have envisioned that this network would grow into what we know as the Internet. No one could have imagined all the ways the Internet would be used to advance communications, commerce, entertainment, and research. In fact, the Internet has become the base infrastructure that enables interoperability in health IT systems. Archimedes gives us that glimpse into a future where health information is easily accessible to be manipulated in real time to improve the health and health care of all Americans.

 ■ Concerns. The importance of this development must be tempered by concerns that must be addressed by the development of a simulation modeling system like Archimedes. Archimedes is built on the records of the real-world experiences of individuals over time. The raw material that enables the building of a model like Archimedes is information about real people and real health experiences. A longitudinal record has to be built based on identifying data that belong to an individual, linking those data over time and geography. As the model is built, any connection between a real person and the string of information is severed as the data are deidentified and aggregated. Because Archimedes is used to simulate the impact of an intervention of a population of people, the structure and use of the model inherently protect individuals from identification. The use of data in this way is called secondary use. A recent report from the American Medical Informatics Association (AMIA) notes:

Secondary use of health data can enhance health care experiences for individuals, expand knowledge about disease and appropriate treatments, strengthen understanding about the effectiveness and efficiency of our health care systems, support public health and security goals, and aid businesses in meeting the needs of their customers. Yet, access to and secondary use of data poses complex ethical, political, technical, and social challenges.

 ■ Privacy. The most immediate social challenge is the protection of privacy. The deliber-
ate or unintentional release of individually identifiable health information can have devastating affects on an individual. The trust that exists in the health care system is based in part on the belief that private information will be kept private. Although Archimedes itself is protective of privacy, very clear and stringent procedures must be adopted in the construction and maintenance of the model to assure that individual privacy is protected. The AMIA report recommends that addressing the policy issues related to secondary data should be high on the national policy agenda. Archimedes’ ultimate usefulness will depend on a firm policy foundation for the secondary use of clinical data.

Assumptions and biases. The second concern is more conceptual. If Archimedes or similar modeling systems are as powerful as the early indications indicate they are, progress in identifying problems and finding solutions can be greatly facilitated. Sizable resources can be preserved by avoiding dead ends before actual research and clinical trials are performed. Promising lines of research can be tested and implemented efficiently and effectively. However, the construction of any model reflects the assumptions and biases of those who build it. Today those assumptions and biases would have minimal impact on an Archimedes-based assessment of an innovation. Over time, though, the assumptions and biases built into the model might become less valid as new research accumulates and knowledge advances. It will be important for the model’s ongoing usefulness that the inherent biases and assumptions be reevaluated regularly.

Future innovation. Finally, as innovative as Archimedes may be, its existence may stifle future innovation if research funders rely too heavily on Archimedes as the arbiter of the usefulness of exploring lines of research. Innovation comes in the form of unconventional approaches to conventional problems. As Archimedes and similar simulation models become conventional, their ability to assess unconventional approaches will need to be used with caution.

Those concerns aside, the development of Archimedes as described in Eddy’s paper represents an important development in the world of health IT. As a powerful tool for the present and a harbinger of things to come, it represents a new age in the application of IT to preserving and restoring health.

NOTES
3. A listing of these papers is available at http://content.healthaffairs.org/cgi/content/full/hlthaff.26.2.w107/DC2.