Appendix 1

Services Specifications

1. Background

1.1 The Chief Executive announced in the 2014 Policy Address that the Government had decided to reserve a site in Tseung Kwan O ("TKO") for setting up a CMH. The 2017 Policy Address stated the Government decided to finance the construction of the CMH and identify by way of tender a suitable non-profit organisation ("NPMO") to operate the CMH.

1.2 CMH will be owned by the Government and the selected NPMO will operate the CMH. The tendering process to select the contractor for the operation of the CMH was launched in September 2019. Upon the completion of the tender assessment, the Government awarded the service deed for the operation of the CMH in TKO to the Hong Kong Baptist University in June 2021.

1.3 The CMH would be positioned as the flagship Chinese medicine ("CM") institution leading the development of CM services and Chinese medicines in Hong Kong. It will be a change driver, promoting service development, education and training, innovation and research, and facilitating collaboration with both local and international parties.

1.4 The CMH with the provision of 400 beds will provide a comprehensive range of CM services. Service types include pure CM services, services with CM playing the predominant role in collaboration with Western Medicine and Integrated Chinese-Western Medicine services. The scope of service to be provided in the CMH covers inpatient, day-patient, outpatient and community outreach services. More information on the services provision and design of the CMH can be found in the following link:

https://www.healthbureau.gov.hk/en/press_and_publications/otherinfo/200900_cmhp/index.html

1.5 The construction works of CMH commenced in mid-2021. It is the target for the CMH to commence services in phases from the fourth quarter of 2025.

1.6 To support the functions and operation of CMH, a number of application systems will be deployed for CMH to support the operation. The diagram below illustrates the overall picture of the major application systems and equipment of CMH:

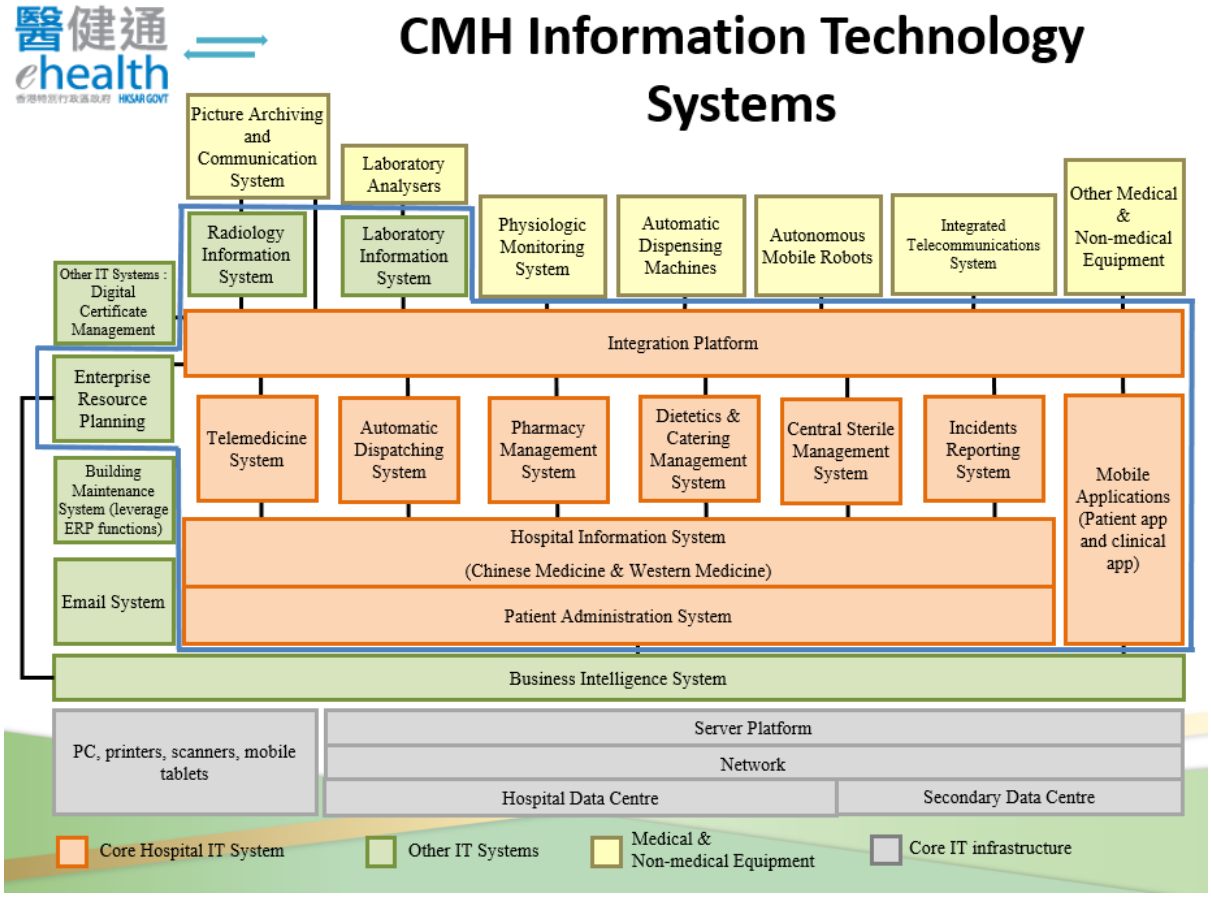


Figure 1: CMH Information Technology Systems

2. Project Overview

2.1 The project is to implement a BIS to support the operations of CMH. It is required to establish a centralised and reliable infrastructure, with balanced availability and scalable solutions.

2.2 The tentative framework of the BIS is illustrated in Figure 2. Data are collected from various data sources and the key components of the BIS include:

(a) On-Premises

- Data Integration
- Data Storage and Management
- Data Presentation
- Data Processing and Analytics
- Online Monitoring
- Data Catalogue
- Access Control Management

(b) Cloud

- AI-Modeler

The high-level descriptions of the key components are illustrated in the ensuing paragraphs, the detailed requirements are provided in **Appendix III.**

