Relationships between Healthcare Analytic Capability, Hospital Quality Management and Service Quality Performance

Presenter: Dr Kelvin LO

Co-authors: Dr Peggy NG

Dr Tiffany LEUNG

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Outline

- Background
- Literature Review
- Conceptual Framework
- Future Research
- Open discussion

Background – Big Data Analytics

- *"…the process of analyzing and understanding the characteristics of massive size datasets by extracting useful geometric and statistical patterns…"* (Suthaharan, 2014)
- *"…involving analysis of huge data in order to unmask valuable patterns/information…"* (Hafiz *et al.*, 2015)

Background – Data in Healthcare sector

- According to Chen *et al.* (2012),

Table 2. BI&A Applications: From Big Data to Big Impact

	E-Commerce and Market Intelligence	E-Government and Politics 2.0	Science & Technology	Smart Health and Wellbeing	Security and Public Safety
Applications	• Recommender systems • Social media monitoring and analysis • Crowd-sourcing systems • Social and virtual games	• Ubiquitous government services • Equal access and public services • Citizen engagement and participation • Political campaign and e-polling	• S&T innovation • Hypothesis testing • Knowledge discovery	• Human and plant genomics • Healthcare decision support • Patient community analysis	• Crime analysis • Computational criminology • Terrorism informatics • Open-source intelligence • Cyber security
Data	• Search and user logs • Customer transaction records • Customer-generated content	• Government information and services • Rules and regulations • Citizen feedback and comments	• S&T instruments and system generated data • Sensor and network content	• Genomics and sequence data • Electronic health records (EHR) • Health and patient social media	• Criminal records • Crime maps • Criminal networks • News and web contents • Terrorism incident databases • Viruses, cyber attacks, and botnets
	Characteristics: Structured web-based, user-generated content, rich network information, unstructured informal customer opinions	Characteristics: Fragmented information sources and legacy systems, rich textual content, unstructured informal citizen conversations	Characteristics: High-throughput instrument-based data collection, fine-grained multiple-modality and large-scale records, S&T specific data formats	Characteristics: Disparate but highly linked content, person-specific content, HIPAA, IRB and ethics issues	Characteristics: Personal identity information, incomplete and deceptive content, rich group and network information, multilingual content

- Genomics and sequence data
- Electronic health records (EHR)
- Health and patient social media

