

## **e-Health: Improving Public Health Care**

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## Abstract.

This paper presents the evolution of a public health care model which is supported by a public health management system that uses online electronic medical records since 1990. The system improves the efficiency of the public health clinics network, enhances the quality of services provided, controls immunization programs and generates epidemiological data for health programs and preventive medicine. It is being used by several large cities, encompassing a total population over 4 million inhabitants. It is presently being implemented in the public health network of the Amazon State using Internet architecture.

## 1. Introduction

Brazil has a health care model – SUS (Sistema Único de Saúde – Unified Health System) with full coverage to every citizen. The administration of the health care budget and payment to the providers are managed at the municipal level and depends on its population and services provided. The healthcare budget comes from federal, state and municipal taxes, not from Social Security. In 2001 the average expense per inhabitant from federal funds [1] was US\$ 38.84 (using 2.20 for the average value for the exchange rate). In general only the lowest income part of the population uses this public system. Because of the poor infrastructure available, most companies offer health insurance to their employees as a fringe benefit.

Every city has a network of clinics that provide free medical services to individuals, especially infants and children, pregnant and nursing women and other conditions. These clinics provide prenatal and pediatric care for children who have no regular access to medical care. The clinics may provide free medications, visiting nurses, home health care services and a family doctor. These public health clinics routinely screen patients for a number of infectious diseases and track the incidence of certain communicable diseases in its area. One of the most important activities of these clinics is immunization.

In larger cities this public network has also more specialty clinics that provide also medical tests and exams. Some have emergency facilities and hospitals. Smaller cities rely on facilities provided by the State for more specialized care.

With all these responsibilities, limited operational funds and not enough health personnel to attend the

population that go to the clinics, most of these networks operate without proper management infrastructure. The typical scenario in front of these clinics is a very long line of people waiting to receive care. The data gathered on infectious and communicable diseases is unreliable and information to subsidize preventive medicine is lacking.

## 2. The public health management system

In 1991 Dr. Capistrano was the Municipal Health Secretary for Santos, a major port city in São Paulo State. He and his team of health professionals partnered with a software company to develop a public health management system for Santos that could also be adopted by other municipalities.

He was a visionary and proposed that if our bank account could be accessed at any time from a bank terminal, we should have the same facility for our health. He wanted a system that organized the demand for health care, which kept a single electronic medical record for every patient and could be accessed online from any of the clinics, apart from automation of all administrative tasks and production of statistical data. Techne accepted the challenge and developed Hygia on mainframe architecture at that time.

## 3. Main functionalities of the system

In order to understand the impact of such a system in the public health network it is important to list its main functionalities.

- Appointments are scheduled centrally or locally or by phone.
- Medical records are kept on-line in a central database and retain full information on all visits for user defined period. Information retained includes demographics, diagnosis, procedures, consultations, physicians, dentists, health professionals and serves as a complete clinical data repository.
- Medical records can be recalled by name, patient number (SUS number) and other personal data
- Abstracts, reports, and retains all required information for each patient.
- Maintains the ICD10 diagnosis/procedure code files as well as editing codes describing

diagnosis usage (i.e., primary, secondary, vague, sex, age).

- Requisitions of exams are made online and the results are received online and registered in the patient medical record.
- Patient Record Access Audit documents all personnel that have accessed on-line any clinical information for a specified date range.
- Registers medication prescribed and sends prescription to pharmacy.
- Registers medication delivered to patients and takes care of pharmacy stock control.
- Maintenance of physician file which includes physician's code number, name, address, primary, secondary, and tertiary services, telephone number, educational data and certifications
- Maintenance of health professionals file which includes code number, name, address, telephone number, educational data and certifications
- Work schedule of health professionals
- Registers and controls health programs designed to assist risk groups (High Blood Pressure, Diabetes, Aids)
- Built-in protocols for immunization according to patient profile
- Controls immunization programs, sends letters to patients that missed immunization and produces reports on patients that did not show on the dates specified to continue immunization
- Produces statistical data on procedures, productivity of health professionals, diseases by region, sex, age.
- Epidemiological data
- Automates billing for SUS

From its mainframe initial version Hygia evolved to client-server architecture and its latest version is based on Internet architecture and runs on either Oracle or SQL Server database.

#### 4. Implementation in other cities

Santos became a reference center for public health care for other municipalities and even other Latin American countries, receiving visits of public health agents interested in optimizing the use of resources and improvement in health care.

Presently Hygia is being used by the following cities: Campo Grande, Londrina, Betim, Ribeirão Preto, São Bernardo do Campo and Manaus.

Unfortunately a change in the public health management at the city of Santos caused a decision of bidding for a new system with improved functionalities. The new system is not yet completed and the part that is already implemented does not have the electronic medical records.

#### 5. Costs

In the case of Betim city, with 350,000 inhabitants, the full cost for implementing the public health management system, including software, training of personnel and acquiring of equipment was US\$ 0.63 per inhabitant/year, for a period of four years. After that, costs decrease, but there will be always need for upgrading equipment [8].

Santos had evaluated that the decrease of administrative personnel used in the clinics paid for the costs of the information system implementation.

There is a significant decrease of administrative work. The usual paper-based charting systems used in the public system clinics require a high allocation of administrative labor dedicated to the retrieval and management of charts. Additionally, paper systems impose labor inefficiencies on the daily operations of clinics because the chart is not universally and instantly accessible in different clinics of the system. With centralized medical records patients can be scheduled in any of the clinics distributing the load in a more rational way.

Also the activity of gathering epidemiological data from paper charts is labor intensive and unreliable. With the Electronic data record this activity is eliminated because all necessary data and statistics derive directly from the central data base.

Another cost saving is produced by the pharmacy control provided by Hygia. A significant decrease in the

costs of medication was observed, suggesting that there was evasion of medicaments prior to the implementation of the system.

There was a significant decrease of expenses with exams for diagnostic. Before the implementation of the electronic data record system, when a patient from one of the clinics went to a different clinic, usually the exams for diagnostic were repeated.

## 6. Results

There has been several studies on the impact of such a system. Henriques and Campos [2] edited a book about the implementation in Santos. There were a few Master Thesis analyzing the improvement in the immunization programs produced by using Hygia [3,4]. However none of the studies produced quantitative data to measure the impact of the system, because there was no previous data to compare.

Some of the studies conducted [3-6] stress that Hygia integrates with CENEP, the national system on epidemiology at the Ministry of Health as well as with the information systems from DataSUS [7], maintaining locally a database with the regional data. Because this data derives directly from the data base that stores all data from patients, data is highly reliable and there is a significant decrease of administrative work related with data gathering.

Another interesting study was conducted [7] to evaluate the impact of decision support systems in the public health network of Ribeirão Preto. They studied the use of Hygia by health professionals and concluded that the full potential of Hygia's data base is not been utilized. As a result of this study, the Nursing School from University of São Paulo is developing two courses designed to better prepare health professionals on the use of information. A new research group was also started to deal with the use of information for planning and decision making in public health.

In general the improvements observed in the cities that are using Hygia are all of qualitative nature:

- The cities that use Hygia have a good scheduling of patients and there are no people in line waiting for care outside the clinics.
- Health professionals are freed from administrative burden and can provide more and better patient care.

- The electronic medical record provides clinicians with a set of tools—not available with paper-based systems—that directly affect the quality of patient care and service. The detailed medical records contribute to better diagnostics and treatment.
- There is a better control of epidemics and health programs are based on actual data.
- The detailed medical records contribute to better diagnostics and treatment.

There is need for more quantitative data on the impact of such a system on the quality and efficacy of public health care. A similar system could be very valuable for other Latin American countries.

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