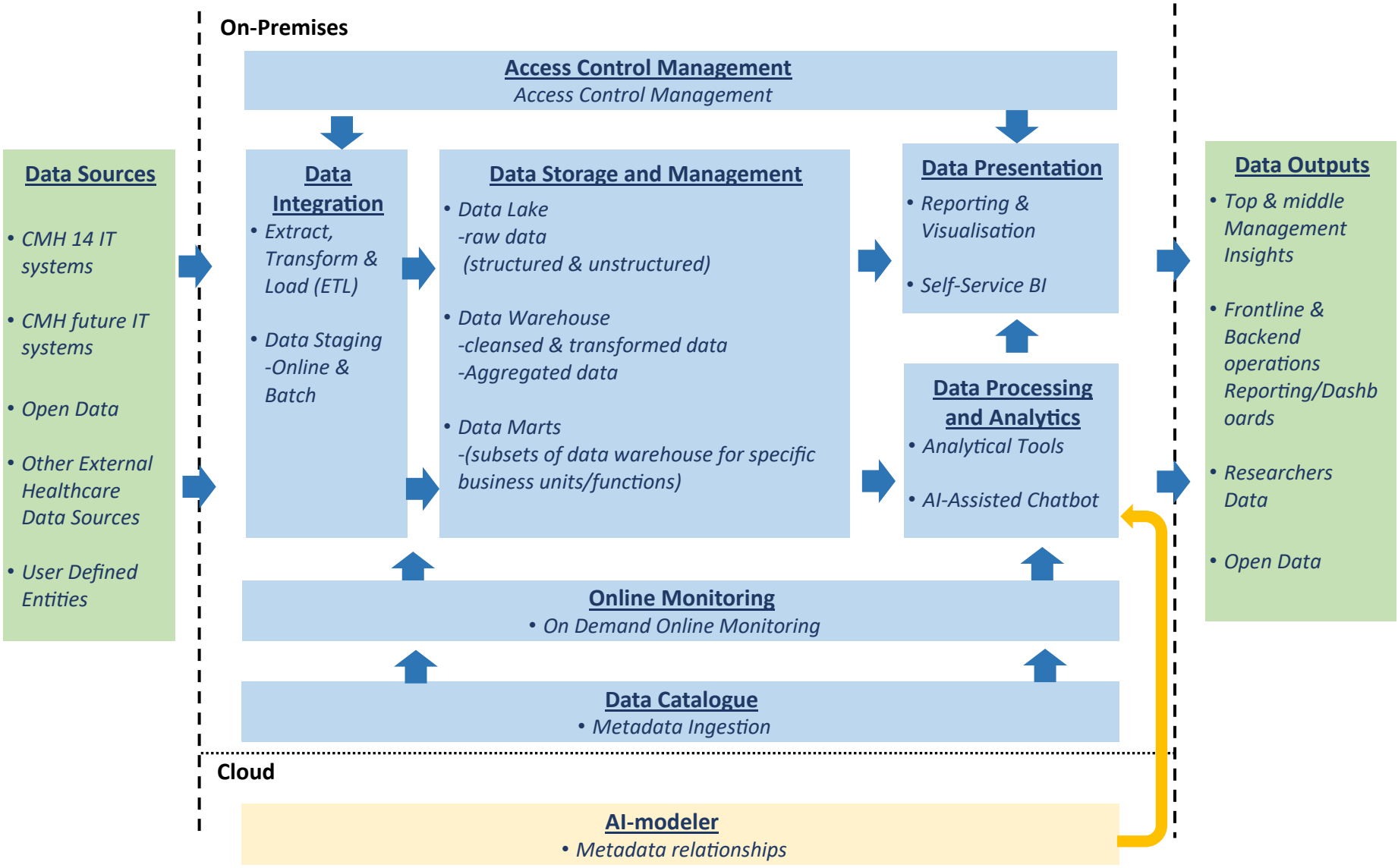


Figure 2: Tentative CMH BIS Framework

2.2.1 Data Sources

Data shall be collected from various data sources, including existing CMH's application systems, future application systems, open data, external healthcare data sources and user-defined entities (data files or spreadsheets at users' table-top), including structured and unstructured data. Related information could refer to the detailed information in **Annex I.**

2.2.2 Data Integration

Data extracted from various data sources shall be automatically transformed, including properly cleaned, aggregated, and enriched, into desired formats to meet CMH's operational needs. Besides, some common communication protocols, well-known medical standards like HL 7 should also be supported. This transformed data shall then be loaded into a central data repository. A data staging area shall be used as a quality control checkpoint to ensure the data is properly formatted and to optimize performance, ensuring the efficiency and reliability of the entire data integration process.

2.2.3 Data Storage and Management

A central data repository, encompassing a data lake, a data warehouse and data marts, with visual interfaces shall be built to ensure efficient data storage, management, and accessibility, enabling comprehensive and timely insights across CMH.

(a) Data lake: shall serve as a vast repository that holds CMH's raw data, including structured and unstructured data, in its native format, to provide flexibility for processing and analysing diverse data types in supporting CMH's clinical services as well as research studies.

(b) Data warehouse: shall serve as a centralized and structured repository for transformed data, optimized for fast query performance and complex analysis, supporting CMH's decision-making processes.

(c) Data marts: various subsets of data warehouses, tailored to meet the specific needs of CMH, different divisions, departments or clinical services in CMH, shall be built for providing focused and relevant data for respective particular analytical requirements.

2.2.4 Data Presentation

The BIS shall present raw/transformed data into meaningful insights and actionable information for CMH users.

(a) Reporting: shall support the generation of structured summaries and detailed reports that provide a clear view of key performance indicators (KPIs) and other relevant data metrics of CMH.

(b) Visualization: shall encompass the creation of graphical representations like charts, graphs, and dashboards that make complex data more accessible and comprehensible, facilitating easier analysis and decision-making.

(c) Self-service BI: shall empower users, even those without deep technical expertise, to independently access, analyse, and visualize data through intuitive interfaces and tools, without relying on IT departments.

2.2.5 Data Processing and Analytical

The BIS shall support advanced data handling and interactive technologies to enhance patient care and operational efficiency.

(a) Analytical tools: shall support applying statistical and computational methods to uncover patterns in patient responses to treatments, efficacy of herbal remedies, operational efficiencies, etc. to reveal valuable insights, such as identifying the most effective treatments for specific conditions or optimizing inventory management.

(b) AI-assisted chatbots: shall provide an analysis of structure and unstructured data with intuitive interface, powered by natural language processing (NLP) and machine learning, to answer queries and assist doctors in quickly retrieving patient data and research insights. The dimension analysis can be done by extracting user queries.

2.2.6 Online Monitoring

The BIS shall support on-demand to continuously track and access real-time data related to various aspects of hospital operations, such as inpatient journeys, to instantly monitor critical metrics such as patient waiting times. Dashboards and real-time alerts shall support CMH staff in promptly identifying and addressing issues, ensuring that operations run smoothly and efficiently.

2.2.7 Data Catalogue

The BIS shall provide data catalogue functions to organise and manage the CMH's data assets, ensuring they are easily discoverable, well-documented, and securely accessible.

Metadata ingestion: The BIS shall systematically collect and integrate detailed metadata of data sources for supporting the creation of a searchable and navigable catalogue for CMH’s users to quickly find and understand the data they need.

2.2.8 Access control management

The BIS shall be able to ensure that sensitive information is protected by defining and enforcing user permissions based on roles and responsibilities. Only authorized

personnel can access specific datasets, thereby maintaining patient confidentiality and complying with regulatory requirements.

2.2.9 AI-Modeler

The AI-Modeler is used to learn the relationships within the metadata, allowing it to extract the appropriate data fields when a user asks a question. By comparing the user's intention and the system's understanding of the metadata, the AI model can provide a relevant response that directly addresses the user's query, without the need for the user to specify exact data field names.

In other words, the AI model acts as an intelligent intermediary, bridging the gap between the user's natural language input and the underlying data structure. This enables a more seamless and intuitive interaction, where the user can focus on asking their question, and the AI system handles the task of identifying and retrieving the relevant information from the metadata.

The BIS shall be able to provide functions to leverage AI-Modeler in the cloud to provide reliable answers to questions asked by users.

2.3 The BIS shall not be treated as a mission-critical system. However, a business continuity and disaster recovery plan shall be in place for the recovery of data accumulated over time. High availability options shall also be implemented in the BIS primary production environment but not necessary in the secondary production environment.