Background – Data in Healthcare sector

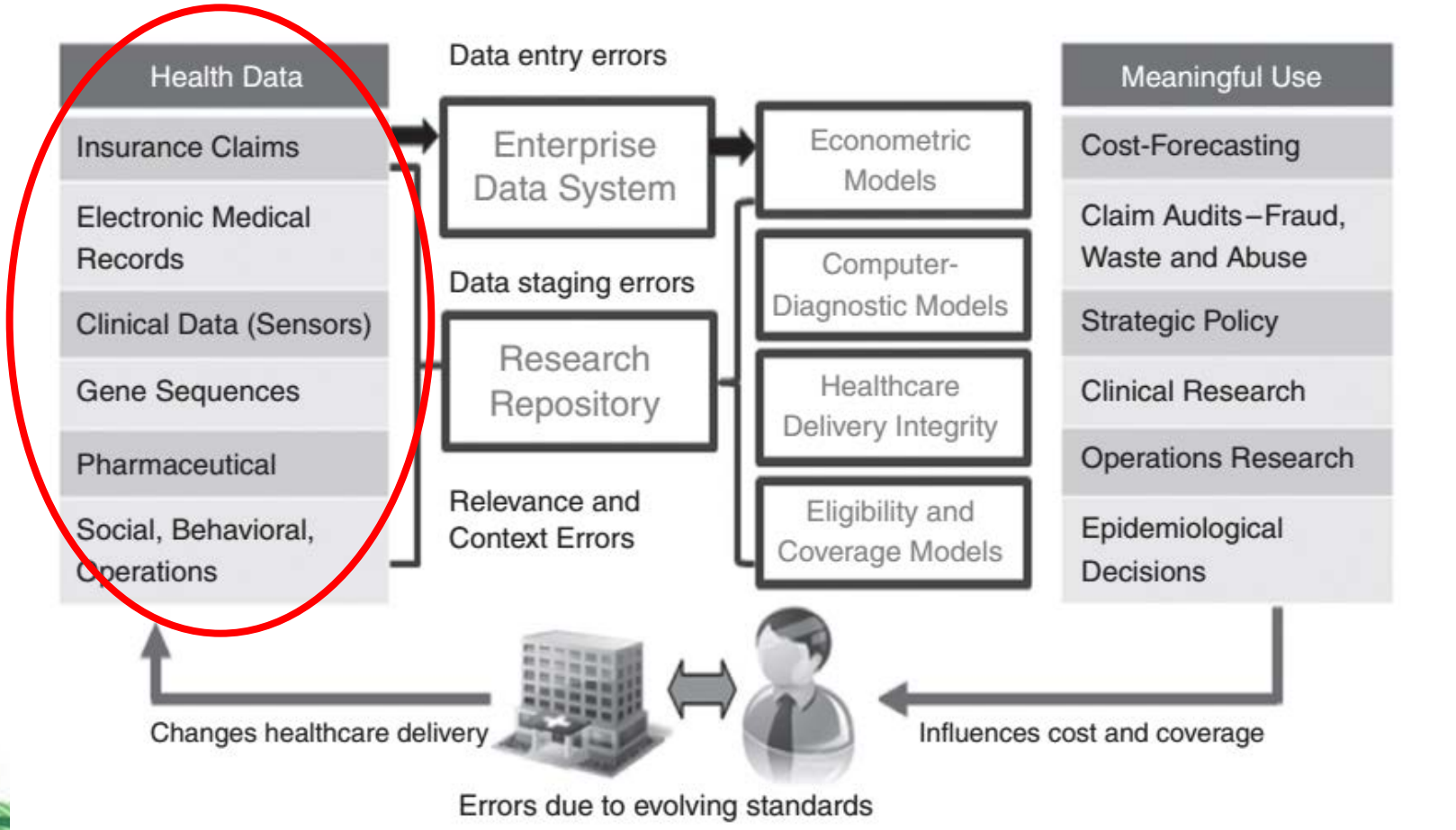
- According to Ward *et al.* (2014),

Table 1. Example data sources within a healthcare delivery system

Data Source	Data Generated
EHRs	Clinical documentation, patient history, results reporting, and patient orders.
LIMS	Laboratory results. Typically interfaced with EHRs.
Diagnostic or monitoring instruments	Range from images (e.g., magnetic resonance imaging) to numbers (e.g., vital signs) to text report (result interpretation). May or may not be interfaced with EHRs.
Insurance claims/billing	Information on what was done to the patient during a visit, the cost of those services and the expected payment. The level of service is often determined from data in EHRs.
Pharmacy	Information on the fulfillment of medication orders. Not typically part of EHRs.
Human resources and supply chain	Lists of employees and their roles in the institution and the location and utilization of medical supplies. Not typically interfaced with EHRs.
Real-time locating systems	Positions and interactions of assets and people.

Background – Data in Healthcare sector

- According to Sukumar *et al.* (2015),



Background – In Hong Kong…

醫健通 ehealth 電子健康紀錄互通系統 Electronic Health Record Sharing System

CDS Communicable Disease Information System

Background – Healthcare Analytics

- Raghupathi & Raghupathi (2013) summarizes that
  - "*…systematic use of data and related clinical and business insights developed through applied analytical disciplines such as statistical, contextual, quantitative, predictive, and cognitive spectrums to drive fact-based decision making for planning, management, measurement and learning…*"
  - "*…collection of decision support technologies for the health care provider aimed at enabling knowledge workers such as physicians, nurses and health officials, health policy makers and pharmacists to gain insight and make better and faster health decisions…*"
  - "*…use of data, information technology, statistical analysis, quantitative methods, and mathematical computer-based models to help health care providers gain improved insight about these patients and make better, fact-based decisions…*"

Literature Review – Big Data in Healthcare (5Vs)

- Volume
  - health care data grows dramatically
- Variety
  - health care data sources and complexity
- Velocity
  - big data analytics
- Veracity
  - data with different quality, pertinence and meaning
- Value
  - improving healthcare value and quality
- Source: Asri *et al. (*2015)

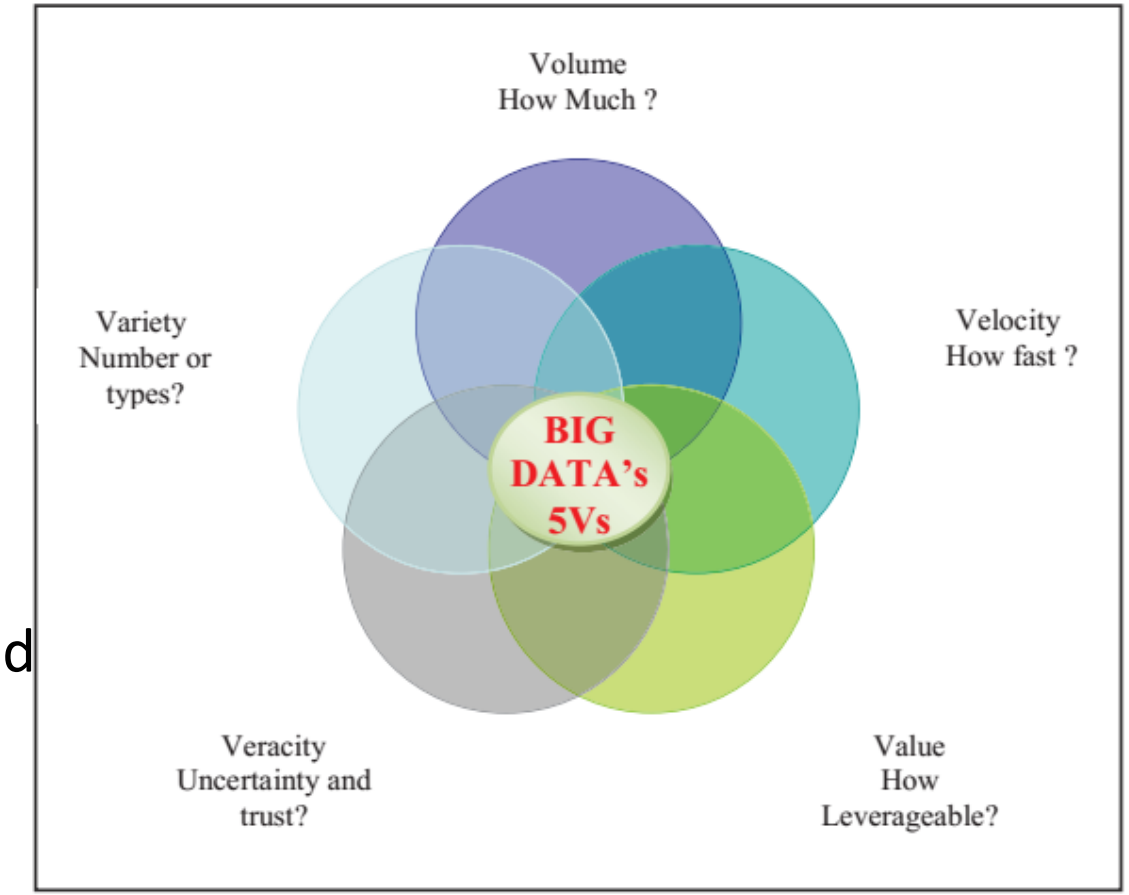
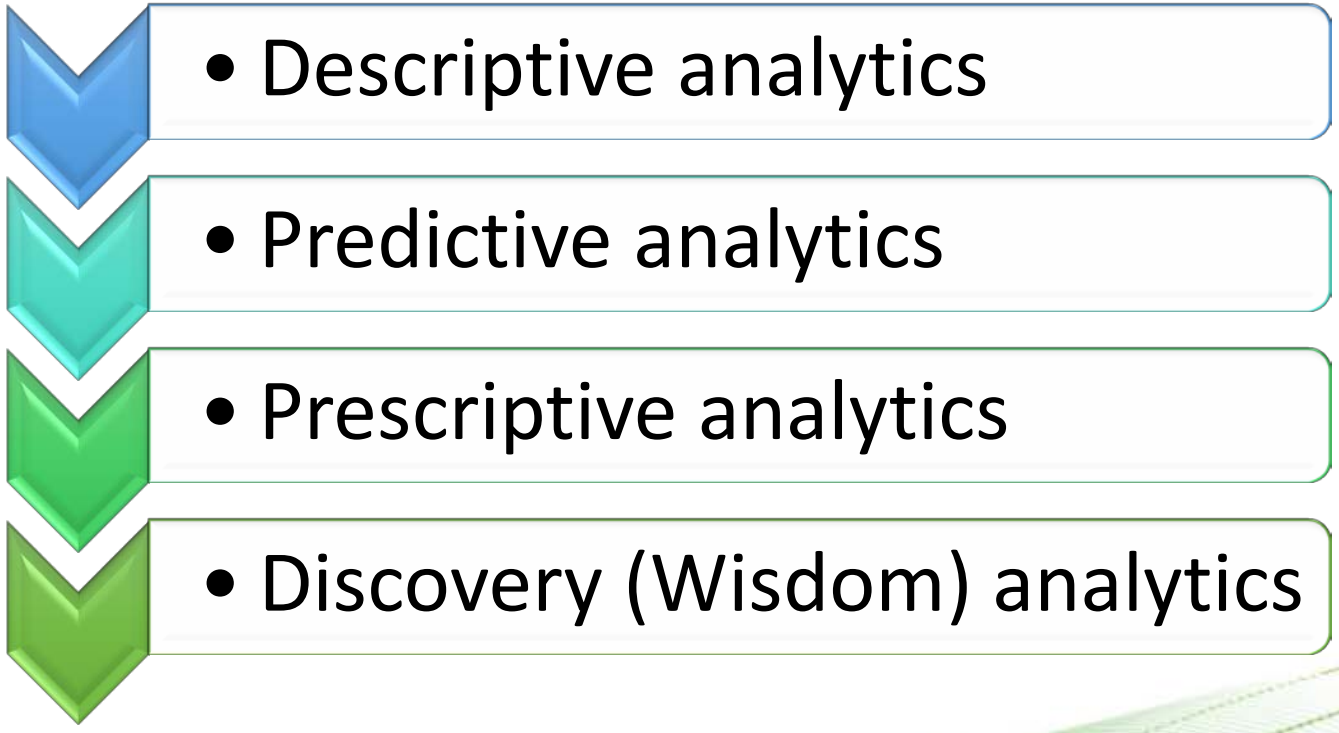


