SMART HOSPITAL

SERVICES CATALOGUE

AWTG SMART Service Catalogue

ABSTRACT

AWTG's SMART Hospital services catalogue is a comprehensive list of SMART solutions available to hospitals looking at digital transformation projects. It will enable hospitals to select the SMART services and applications that are best suited to deliver your vision of a Smart Hospital that is a leader in its field globally.

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AWTG LTD
SMART HOSPITAL SERVICE CATALOGUE

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EXECUTIVE SUMMARY

AWTG Ltd is pleased to present our SMART Hospital Services Catalogue, which provides a comprehensive list of all possible SMART health service implementations that are commercially available today. The use of our catalogue will enable you to select and prioritise those SMART services that are best suited to deliver your vision of a leading SMART hospital development that is at the forefront of healthcare provision and unique in its capability globally.

Healthcare has historically been focused on curative solutions, where the biggest problems were treatable conditions such as infectious diseases and fractures etc. Modern healthcare needs are radically different due to massive changes in socioeconomic, demographic and technological factors:

- **Population growth** – Nearly all regions of the world are experiencing population growth meaning more people require access to healthcare than at any time in our history
- **Increased life expectancy** – Successive generations have enjoyed increased life expectancy meaning people require healthcare provision over a greater span of time
- **Medical advances –** These have transformed previously fatal diseases to manageable but chronic conditions where patients require constant ongoing care
- **Increase in long-term conditions** – Many countries are witnesses a steady increase in long term debilitating conditions such as diabetes, hypertension, high cholesterol, strokes etc. that require life-long management

Additionally, the present global economic situation means that both public and private sector institutions have to deliver more for less – reducing costs and manpower while increasing efficiency and utilization of existing resources. This creates the impetus for a new way of thinking about healthcare and health systems.

These industry challenges are driving healthcare solution providers to forge new innovative and imaginative ways to manage the growing expense and complex social burdens that aging populations and increasing chronic disease rates bring. In order to meet these challenges, an emerging trend in healthcare is the development of the SMART hospital.

SMART hospitals can deliver improved efficiency, reduced costs, and personalized services for its patients. Using M2M, IoT, big data and open-source technology, providers can increase the availability and cost effectiveness of medical help, thereby improving the quality of patients' lives. In both developed and emerging economies, the healthcare infrastructure is transforming to address the steady rise in both healthcare demand and costs. In emerging economies such as those in China, India, the Middle East and Latin America, state-of-the-art hospitals and medical centres are being built or retrofitted to meet these challenges.

AWTG is an ISO: 9001 certified company with a broad array of experience delivering Smart Infrastructure Solutions to a wide range of businesses sectors, including healthcare providers,

telecommunications operators, equipment vendors, government bodies and industry regulators. We have supported our clients to create SMART infrastructure business models for both single standalone cases and large national level infrastructure programmes.

AWTG's focus on excellence and our reputation for delivering high value add to clients means that we're trusted advisors to government bodies as well as to regulatory bodies. Our drive to be at the leading edge of technological advancement resulted in our selection as the key delivery partner for Europe's first fully functional 5G test bed, where we supplied full end to end service capability including Programme Management, technical design, all civil construction works and the installation of a fibre ring backbone. At AWTG we pride ourselves on the quality of our people who have wide ranging expertise and experience of providing key strategic client side advisory services across a diverse range of topics covering:

- Market opportunity and sizing assessments
- Business case creation
- Design of implementation/execution strategies and integration plans
- Technology and Vendor evaluations and feasibility assessments
- Financial and Technical due-diligence
- Large infrastructure programme contracts and process review

We are the right partner to help guide and deliver maximum value to S in fulfilling its vision of a unified SMART Hospital development utilizing leading edge SMART Technologies as we cover the complete advisory and implementation stages with a breadth of experience in the delivery of similar projects.