3. The Tentative Project Scope:

3.1 The contractor shall provide the following implementation services in the project.

(a) performing a System Design and Analysis (SA&D) for the BIS. The detailed requirements are illustrated in **Annex II**;

(b) Data Sources and Integration

- Identify the final CMH IT Application Systems that shall be connected as specified in **Annex I**, and work out the data replication/extraction mechanism.
- Work out the data extraction plan, including the specific database tables and data elements that will be extracted from each system.
- Develop the necessary database tables and schemas to accommodate the extracted data, ensuring data integrity and consistency.
- Develop the necessary tables (e.g. Herb Classification Mapping Table) as a User-Defined Entity.

- Incorporate standard Excel tables as the standard data input for the Business Intelligence System (BIS), allowing for easy integration of manually maintained data.
- Confirm the design of the staging area, online data store for online analysis, the design of data lake, data warehouse, and data mart for data visualization, self-service analysis and AI-assisted chatbot functions.
- Use the proposed BI tools for data extraction, transformation, and loading (ETL) to clean, harmonize, and consolidate data.
- Establish real-time or near real-time data (on-line) integration and refreshes.

(c) Data Modelling and Management:

- Build data models that represent the business entities, relationships, and hierarchies.
- Use the proposed data catalogue tool to manage the entire table and field names, and connect the metadata for the data fields with reference to the provided CMH IT Application System data dictionary and/or systems documentation.
- Use the proposed BI tools for data governance and master data management to ensure data quality, security, and consistency.
- Handle structured, semi-structured, and unstructured data formats.
- Define the necessary data mapping and transformation rules to align the field meanings and ensure data consistency. This may involve renaming fields, converting data types, performing data normalization, and handling any other data quality issues.

(d) Semantic Layer Design:

- Develop a comprehensive semantic layer that provides a business-friendly abstraction of the underlying data including the table/dimension and measurements.
- Establish a metadata management system (using the proposed data catalogue tool) to define and manage business concepts, measures, and hierarchies.
- Implement the proposed BI tool that can translate business-oriented requests into efficient data queries.

(e) Pilot Testing of Semantic Layer:

- Conduct pilot runs for the **30 and 10 major dashboards/reports identified in Phase 1 and Phase 2 respectively**.

- Perform test runs of the semantic layer to ensure it can effectively support the required KPIs and reporting needs.
- Gather feedback from end-users and the IT team to identify any gaps or improvements needed in the semantic layer design.
- Incorporate the learnings from the pilot testing to refine and optimize the semantic layer before the full deployment.

(f) Reporting and Dashboard Development:

- Use the proposed BI tools to develop the **identified interactive, and customizable reports and dashboards**.
- Enable self-service capabilities for users to create, customize, and share reports.
- Offer various visualization types (e.g., charts, graphs, tables, maps) to effectively communicate insights.

(g) Analytics and Insights:

- Use the proposed BI tools to offer advanced analytical capabilities, including predictive analytics, statistical analysis, and machine learning models.
- Enable ad-hoc analysis, drill-down, and data exploration functionalities.
- Provide mechanisms for generating alerts, notifications, and recommendations based on data patterns and thresholds.

(h) Self-Service Analysis:

- Provide hand-on-hand training to end users, and empower end users to develop their dashboards and reports.
- Use the proposed BI tools to offer guided analytics and visual data exploration capabilities to assist users in discovering insights.
- Use the proposed BI tools to implement self-service data preparation features, allowing users to combine, transform, and enrich data as needed.
- Deliver comprehensive training and documentation to enable users to effectively leverage the self-service analysis capabilities of the proposed BI tools.

(i) Testing of AI-Assisted Chatbot Function:

- Develop a set of test scenarios to validate the chatbot's ability to ensure that it can provide accurate and relevant information based on the BI semantic layer.

- Engage end-users to interact with the chatbot and provide feedback on the quality and usefulness of the responses.
- Analyse the chatbot's performance in answering various types of questions, such as ad-hoc queries, KPI lookups, and report-generation requests.
- Identify any gaps or limitations in the chatbot's knowledge and capabilities, and work with the development team to enhance the underlying natural language processing and data integration capabilities.
- Conduct iterative testing and refinement of the chatbot function until it can reliably and efficiently assist users in accessing and understanding the BI data and insights.

(j) Implementation of AI Modeler:

- Ensure the AI Modeler can ingest data from the BI Catalogue and metadata, as well as the Dimension and Measure information (semantic layer) to explore potential data relationships.
- Develop user input rules, guidelines, and algorithms for the AI Modeler to generate insights, forecasts, and recommendations based on the contextual information available in the BI system.
- Provide training to the IT team and end-users on how to effectively utilize the AI Modeler's capabilities, such as:
  - Defining modelling parameters and objectives
  - Interpreting the AI Modeler's outputs and recommendations
  - Incorporating the AI-generated insights into their decision-making processes
- Conduct thorough testing and validation of the AI Modeler's performance across a variety of use cases, including:
  - Generating prescriptive analytics and recommendations based on metadata
  - The BIS platform can leverage intelligent data integration and recommendation capabilities to generate personalized suggestions for models and data fields from various systems, tailored to the user's specific needs and objectives
- Continuously monitor the AI Modeler's accuracy, reliability, and user feedback, and make necessary refinements to the underlying models and algorithms to improve the quality of insights generated.
- Integrate the AI Modeler's outputs into the BI platform's reporting and dashboarding functionalities, allowing users to access and leverage the predictive analytics and recommendations directly within their decision-support tools.

- Integrating state-of-the-art natural language processing (NLP) tools, such as large language models (LLMs), but not limited to, can significantly enhance the capabilities of the Business Intelligence System (BIS) by leveraging their extensive knowledge and advanced language understanding capabilities. Additionally, utilizing the structured data and metadata available in the BI Catalogue and semantic layer can enable the AI Modeler to generate more contextual and relevant recommendations, and this combination of cutting-edge NLP tools and the leveraging of the existing data infrastructure can ultimately enhance the overall effectiveness of the Business Intelligence System.

(k) Collaboration and Sharing:

- Use the proposed BI tools to provide role-based access controls and permissions management to ensure data security and privacy.
- Facilitate the distribution of reports and insights to stakeholders via email, PDF, or other formats.

(l) Scalability and Performance:

- Ensure the system can handle growing data volumes and user demands without compromising performance.
- Implement caching, indexing, and other optimization techniques to provide fast query response time.
- Offer load balancing, failover, and disaster recovery mechanisms to ensure high availability and reliability.

(m) Extensibility and Customization:

- Provide a flexible and extensible architecture that allows for the integration of third-party tools and applications.
- Use the proposed BI tools' APIs and SDKs to enable custom integrations and development of additional features or applications.
- Support white-labelling, branding, and personalisation to align with the organization's visual identity and requirements.

(n) Security and Compliance:

- Implement security measures, including user authentication, authorization, and access control.

- Ensure compliance with relevant data privacy regulations and industry standards, conduct Security Risk Assessment and Audit (SRAA), Privacy Impact Assessment (PIA) and Privacy Compliance Assessment (PCA) by independent qualified experts in the areas for the BIS during SA&D and production launch, and rectify the BIS for non-compliance issues.
- Use the proposed BI tools' audit logging, activity tracking, and data lineage capabilities to maintain data integrity and governance.

(o) Deployment of Primary and Secondary Production Environments:

- Establish a primary production environment at one site, and a secondary production environment at a separate site for high availability and disaster recovery.
- Implement robust data replication and failover mechanisms to ensure seamless switchover between the primary and secondary environments in the event of a disruption.
- Regularly test the failover and recovery procedures to validate the integrity and reliability of the dual-site production setup.