Figure 1: Big Data's 5V in healthcare.

Literature Review - Health Analytics Stages

- Raghupathi & Raghupathi (2013)



Literature Review - Health Analytics Stages

Raghupathi & Raghupathi (2013)

- Descriptive analytics
  - …categorize, characterize, aggregate and classify data, converting it into useful information for understanding and analyzing health care decisions, outcomes and quality…
  - Meaningful charts and reports
  - Uses a lot of visualization
- Predictive analytics
  - …looks at past performance in an effort to predict the future by examining historical or summarized health data, detecting patterns of relationships in these data, and then extrapolating these relationships to forecast…
  - …data mining allow predictive analytics to detect hidden patterns in large quantities of data…

Literature Review - Health Analytics Stages

Raghupathi & Raghupathi (2013)

- Prescriptive analytics
  - …uses health and medical knowledge in addition to data or information…
  - Application includes drug prescriptions and treatment alternatives.
  - For example, one may determine the maximum dosage of the drug that is effective to maximize treatment outcome, or alternative surgical options can be considered weighing the pros and cons of each.
- Discovery (Wisdom) analytics
  - …utilizes knowledge about knowledge, or wisdom, to discover new drugs (drug discovery), previously unknown diseases, alternative treatments, etc.
  - Predicting the future in the context of such uncertain public health situations as epidemics

Literature Review – How to develop such capability?

- Ghosh & Scott (2011)identified two antecedents and two catalysts for developing healthcare analytic capability
  - Antecedents (necessary conditions)
    - Setup of procedures for data quality and data aggregation.
    - Establishment of standard data definitions
  - Catalysts (speeds up or facilitates a process)
    - Community of Practice
    - Reassessments of Patient Data

