



The new data-driven enterprise architecture for e-healthcare: Lessons from the Indian public sector



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ABSTRACT

Healthcare delivery is a complex issue and better planning of resources is important. The Indian Government suggested the requirement of developing a healthcare framework for providing easily accessible, affordable healthcare and universal health coverage to all citizens in India. The Health Management Information System (HMIS) at Tamil Nadu was conceptualized in response to this requirement as a case of architectural correction from the manual to a unified healthcare system covering more than 74 million people and 2000 plus healthcare institutions in the state. The system consolidates state-level data in real time, links all health institutions, and makes it possible to track individual health indices. This data is used for planning healthcare, managing drug inventory, and planning health initiatives at the state level. We study the modified enterprise architecture (EA) of Tamil Nadu Health Management Information Systems (TNHMIS) and its comparison to existing EA approaches and operating models. We also discuss the high-level core diagram, the key elements of business processes, IT infrastructure, shared data and customer interfaces and how they are linked. We suggest an EA based approach to managing healthcare.

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1. Introduction

Health is associated with physical and mental well-being. Healthcare therefore becomes an essential sector to be addressed so as to holistically manage the social sector. Health not only increases the productivity in the human beings, but also instills a feeling of strength to contribute towards a society. In the Indian context, the National Rural Health Mission (NRHM) was launched in April 2005 by the Government of India. The goal of the NRHM was to provide accessible, affordable and quality healthcare to the rural population with a focus on 18 states (out of a total 28 states in India)¹ that had poor public health indicators and/or weak infrastructure. Tamil Nadu was one of these 18 states where the health indices were particularly poor and the manual systems existed. The Tamil Nadu government initiated changes at the policy, processes and systems level in view of the National policy which has yielded results. The state health rural mission (SHRC) was launched in Tamil Nadu in 2005, with a – “view to bring architectural correction of the health system to enable it to effectively handle increased allocation and promote policies that strengthen public health management and service delivery as prescribed under NRHM of India”² for the period 2005 to 2012. The state introduced new systems driven by the objective of improving the effectiveness of healthcare by leveraging technology and rationalization of key processes.

Though prior studies (Mutemwa, 2006) mention that health information systems have been an important enabler of health policy, the role of the enterprise information strategy has not been emphasized. We, therefore pose the following research questions:

- RQ1: How does health information policy influence the health information flows and practices?
- RQ2: What is the relevance of EA-led approach to planning and delivery of healthcare services? What could be the operating model and enabling EA for a large-scale healthcare project?
- RQ3: What is the impact of HMIS in improving information management and delivery of healthcare services?

To address these questions, we discuss the case of TNHMIS. Prior to the HMIS, the manual systems for healthcare management were in place, which had many challenges. For instance, the system of data collection and use was fragmented, disease specific, inconsistent and often of poor quality. Further, the expanding public health systems made the administration of healthcare even more complex. We studied the existing enterprise architecture (EA) approaches and the TNHMIS project in detail and found that the unification led EA model proposed by Ross, Weill, and Robertson (2006) sufficiently explains the EA of TNHMIS. Accordingly, the operating model and EA for healthcare is proposed in this study.

The paper is divided into multiple sections. In this paper, we first synthesize the literature on significance of healthcare policies on

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¹ www.indiaportal.gov.in.

² <http://www.nrhmtn.gov.in>.

enterprise information strategy and architecture in Section 2. This section also presents the health policy in India and the Tamil Nadu health policy in particular to understand the government structures of health policy. In Section 3, the relevance of enterprise architecture (EA) led approach to healthcare planning is discussed. Further, Section 4 explains the research approach. In Section 5, we discuss the enabling EA for a large-scale healthcare project as in Tamil Nadu. In Sections 6 and 7, we exemplify how the health policy and TNHMIS affect the government information flows, the availability of information and delivery of healthcare services in Tamil Nadu. Finally, the conclusion and research agenda for the future are drawn based on this research.

2. Significance of health information policy in relation to health information flows and practices

The delivery of healthcare services and medicine has seen a transformational change over the last few years. As people are experiencing better health services in the private sector, they expect better delivery from the public sector too. Therefore, better planning of resources for the delivery of healthcare services is important. Healthcare delivery is a complex issue (Braa, Monteiro, & Sahay, 2004). Though healthcare information system has yielded success, there have been few cases of failures also. In such cases, public health incurs financial losses as the system does not function properly. There are opportunities as well, in terms of patients who could have been served through better healthcare.

Information is important in making healthcare decisions and technology solutions make the information more accessible at all levels — specifically for the patients, healthcare providers and non-health providers in the healthcare sector (Kumar, 2011). Even though the health policy may be based on centralized planning, priority setting, and training in information systems, the policy implementation in the case of healthcare systems is a complicated task (Cassels, 1995; Chopra et al., 2009; Gladwin, Dixon, & Wilson, 2003). The complexity increases due to non-prioritization of tasks in tandem with policy priorities. Therefore, mapping policy priorities with facilitating mechanisms like information technology implementation becomes important.