(p) Containerization of Non-Production Environments:

- Leverage containerization technology to deploy the development, pilot test, training, UAT, and data ETL environments in the secondary site.
- Ensure the containerized environments can be easily provisioned, scaled, and maintained using automated deployment pipelines.
- Implement processes to synchronize the configuration and data between the containerized non-production environments and the primary/secondary production environments.

(q) Conduct Technical / End User Training and Documentation:

- Provide comprehensive training for the IT team on the deployment, configuration, and administration of the BI tools.
- Deliver hands-on training sessions for end-users to teach them how to develop their own reports and dashboards using the BI tools listed in **Annex III**.
- Ensure end-users are comfortable with the BI tool interfaces, report-building functionalities, and data visualization capabilities.
- Develop training materials, user guides, and online resources to support the ongoing use of the BI tools.

- Schedule regular refresher training sessions to address any questions or challenges users may face during the adoption of the BI tools.

(r) Enhancement and ongoing Support & Maintenance:

- Provide continuous enhancement of the semantic layer to accommodate new KPI or report requirements within the scope of the implementation phase.
- Conduct regular refresher training sessions for end-users and IT team developers to ensure they stay up to date with the latest BI tool capabilities.

4. CMH Business Domain and 2-Phase Implementation

4.1 To effectively monitor the business performance of CMH, it is essential to implement the Business Intelligence System (BIS) system that leverages both real-time and historical data that are available from the CMH IT Application.

4.2 The BIS shall support mainly 3 types of data analysis views including:

(a) Retrospective View
(b) Forward Projection / Prospective view
(c) Real-Time view

4.3 The BIS shall enable CMH to gain valuable insights into key metrics, identify trends, and make informed decisions quickly. By integrating advanced analytics and visualisation tools available from the BIS, CMH can enhance their operational efficiency, respond to market changes promptly, and ultimately drive strategic growth.

4.4 In considering the complexity of the business analysis dimensions and availability of operation data, CMH will only provide in-patient and outreach community services in 2nd year of CMH services. Thus, in the implementation of 1st year of the BIS, we would expect the analysis will concentrate on the out-patient and day-patient customers. The availability of related in-patient and outreaching patient data in the 2nd year may lead to further enhancement of the Phase 1 dashboard/reports in the Phase 1 nursing period.

4.5 While Phase 1 will concentrate on those operation process analysis and key performance measurements, phase 2 will concentrate on the business continuous improvement areas, competitive edge development and Chinese medicine industry development areas. In addition, we expect system enhancement will be required to take care of advanced data analytics in the warranty period. Thus, CMH expects at least 100 man-days to be reserved for BIS continuous enhancement.

Implementation Time Schedule

Phase	**Patient Service Type**	**Analysis Time Dimension**
Phase 1: 15 Months Nursing: 9 Months	Out-Patient / Day-Patient	- Annual-Base Analysis - Analysis / Projection of Current Year

Phase 2: 6 Months Nursing: 3 Months (overlap with Phase 1 nursing period)	In-Patient / Community and Outreach Services AI-Modeler	- Year-to-Year Comparison Analysis - Analysis / Projection over the years
1st Year Warranty Service: 12 Months	Integrated Chinese-Western Medicine (ICWM) Research	- Elapsed-Time, Time-Trend, Cycle, Seasonality and Event-Based

4.6 The following major 30 and 10 business domain areas in Phase 1 and Phase 2 are identified respectively. The detailed analytics of the respective domains are provided in **Annex III**.

Phase 1
1. CMH Key Performance Measurement
2. CMH Internal Process
3. Chinese Medicine (CM)
4. Western Medicine (WM)
5. Clinical
6. Quality and Safety
7. Customer (Patient Experience)
8. Financial Performance, Efficiency, and Cost Control, Standard Cost
9. Human Resource (Work Force Planning)
10. Operational Efficiency
11. Service Growth
12. Service Capacity

Phase 1
13. Quality of Care
14. Medication Management
15. Service Planning and Enablement
16. Service Planning – Demand and Supply
17. Efficiency in Use of Resources
18. Bed Management
19. Day and Same Day Surgery Services
20. Case Management and Productivity
21. Drug/Herb Inventory (CM / WM)
22. Rational Drug Use
23. Drug/Herb Operation Efficiency (CM / WM)
24. Alert Incident, Variation and Remedy Action
25. Command Center and Clinical Intelligence
26. Customer Service / Patient Journey
27. Patient Appointment-Admission to Discharge Journey
28. Patient Medicine Journey
29. Specimen Journey
30. Patient Satisfaction Evaluation

Phase 2
31. Competitiveness and Business Development
32. Chinese Medical Practitioner Development
33. Clinical Pathway Development
34. New Herb Development

Phase 2
35. Integrated Chinese Western Medicine Programme
36. Manpower position by Staff Group (Medical, Nursing, Allied Health, Supporting (Care-related) and Others)
37. Patient Vital Sign Monitoring
38. Human Resource (Talent Management)
39. Education and Research (Research)
40. Education and Research (Education)

4.7 Upon reviewing the aforementioned business domains—including approximately 30 in Phase 1 and 10 in Phase 2, we envision a comprehensive approach that will empower the hospital to enhance its operations and overall performance. This initiative aims to identify key areas for improvement, streamline processes, and foster an environment of continuous advancement. By leveraging insights gained from this analysis, we can implement targeted strategies that not only uplift service quality but also improve patient outcomes and operational efficiency.

4.8 The contractor is required to design the semantic layer and enable end users to carry out the detailed analysis in the respective business domains. The contractor is required to **implement one dashboard/report together with end-users for each business domain** and demonstrate that each business domain has its all necessary business analysis dimensions/measurements elements being considered and put into the data schema, semantic layer for self-service analysis and AI-assisted chatbot analysis. In addition, the contractor shall provide hands-on training sessions to CMH IT and end-users to build/develop their required dashboards/reports during the implementation phases and nursing period.

5. Nursing Period Service Specification

5.1 The service requirements during the respective Phase 1's 9-months and Phase 2's 3-months nursing period include:

- Stablise Phase 1's BIS with out-patient and day-patient data analysis capabilities.
- Stablise Phase 2's BIS with in-patient and community and outreach program data analysis capabilities.
- Stablise Phase 2's AI Modeler data analysis capabilities.

- Provide remote helpdesk support to CMH technical users and end users during prime operating period of the BIS.
- Provide quarterly BIS system monitoring and issue reports.
- Conduct monthly on-site knowledge transfer sessions and one capacity building training program.
- Conduct one disaster recovery drill in Phase 1 nursing period.
- Work with CMH to identify areas of improvement and implement necessary enhancements to the BIS. This may include:

  (a) Refinement of dashboards and reports based on user feedback.
  (b) Optimization of data integration and processing workflows.
  (c) Enhancement of semantic layer, analytical capabilities and visualization tools.
  (d) Improvement of system performance and scalability.