Antecedents

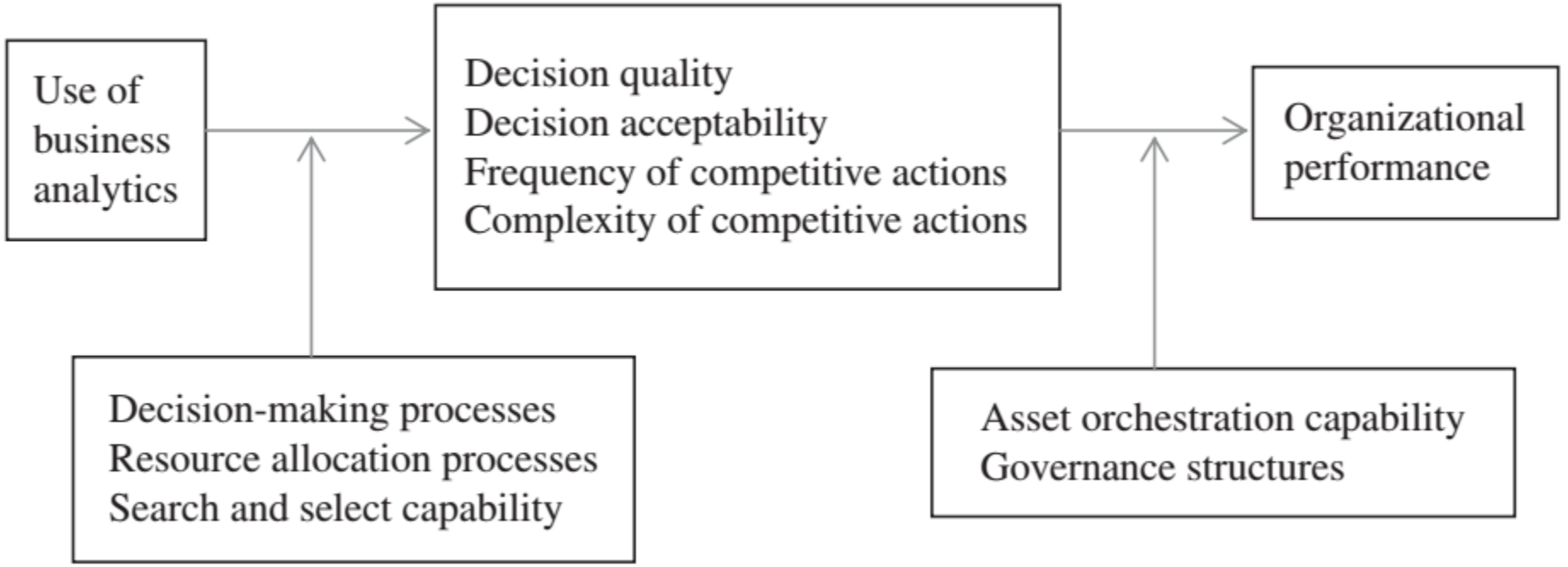
Table 2: Antecedents for an Analytic Capability		
Procedures for Systems Interoperability	Automated validation (see below) and manual procedures were required.	
	Automated Validation	*Example*
	Completeness of the records	All fields are present and all surgeries for the period are accounted for.
	Range of values	Systolic blood pressure between 50 and 250.
	Consistency between fields	Date of discharge is after date of admission.
	Duplication	Flag all exceptions for manual certification. Duplications and conflicts in physician's notes, lab values, and measurements like surgical time.
	Verify totals, concordance of multiple data sources	Verify total complication counts, mortality counts using clinical data and administrative (benefits) databases
Standard Data Definitions to support Semantic Interoperability	Establish practices for supporting the creation of standard data definitions and supporting those data definitions	
	Practice	*Example*
	Periodic Conferences to "Harmonize" Data Definitions	Data definitions and the way patient cases were being categorized (e.g., "Acute renal failure—yes or no") was discussed periodically to harmonize
	"The Data Bible"	The nurses consulted a "bible" of definitions constantly to check for updates.
	Annual Inter-rater Testing Case	Inter-rater reliability testing used to ensure data quality was consistent among the nurses.

Catalysts

Table 3: Catalysts for an Analytic Capability		
Community of Practice	The CoP encouraged discussion of the data inputs and outputs to build understanding of procedures and interpretation of outputs.	
	Practice	*Example*
	Build common understanding of data fields	"Operative Death" is defined as within 30 days by us, 60 days by the contract facility."
	Build correct interpretation of the analytic models	"How are surgical outcomes from affiliated facilities factored into the morbidity risk model?"
Reassessments of Patient Data	This step allowed comprehensive patient assessment.	
	Task	*Example*
	Resolve conflicts between multiple data sources and multiple facilities	"Physicians are reluctant to rely on the symptoms recorded at another facility for lack of standardized evaluation charts across facilities."
	Build holistic view of patient case—abstract meaning from patient charts	"We lose information, such as why a patient is on a certain drug, if no one looks at charts."