The examples of developed countries show how the innovation and organization change strengthened with policy can help in the better use of HMIS, whereas the example of the developing countries portray the case of redefining the system as per the changing policies. In developed countries like United States of America, e-prescribing occurs in the context of electronic medical record (EMR). However, only 15% of the medical groups have actually installed EMR systems (Smith, Bradley, Bichescu, & Tremblay, 2013). The electronic health records are becoming successor to the EMR systems. In the U.S., the Health system strengthening funding in 2012 includes 28% for system level interventions (U.S. \$139 million). The major functions that form a part of the assessment framework are the strategies to increase evidence-based planning and increasing the accessibility of information (Warren, Wyss, Shakarishvili, Atun, & de Savigny, 2013). The UK government intended to spend six billion pounds on the IT systems (Connell & Young, 2007) in healthcare.

The health policy and the information system research face a lot of challenges in the context of developing countries. Several reports show that the healthcare research and reporting face a lot of issues with respect to data collection, over-reliance on surveys, poor information use, lack of strategic vision and architecture and lack of an overall information strategy (Braa, Heywood, & Shung King, 1997; Gladwin, 1999; Lippeveld, Sauerborn, & Bodart, 2000; Van Hartevelt, 1993). The study on Mexican health information policy (Durán-Arenas et al., 1998) mentions that the integrated quality information system for the health information management helped them in the standardization of healthcare needs and to measure and compare the quality performance of health facilities worldwide.

The study on Jordan on the new integrated clinical record (Khreshheh & Barclay, 2007) construes that the health information system not only helped the managers, but demonstrated improved clinical reporting and served as basis for policy makers in developing the national maternity data monitoring system. Further, the studies on Papua New Guinea (Cibulskis & Hiawalyer, 2002) mentioned that coordination of system design is important to ensure alignment of information with government priorities. The study concluded that good implementation of systems in a strategic manner coupled with the skills of human resources helped them churn out a good system. The study on China rural healthcare information system (Liu et al., 2013) mentions that the health information systems helped in China's national health reforms by improving the accessibility, appropriateness and affordability of healthcare.

The studies on Zambia (Mutemwa, 2006) show that there is a need to radically rethink about the solutions that could help them become accountable in a better manner. The case of Uganda (Gladwin et al., 2003) indicates that the diffusion of innovation models by Rogers can be aptly applied to the health management information system. They draw a framework which shows how structure, intended strategy, individuals and roles with the help of management style, tools and procedure help in the apt data collection, processing of health information and helps the health manager portray an informational approach. Studies on Malawi (Chaulagai et al., 2005) deduce that despite following a strategic planning process, the improvement in rational decision-making could not be achieved. They mention that the commitment from the leadership is equally important to put health policy into action.

The health policies have been strengthened with the help of the health system decentralization coupled with the health system reforms such as HMIS (Mutemwa, 2006). HMIS has been construed as an important element helping the strategic management of healthcare in both developing and developed nations. The health systems contribute towards improved accountability in terms of financial, performance and political/democratic accountability, and helps generate a system wide perspective on health sector reform, connections in individual improvement interventions and reveal the gaps requiring policy attention (Brinkerhoff, 2004). The world health organization (WHO) has an important role in supporting the information led healthcare. The WHO global healthcare policy recommendations include setting bold national goals, tying funding to development and adoption of common standards and engaging key stakeholders. It further recommends the policies that can secure patient data and improve broadband capacity of the regions.

2.1. Health policy in India

The national health policy was endorsed by the Parliament of India in 1983 and further updated in 2002. The National Rural Health Mission (NRHM) was launched in April 2005 by the government of India, whose goal was to provide accessible and affordable quality healthcare in rural areas of 18 states, which had poor public health indicator and/or weak infrastructure. The NRHM was planned to be converted into the national health mission (NHM) to cover all the villages of the country. Under the NHM, it was proposed to provide flexibility to the states. India's health sector was allocated INR 3, 73,300 million in 2013–14 which is an increase of 8.24% from the previous year. The Health research was specifically allocated a budget of INR 6, 600 million. Subsequently, the twelfth plan by National Planning commission of India (Planning Commission, 2013) suggested that the start must be made towards achieving long-term goal immediately by putting into place longer term architecture for health. The vision was to develop a framework for providing easily accessible and affordable healthcare for Indians. Further, the universal health coverage was defined as “the equitable access to health by all citizens, regardless of where they reside, their social status, gender, caste or religion to affordable and accountable public health services where the government is the guarantor and enabler of

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