6. Warranty Period and On-going Support Service Specification

6.1 The service requirements during the period include:

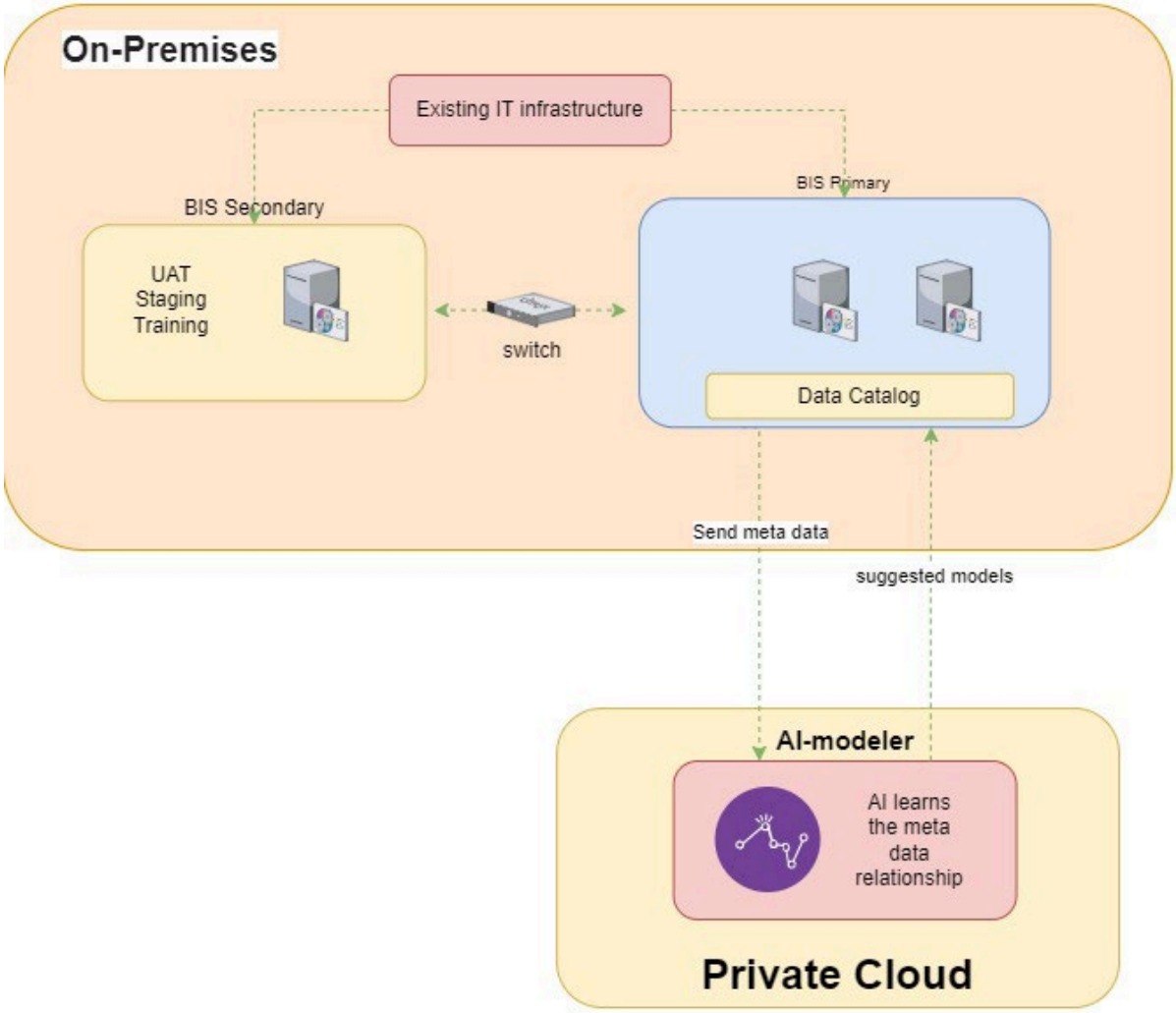
- Stablise BIS data analysis capabilities.
- Stablise AI-Modeler data analysis capabilities.
- Provide remote helpdesk support to CMH technical users and end users during prime operating period of the BIS.
- Provide monthly BIS system monitoring and issue reports.
- Conduct bi-monthly on-site knowledge transfer sessions when requested.
- Conduct annual disaster recovery drill.
- Work with CMH to identify areas of improvement and implement necessary enhancements to the BIS. This may include:

  (a) Refinement of dashboards and reports based on user feedback.
  (b) Optimization of data integration and processing workflows.
  (c) Enhancement of semantic layer, analytical capabilities and visualization tools.
  (d) Improvement of system performance and scalability.

- The service provider will reserve 100 man-days for BIS System Change during the warranty period.

7. Sizing estimation, system environments and workload

7.1 The infrastructure as well as the network for the BIS of CMH is illustrated below:



7.2 Workload

(a) The following table shows the estimated no. of users of the BIS System.

Users	License	Estimated No. of Users
Management	Viewers	40
Division (assume 2 designer licenses for each division)	Designers	12
Departments	Viewers	80
Total		132

(b) For normal user operation, the System is estimated to support a maximum workload throughput capability to serve 50 concurrent users.

8. Tentative Project Requirements of the BIS

8.1 Subject to any changes made by the Government at any time before the upcoming tender exercise for the BIS, the project requirements and the contractual obligations of the contractor of a contract awarded for the BIS may include but are not limited to the following:

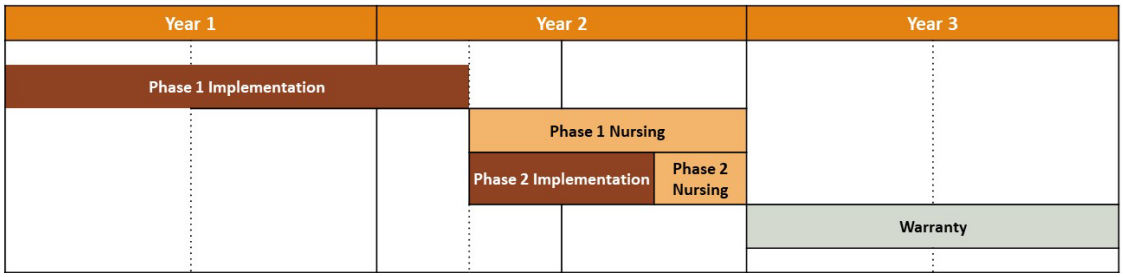
No.	Category	Key Functions (not exhaustive)
1	Data Warehouse	a) Primary Production Environment connects to the SDC site of the CMH (please be aware that BIS will be connected to the PDC of CMH) b) The secondary Production Environment (at the PSC site of CMH) connects to the SDC site of the CMH Data Centre management system
2	Server Farm	a) Server system at PDC and SDC including the virtualised machine and physical server (if any) for the data warehouse system
3	Storage and Backup	a) Storage and backup equipment to support server system and backup and restore service for data warehouse system
4	AI	a) Basic machine learning modelling for data analysis, prediction b) AI-Modeler: Capability to learn the inter-relationship among metadata

Note: Please refer to Annex IV for the Technical Specifications of CMH infrastructure Services provided by the CMH.

8.2 Project management

(a) Provide project management services during all the stages of implementation of the system, which include, but not limited to, project monitoring and coordination of the implementation activities of all relevant parties including other contractors, and in-house project teams of the Government; and

(b) It is estimated that the implementation services of the project would last for **24 months** and the contractor is required to provide services which consist of technical design, hardware and software for all categories as shown in the table in paragraph 7.1 above. The high-level tentative implementation schedule is illustrated below:



	Period	Description	Duration (months)
Phase 1	Implementation	To implement all BIS function features (except AI Modeler) of BIS, build semantic layer and develop 30 dashboard/reports	15
	Nursing	To provide BIS system nursing and enhancement services	9
Phase 2	Implementation	To enrich the semantic layer, develop 10 dashboards/reports and implement AI Modeler	6
	Nursing	To provide BIS system and AI Modeler system nursing and enhancement services	3
Warranty		To provide warranty services	12

8.3 Rollout and System Nursing

(a) Be responsible for the rollout approach, overall planning, installation, drill, on-site support and coordination work with other contractors and parties; and

(b) Provide 9 months and 3 months of system nursing period in phase 1 and phase 2 respectively. The nursing service specifications are described in Section 5 of this document.