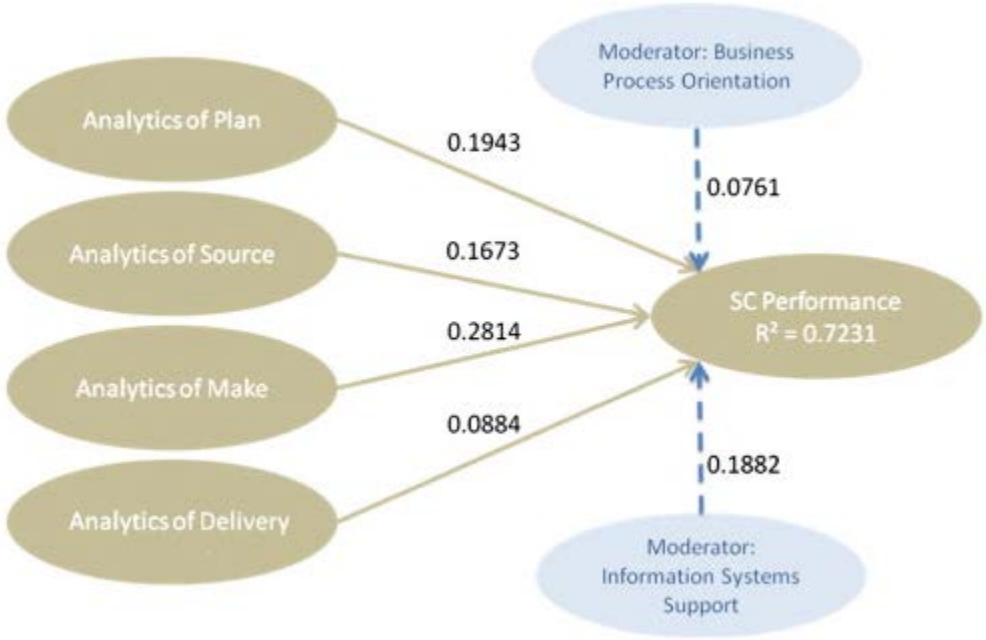
Research Gap

- According to Sharma *et al.* (2014),

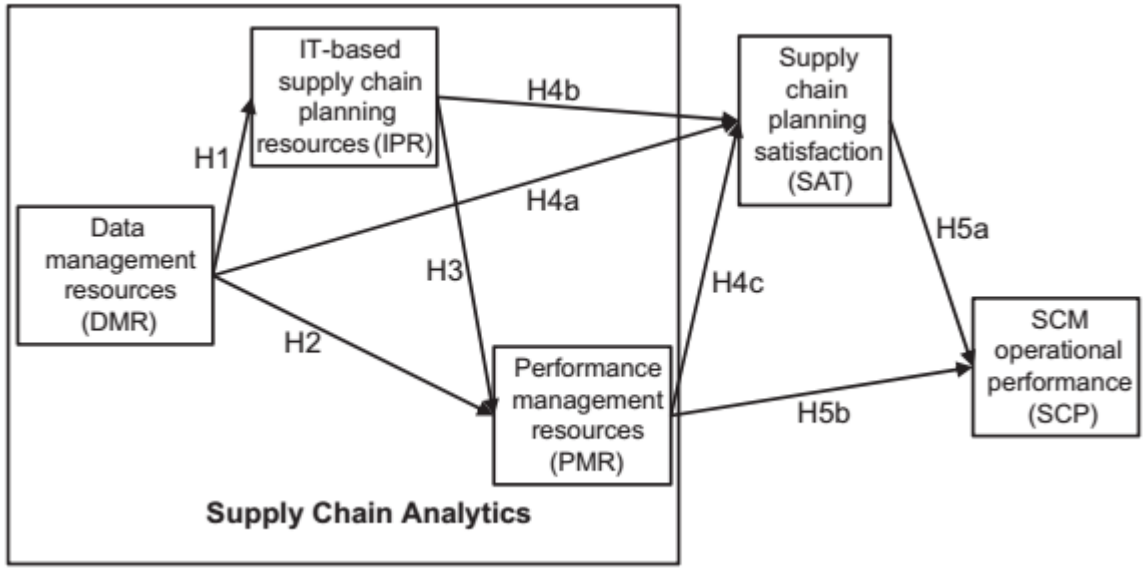


Research Gap

- Trkman *et al.* (2010)

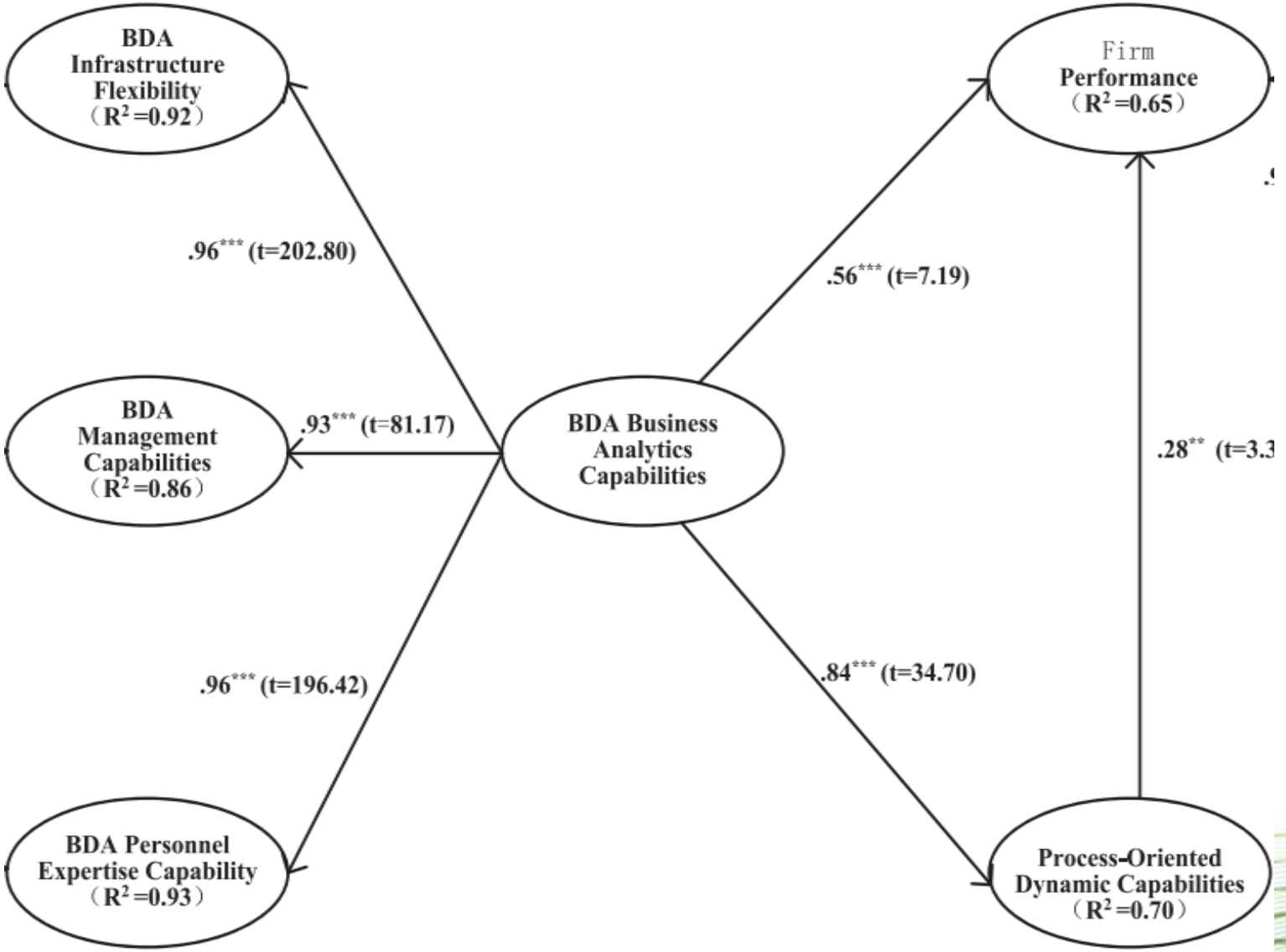


- Chae *et al.* (2014)