8.4 Warranty

(a) Be responsible for providing a 12-month warranty period after satisfactory completion of 3-month nursing period of Phase 2 of the BIS. The warranty service specifications are described in Section 6 of this document.

8.5 Training

(a) Provide adequate training (technical training and end-user training), training facilities, training materials and ongoing maintenance and update on the training materials.

8.6 Hardware Facilities and Maintenance

(a) Propose comprehensive hardware and system configurations for the system in production and non-production environments to meet the system and application software requirements.

(b) Recommend the configuration of the front-end desktop or mobile machines in running the BIS.

8.7 Software Facilities and Maintenance

(a) Propose all software required to be comprised in the system for both production and non-production environments.

(b) Maintain each contractor-supplied software to ensure they are operating in full and proper working orders.

(c) Provide maintenance services covering the supply of all new versions, upgrades, updates, patches (including security patches) and hotfixes.

(d) Propose end-point security solution if the proposed solution uses a special environment other than Windows or Linux.

8.8 Security Risk Assessment and Audit, and Privacy Impact Assessment

(a) Engage, at the contractor's own costs and expenses, an independent third-party contractor to perform an IT security risk assessment of the system at the later stage of System Analysis and Design, and an IT security risk assessment and audit exercise of the system before production rollout.

(b) Appoint, at the contractor's own costs and expenses, an independent third-party consultant to be agreed upon by the Government to conduct a Privacy Impact Assessment and Privacy Compliance Audit for the system at different stages.

8.9 Maintenance Support

(a) Provide support and maintenance services for the BIS.

(b) The maintenance period is 6 years from the date of acceptance of the BIS after completion of the nursing period in Phase 2 (inclusive of 1 year warranty service period which shall be free-of-charge). The service requirements during the maintenance period include:

- Stablise BIS data analysis capabilities.
- Stablise AI-Modeler data analysis capabilities.

- Provide remote helpdesk support to CMH technical users and end users during prime operating period of the BIS.
- Provide monthly BIS system monitoring and issue reports.
- Conduct annual disaster recovery drill.
- Work with CMH to identify areas of improvement and implement necessary enhancements to the BIS. This may include:
  (i) Optimization of data integration and processing workflows.
  (ii) Enhancement of semantic layer, analytical capabilities and visualization tools.
  (iii) Improvement of system performance and scalability.
- Provide on-demand service for BIS System Change during the maintenance period.

8.10 System Change

(a) Provide change services for the BIS with new hardware from other contractors and support the new application system being implemented.

(b) The Contractor shall quote the man-day rate and reserve 100 man-days in each year covering the maintenance period (inclusive of the warranty period), and implement the System Change upon requested. The charging man-days shall be agreed with CMH as per each case. The unused man-days shall be carried forward to next year as the cumulated resources pool.

Annex I: Information of Data Sources

1. Existing application Systems

The BIS shall have the ability to connect to various CMH's internal application systems. The information on the existing application systems is illustrated in the table below:

Application name	Daily transaction volume (MB)	Sizing (GB)	Operating System of Application System	Underlying Database	Estimate No. of Tables & Columns
Hospital Information System (HIS)	1,820	5,500	Redhat	MSSQL	113 tables / 1725 columns
Pharmacy Management System (PMS)	70	210	Redhat	MSSQL	267 tables / 4344 columns
Patient Administration System (PAS)	40	120	Redhat	MSSQL	57 tables / 1036 columns
Telemedicine System (TS)	500	1,500	Ubuntu Server / Redhat	MSSQL	30 tables / 300 columns
Dietetics & Catering Management System (DCMS)	80	300	Ubuntu Server / Redhat	MSSQL	30 tables / 500 columns
Incidents Reporting System (IRS)	Data shared in the Hospital Information System (HIS)				
Automatic Dispatching System (ADS)	100	300	Ubuntu Server / Redhat	MSSQL	15 tables / 160 columns
Central Sterile Management System (CSMS)	4	1	Redhat	MSSQL	33 tables / 370 columns
Radiology Information System (RIS)	380	530	Windows Server 2019 Std	MSSQL	300 tables / 6,200 columns
Laboratory Information system (LIS)	55	140	TBC	TBC	250 tables / 3000 columns
Enterprise Resource Planning (ERP)	200	20	Windows	MSSQL	2000 Tables / 30000 Columns
Mobile Applications (Patient app & clinical app)	Data shared in Patient Administration System (PAS)				
Integration Platform (IP)	1024	3072	Redhat	PGSQL (Config) / ES (Log)	26 tables / 280 columns / 7 indexes

2. Future application Systems

The BIS shall be designed to facilitate seamless integration with future CMH application systems. It must support scalable storage solutions, ensuring it can handle increased data volumes and processing needs.

3. Open Data

The BIS shall provide robust data ingestion capabilities to efficiently gather data from various public sources, including APIs, web scraping, and open data portals. It should support diverse data formats (e.g., CSV, JSON, XML) and provide functions for data cleansing and normalization to ensure data quality and consistency. It shall offer automated scheduling features to regularly update and refresh the data, maintaining its relevance and accuracy for analysis.

4. External Healthcare Data Sources

The BIS shall provide capabilities to efficiently gather and upload data from external healthcare data sources (e.g. eHealth of Hospital Authority).

5. User-Defined Entities

The BIS shall provide intuitive interfaces of flexible data import mechanisms for CMH's users to upload data from various sources, such as data files or spreadsheets at users' computers or network drives, etc.). It shall provide functions for data cleansing and validation to ensure data quality and consistency. It shall offer automated scheduling features to regularly update and refresh the data, maintaining its relevance and accuracy for analysis.

User-Defined Entities Planned	Fields (To-be-confirmed in the project)
CMH Organisation Structure Hierarchy	CMH Division Department Service
CMH Service Centre Location	Service Location
CMH Seminar and Programs	Event Date/Time Venue Event Name Event Classification/Type Event Hours No. of Attendees
CMH Resources Capacity	Resource Type Resource Service Capacity per Unit
CMH Establishment	Financial Year Staff Grade/Rank/Position Establishment
CMH Strength	Financial Year Staff Establishment Grade/Rank/Position Strength Staff Code / Name

User-Defined Entities Planned	Fields (To-be-confirmed in the project)
	Staff Actual Grade/Rank/Position Staff Experience
CMH Staff Performance Appraisal Results	Financial Year Staff Establishment Grade/Rank/Position Staff Code / Name Staff Actual Grade/Rank/Position Performance Appraisal Results

Annex II: Requirements of SA&D

The Contractor shall review and refine the design of the System during the system analysis and design stage. Documentation deliverables include, but are not limited to, the System design specification.