Research Gap

- Wamba *et al.* (2017)



Research Gap

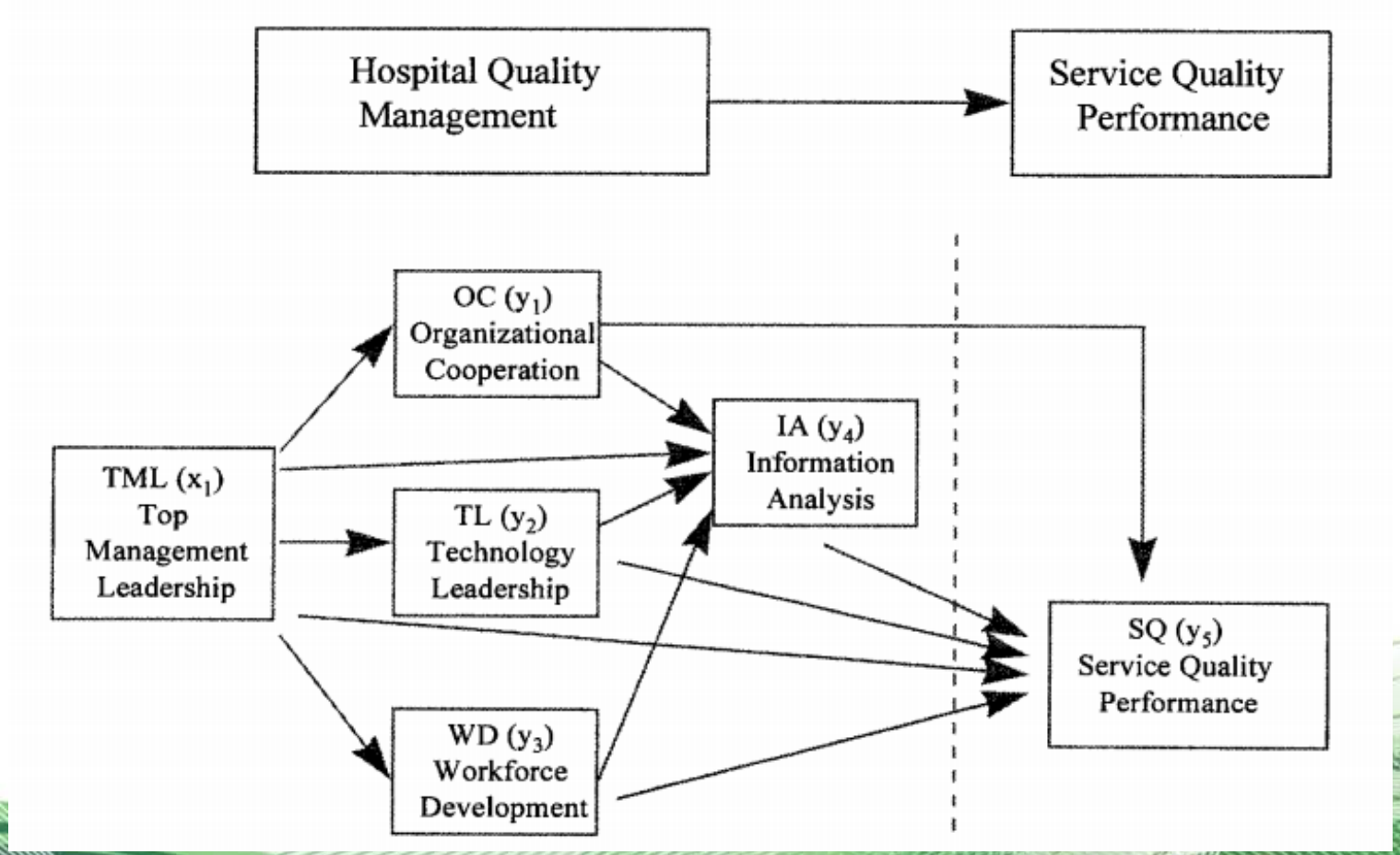
Literature	Industry	Key findings
Trkman *et al.* (2010)	Supply Chain	● Four capabilities and two moderators were assessed ● Significant positive relationships were proven between business analytics and supply chain performance
Chae *et al.* (2014)	Supply Chain	● Supply Chain Analytics was composed of three resources ● Significant positive relationships were proven between Supply Chain Analytics and Operational Performance
Wamba *et al.* (2017)	Mixed	● Business Analytics capability (moderated by process-oriented dynamic capability) has a positive relationship with firm performance

Source: Developed for this study

- Limited study investigating the linkage between healthcare analytics and the quality management in healthcare sector

Conceptual Framework

- Modify the research model by Li (1997)



Conceptual Framework

- Modify the research model by Sreenivas *et al.* (2015)

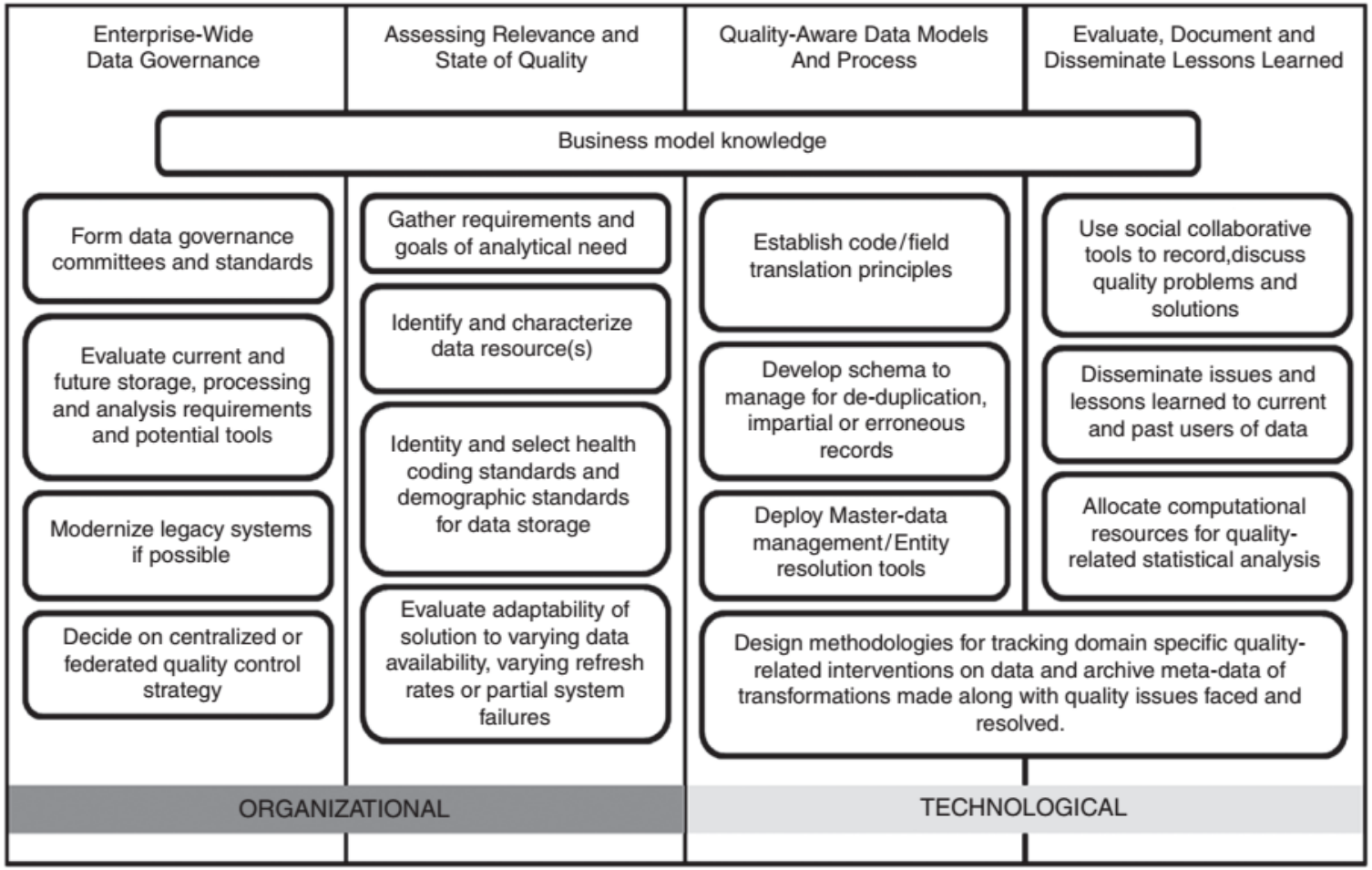


Figure 2.
Road map for incorporating data quality for health care organizations embracing Big Data and analytics

Conceptual Framework

- Modify the research model by Venkatraman *et al.* (2015)