1. System Design Specification

The content of the detailed system design specification should include, but not limited to, the following:

(a) Corporate Data Model

(b) Physical Data Model with ER diagrams

(c) Data Flow Diagrams

(d) Data Mapping with transformation logic

(e) Business / Semantic layer Designs (Level: Hospital, Divisions, Departments and Services)

(f) Specify detailed designs for all components as specified in BIS framework:

- Data Integration
  - ETL processes
  - Data staging
- Data Storage and Management
  - Data lake
  - Data warehouse
  - Data marts
- Data Presentation
  - Reporting and visualisations
  - Self-service BI
- Data Processing and Analytics
  - Analytic Tool
  - AI-assisted chatbot
  - AI-Modeler
- Online Monitoring
  - On-demand online monitoring
- Data Catalogue
  - Metadata Ingestion
- Access Control Management
  - Access Control Management
- Data Output
  - Top & middle Management Insights
  - Frontline & Backend operations Reporting/Dashboards
  - Researchers Data
  - Open Data

(g) Design for Presentation and Reporting with detailed methodology on Report and Dashboard Construction in the following areas:

- Query / Report / Dashboard designs
- Layout design
- Folder and object naming convention
- Scheduling design
- Sizing Planning on:
    - Database server
    - ETL server
    - Reporting / Analysis server

(h) Report scheduling design

(i) Design for Self-Service BI

(j) Design for AI-assisted chatbot

(k) Implementation of AI Modeler

(l) Design for Data Catalogue

(m) Design for access control management

(n) Other Design Considerations

- Validation criteria and exception handling
- Design constraints
- Performance related consideration

Annex III Detailed Business Domain Analytics

Phase 1

1. CMH Key Performance Measurement
   - Analyse key performance metrics for service delivery, such as service capacity utilization, service throughput, service quality and service efficiency.

2. Internal Process
   - Evaluate the efficiency and effectiveness of core operational processes, such as e-booking management, consultation delivery, clinical services, herb/drug preparation, etc.

3. Chinese Medicine (CM)
   - Evaluate the integration and effectiveness of Chinese medicine practices within the organization's overall care delivery model.

4. Western Medicine (WM)
   - Evaluate the integration and coordination of Western medicine practices within the organization's overall care delivery model.

5. Clinical
   - Analyse key clinical performance indicators, such as patient outcomes, readmission rates, and adherence to evidence-based practices.

6. Quality and Safety
   - Evaluate the organization's quality management system, including processes for incident reporting, root cause analysis, and corrective action.
   - Optimize the waiting time for new patient appointments with specialist outpatient services. This helps improve access to specialty care and patient satisfaction.
   - Monitor medical quality and safety, covering clinical protocols, medication management, infection control, and incident reporting and analysis, helping to identify and address potential risks to patient safety.

7. Customer (Patient Experience)
   - Evaluate the patient experience through various touchpoints, such as access to care, communication, and care coordination.

8. Financial Performance, Efficiency, and Cost Control, Standard Cost:

By addressing the financial dimensions, the hospital aims to achieve robust financial performance, maintain operational efficiency, effectively manage costs and capital expenditures, and ensure long-term financial sustainability to support its mission of delivering high-quality healthcare services.

- Evaluate the organization's financial planning and budgeting processes and their alignment with business objectives.
- Monitor overall financial performance, focusing on key metrics such as revenue, expenses, and profitability. Emphasize improving operational efficiency and implementing robust cost control measures to optimize financial outcomes.
- Apply standard costing procedures to enhance transparency, facilitate budgeting, and support informed decision-making across various service lines and cost centres.
- Enhance overall operating efficiency by focusing on revenue cycle management, cost structure optimization, and resource utilization, which supports the hospital's financial sustainability and ability to deliver high-quality services.

9. Human Resource (Work Force Planning)
   - Assess the organization's human resource management practices, including resource pool utilization, staff development and performance management.
   - Evaluate the effectiveness of the organization's workforce planning and its ability to engage talent and develop junior Chinese Medicine Practitioners.

10. Operational Efficiency
    - Analyse the efficiency and effectiveness of the organization's core operational processes.

11. Service Growth
    - Assess the organization's ability to meet evolving customer needs and market demands.

12. Service Capacity
    - Evaluate the organization's capacity to deliver services effectively and efficiently.

13. Quality of Care

By addressing the multidimensional operational, clinical, and resource management areas, the hospital aims to drive continuous service growth, enhance overall medical quality, and achieve operational efficiencies across its diverse range of healthcare

services.

- Assess the organization's clinical performance, including patient outcomes, safety, and adherence to evidence-based practices.
- Identify opportunities to improve the quality of care and enhance the patient experience.

14. Medication Management
    - Evaluate the organization's processes for prescribing, dispensing, and monitoring medication usage.
    - Identify opportunities to optimize medication management practices and promote rational medication use.

15. Service Planning and Enablement
    - Evaluate the organization's approach to service planning, including demand and supply analysis, to ensure the alignment between service offerings and patient/community needs.

16. Service Planning – Demand and Supply
    - Assess the organization's ability to align its service supply (e.g., facilities, equipment, and staffing) with the identified demand.

17. Efficiency in Use of Resources
    - Evaluate the utilization of key resources, such as beds, and day/same-day surgery services, to identify areas for optimization.
    - Assess the organization's manpower planning and management practices, including staffing levels, skill mix, attrition rates, and leave balances, to ensure efficient and effective resource deployment.

18. Bed Management
    - Assess the organization's processes for managing inpatient beds, including occupancy rates, length of stay, and bed turnover.

19. Day and Same Day Surgery Services
    - Evaluate the organization's utilization of day and same-day surgery services, including factors such as case volume, patient throughput, and pre-/post-operative care management.

20. Case Management and Productivity
    - Evaluate the organisation’s case management and productivity across various service lines, including inpatient, specialist outpatient, primary care, allied

health outpatient, day hospital, and community/outreach services, which helps drive service growth and improve overall healthcare delivery.

21. Drug/Herb Inventory (CM / WM):
    - Monitor and analyse inventory of both Chinese and Western medicines, ensuring optimal stock balances, appropriate holding periods, and rational usage. This supports the overall quality of medical services.

22. Rational Drug Use
    - Monitor the rational use of medicines, including drug utilization reviews, prescribing guidelines, and patient education initiatives. This helps optimize therapeutic outcomes and minimize the risks associated with inappropriate or excessive drug use.

23. Drug/Herb Operation Efficiency (CM / WM):
    - Monitor the operational efficiency of drug and herb management for both Chinese and Western medicines.

24. Alert Incident, Variation and Remedy Action:
    - Identify and monitor alert incidents, variations, and remedial actions, further strengthening its commitment to medical quality and service delivery.

25. Command Centre and Clinical Intelligence:
    - A comprehensive view for the hospital's command center and clinical intelligence to monitor the journeys of patients, staff, medications, radiology, and specimens. The goal is to leverage data-driven insights to improve operational efficiency and support service growth.

26. Customer Service / Patient Journey:
    - A combined dashboard to review the different aspects of customer service, patient journeys, medical quality, service processes, and medicine management. The hospital aims to deliver a comprehensive and satisfactory healthcare experience for its patients and to enhance the overall customer service experience and optimise the patient journey across all touchpoints. This includes improving patient-centric processes, communication, and support to ensure a seamless and satisfactory experience.

27. Patient Appointment-Admission to Discharge Journey:
    - A statistical analysis view for studying the patient journey from appointment, admission, to discharge. This covers areas such as appointment scheduling,

admission procedures, inpatient care, and discharge planning to deliver a comprehensive and efficient patient experience.