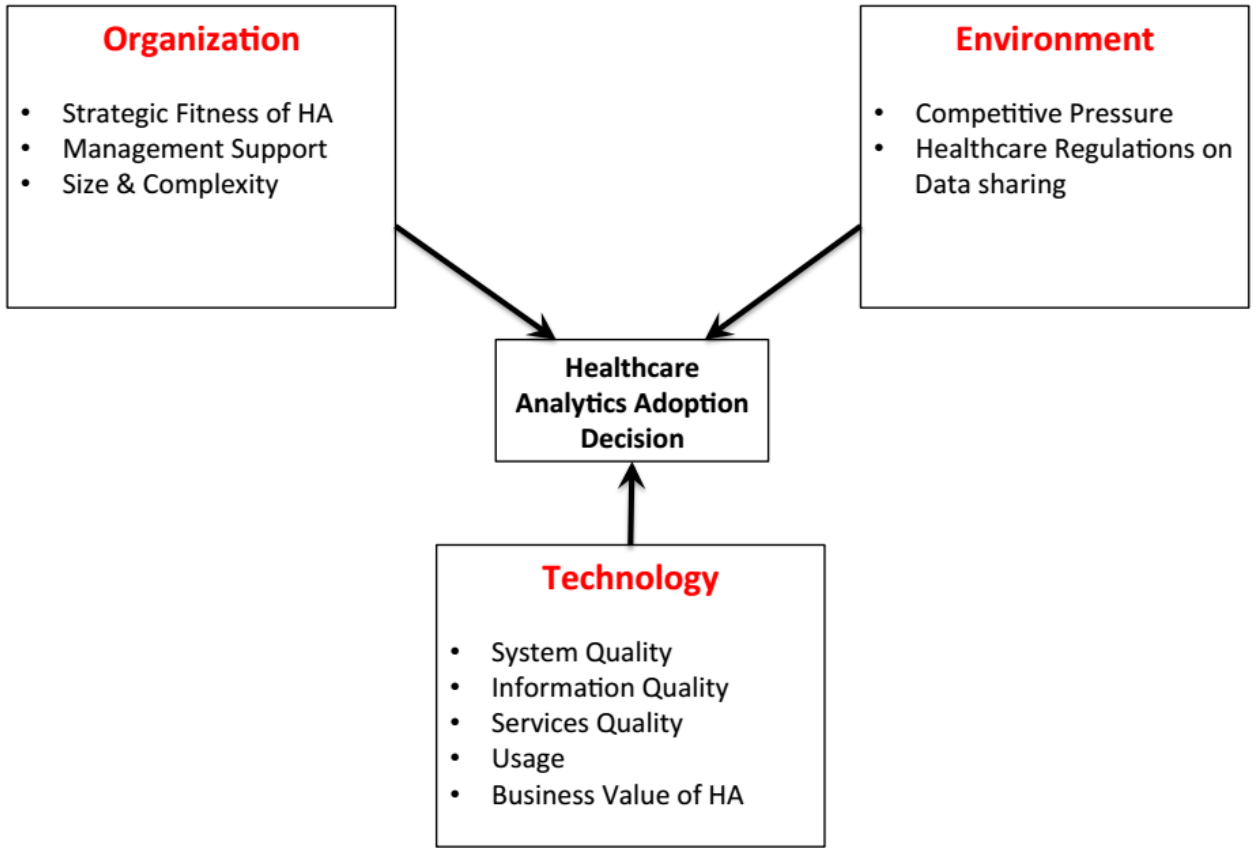
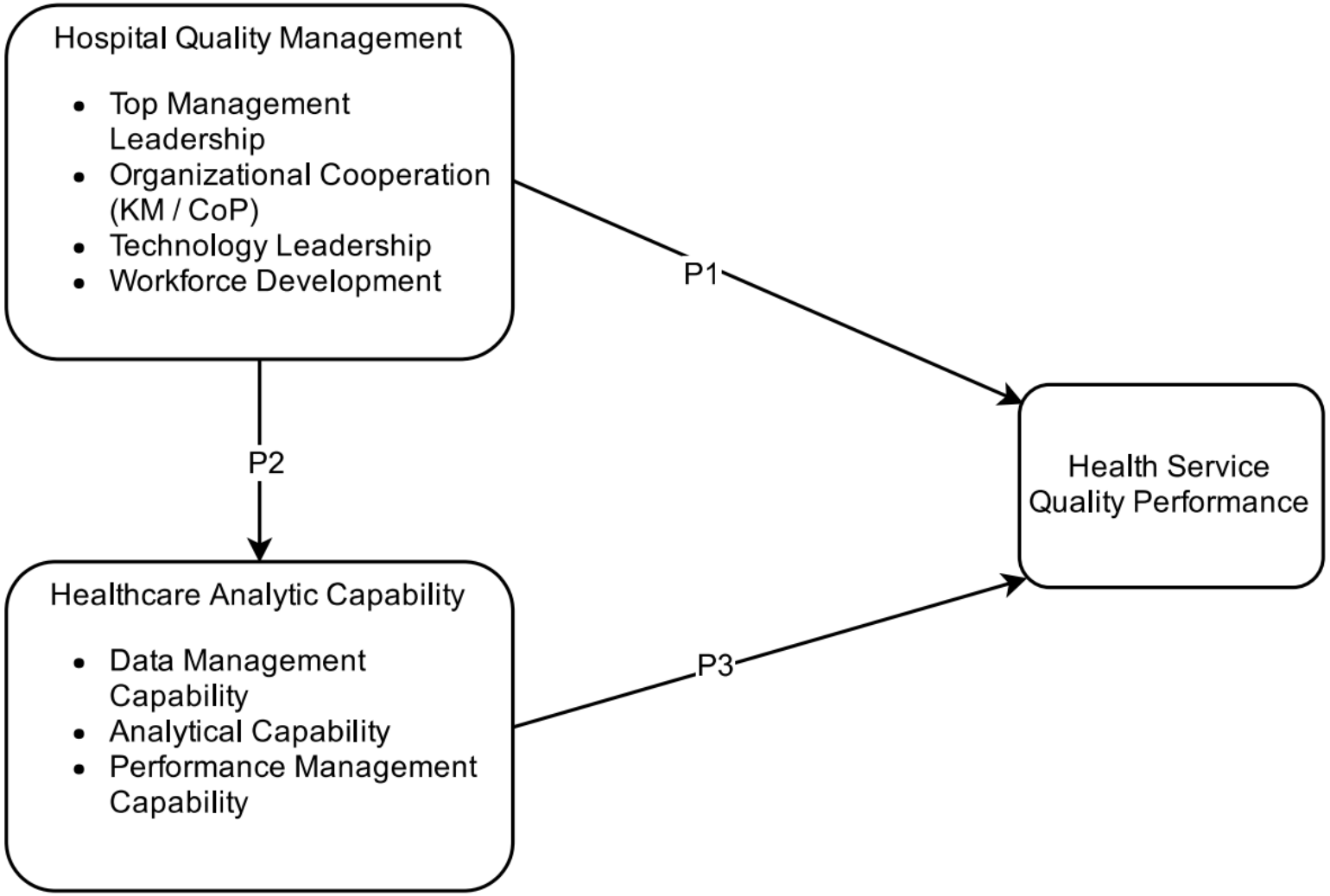


Figure 1. Healthcare Analytics Adoption-Decision Model

Conceptual Framework



Source: Developed for this study

Conceptual Framework

- Proposition 1
  - Hospital Quality Management has a positive relationship with Heath Service Quality Performance
- Proposition 2
  - Hospital Quality Management has a positive relationship with Healthcare Analytical Capability
- Proposition 3
  - The greater the level of Healthcare Analytical Capability, the better the Heath Service Quality Performance

Future Research

- Collect suggestions and feedbacks from practitioners and academics in healthcare and big data sectors
- Refine the framework and develop questionnaire survey
- Conduct empirical research and SEM analysis
- Potential practical implications
  - Provide insight to healthcare management in developing strategy enhancing healthcare analytical capability, thus improving service quality
  - Draw the attention of practitioners about data quality, data privacy and governance issues

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OPEN DISCUSSION

THANK YOU