28. Patient Medicine Journey:
    - A statistical analysis view to manage the patient's medicine journey, ensuring the appropriate selection, prescription, dispensing, and administration of both Western and Chinese medicines. This helps promote rational drug use and improve medication safety.

29. Specimen Journey:
    - A statistical analysis view to manage the specimen journey, from collection to analysis, to ensure the integrity, accuracy, and timely reporting of diagnostic test results. This supports the overall quality of medical services.

30. Patient Satisfaction Evaluation:
    - Measure and evaluate patient satisfaction across various service dimensions, including overall experience, care quality, and staff interactions. It drives continuous improvements and enhance the patient-centric focus of the organization.

Phase 2

31. Competitiveness and Business Development
    - Analyse the organization's competitive position within the industry.
    - Evaluate the organization's strategies for service portfolio, expanding new capabilities and strengths, and enhancing its competitive edge.

32. Chinese Medical Practitioner Development
    - Assess the effectiveness of training programs, career development opportunities, and talent management strategies.
    - Identify opportunities to enhance the organization's capability in Chinese medicine and ensure a sustainable supply of skilled practitioners.

33. Clinical Pathway Development
    - Analyse the organization's approach to developing and implementing Chinese medicine evidence-based clinical pathways for patient care.

34. New Herb Development
    - Evaluate the organization's research and development efforts in exploring and introducing new herbal remedies and Chinese medicine formulations.

35. Integrated Chinese Western Medicine Programme
    - Assess the organization's approach to integrating Chinese and Western

medicine practices within its overall care delivery model.

36. Manpower position by Staff Group (Medical, Nursing, Allied Health, Supporting (Care-related) and Others)
    - Analyse the organization's staffing levels and skill mix across different employee groups to ensure adequate and appropriate human resource deployment.
    - Identify any imbalances or gaps in staffing that may impact service delivery and patient care.

37. Patient Vital Sign Monitoring:
    - Monitor patient vital signs, ensuring high-quality medical services and enabling timely intervention when necessary.

38. Human Resource (Talent Management):

    By focusing on these human resource and organizational development dimensions, the hospital aims to build a highly capable, motivated, and engaged workforce that can deliver exceptional healthcare services and contribute to the continued growth and success of the organization.

    - The hospital actively engages with the external Clinical Management Professional (CMP) resources pool to supplement its workforce and needs to monitor the utilization of these specialized resources to meet the healthcare needs of the community.
    - The hospital closely monitors the composition and distribution of its staff, ensuring the right mix of skills, expertise, and experience to support the organization's strategic objectives.
    - The hospital maintains a comprehensive staff profile, tracking key demographic, educational, and professional attributes to inform workforce planning and development initiatives.
    - The hospital closely manages its staff establishment, monitoring vacancy rates, and implementing strategies to maintain optimal staffing levels and ensure the timely recruitment of qualified personnel.
    - The hospital closely monitors the day-to-day experiences and workloads of its clinical staff, including CMPs and doctors, to understand the impact on service delivery and patient care, and implement strategies to improve staff wellbeing and productivity.

39. Education and Research (Research)

    By emphasizing education, research, and the integration of traditional and modern medicine, the hospital aims to position itself as a centre of excellence, driving the advancement of healthcare practices and contributing to the overall progress of the medical field. In the research area, the hospital will emphasis on:

- Analyse the alignment of the organization's education and research activities with its strategic priorities and mission.
- Assess the impact of these activities on clinical outcomes, patient experience, and organizational reputation.
- Identify opportunities to enhance the organization's research capabilities and knowledge-sharing initiatives.
- The hospital prioritises the continuous training and learning of its workforce, investing in comprehensive programs, and providing opportunities for professional development to enhance the capabilities and competencies of its staff.
- The hospital actively invests in the development and strengthening of its clinical disciplines, ensuring the availability of specialized expertise and the continuous advancement of medical knowledge and practices.
- The hospital closely monitors the disease types and patient profiles it serves, informing the design and delivery of targeted healthcare services and staff training needs.
- The hospital provides comprehensive training programs to its staff, focusing on the delivery of high-quality patient care, the implementation of best practices, and the continuous improvement of service delivery.
- The hospital aligns its staff performance management with key result areas and systematically identifies and addresses the training needs of its workforce to support their professional growth and the achievement of organizational goals.
- The hospital tracks and reports on the total number of training days provided, as well as the average training days per staff member, to ensure adequate investment in the continuous development of its workforce.
- The hospital has a strong focus on talent development, implementing strategies to identify, nurture, and promote internal talent to build a robust pipeline of future leaders and subject matter experts.

40. Education & Research (Education)

By emphasizing education, research, and the integration of traditional and modern medicine, the hospital aims to position itself as a centre of excellence, driving the advancement of healthcare practices and contributing to the overall progress of the medical field. In the education, the hospital will emphasis on:

- The hospital places a strong emphasis on education and research, recognizing their critical role in advancing medical knowledge, improving patient outcomes, and nurturing the next generation of healthcare professionals.
- The hospital actively engages in educating students, providing hands-on training opportunities and developing comprehensive case studies to enhance their learning and prepare them for their future roles in the healthcare industry.
- The hospital's education and research initiatives are closely integrated, with a focus on translating research findings into practical applications that enhance the quality of patient care and drive continuous improvement.
- The hospital offers comprehensive post-registration training sessions (PRTS(SS3)) to its staff, ensuring they stay up to date with the latest medical

advancements, best practices, and regulatory requirements.

- The hospital conducts research on the use of herbs, traditional Chinese medicine, and integrative complementary and Western medicine (ICWM) approaches, exploring their potential benefits and integration into the overall healthcare delivery model.

Annex IV Technical Specifications: CMH IT Infrastructure Services

This document describes the CMH IT infrastructure services and their technical specifications for Tenderers who plan to implement BIS in the CMH IT Infrastructure.

The following CMH IT infrastructure services will be provided by other IT contractors:

1. Network services

(a) Type of network connections in different area:

Type of network connection	**Description** [ii]
Server or network equipment in data centres [i]	Speed: 10 Gb/s Connector: Multi-mode LC fibre
Data outlets [i]	Speed: 1 Gb/s Connector: RJ45
Network across primary and secondary data centres	Speed: 10 Gb/s
Wireless LAN	Wi-Fi 6

Notes:

i. Network patch cord will **NOT** be provided.
ii. Gb/s : gigabit per second; LC : Lucent Connector

2. Data Centre Services

(a) Data Centre Services include Primary Data Centre in CMH Building and Secondary Data Centre in hosting site.
(b) EIA standard 19-inch 42U equipment rack (with depth = 1,200mm).
(c) Mobile cart with monitor and keyboard (with touchpad or trackball) will be available for share use.
(d) Environment

Indoor temperature	23°C ± 3°C
Indoor relative humidity	50% ± 10%

(e) Power supply
   i. Two power distribution units (PDU) with output power connection type IEC 320 C13 and IEC 320 C19 will be available in equipment rack and supported by different Uninterruptible Power Supply (“UPS”)

ii. Power cord will **NOT** be provided.

3. Common Infrastructure Services

(a) Domain Name System ("DNS")
(b) Lightweight Directory Access Protocol ("LDAP") for account authentication
(c) Network Time Protocol ("NTP") service
(d) Global Server Load Balancing ("GSLB")
(e) Endpoint security
(f) Email service
(g) System monitoring service