We look forward to working with S and supporting your efforts to build a Smart Hospital that will be unique within the region and at the forefront of innovation. We are confident that we can meet and exceed the challenges ahead, and stand ready to partner with you in delivering our proven and effective support solution.

If you have questions on this proposal, feel free to contact Rohan Martin at your convenience by email at rohan.martin@awtg.co.uk

Thank you for your consideration,

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1. OUR UNDERSTANDING OF THE REQUIREMENTS

AWTG Ltd. was pleased to be able to attend a recent meeting with hospital at their offices, during which we discussed your SMART Hospital vision and longer term objectives. AWTG understands that their strategic vision for this development once completed, is for the Hospital to be a geographic regional leader in the provisioned of leading edge SMART healthcare services that will deliver improved outcomes for patients whilst simultaneously delivering increased efficiency and operating cost reductions.

As a first step on this road to a fully functional SMART hospital institution, the hospital would like to understand the full range of SMART healthcare services available on the market today and request AWTG to provide them with a prioritisation on these services into short term, medium term and long term priority classes based on our knowledge and experience of delivering SMART infrastructure services to other leading tier 1 clients.

In order to fulfil your request, AWTG presents our SMART Hospital Services Catalogue which details the full range of commercial solutions available today. Based on our experience and knowledge of working on similar SMART hospital programmes for major clients in the UK, we have then prioritised these services into the classes listed above, in the order which will most benefit and deliver maximum value.

2. CURRENT HEALTHCARE INDUSTRY OVERVIEW

The healthcare industry is currently experiencing a large scale evolution driven by a combination of factors such as:

- Shifting patient demographics that will continue to change significantly throughout the next decade – growing populations, rising life expectancy, high incidence of lifestyle-related diseases.
- Political and regulatory pressures are compelling hospitals and care systems to provide efficient and optimal patient care.
- Hospitals need to serve multiple patient populations effectively—e.g. cash as well as insurance beneficiaries, rural and remote populations, growing offsite patient care and chronically ill patients requiring enhancement of care-coordination as well as increased integration with a number of third parties.
- Harsh economic climate and stakeholder expectations demanding highest quality care to the most people possible at the lowest possible cost.

Globally, the challenges of healthcare delivery vary widely, yet health systems around the world have similar transformational goals and objectives: To improve the quality, value and outcomes of care, better alignment and coordination whilst maximizing return on investment (ROI).

As a result, we are seeing the emergence of more efficient SMART hospitals that provide a mechanism to drive forward greater efficiency, improve quality of care and provide access for more people than ever before.

SMART hospitals, whether newly-built or existing bodies that are retrofitted with the latest SMART technology, promise to boost efficiency and quality through better integration with all sources of care. They are enabling deployment of eHealth systems that provide online information, disease management, remote monitoring and telemedicine services that can extend the reach of scarce medical resources and expertise. SMART hospitals provide faster and safer throughput of patients, creating more capacity through process efficiencies, while containing costs.

Market Drivers toward a digital future

In addition to the attractiveness of these benefits, other market forces are pressing toward more technology intensive healthcare environment as well as a paperless organization:

- Computers are widely used in front and back office functions.[1]

- Insurance authorization and payment processes are driving toward electronic transactions and exchanges.

- Patient privacy regulations can be more reliably met with electronic-based systems that provide automated security features and audit trails.

- New diagnostic technology increasingly generates digital output that can be viewed and stored directly on a PC.

- New generations of patients, physicians, and healthcare workers — already very comfortable with using digital technology in their personal lives — are more likely to accept that computers can enhance medical care.

- Practice management and electronic medical record (EMR) systems continue to evolve toward more physician-friendly interfaces, while incorporating expert systems and built-in safeguards that help prevent medical errors.

- Rising adoption of Cloud-based solution and the evolution of big-data systems to create system, interoperability and organizational gains.

- Rapid advancement made in IoT, M2M, wearable and diagnostic technologies enabling for more advance forms of diagnostics, treatment and monitoring.

Benefit gains expected by next generation hospital systems

The overall benefits expected to be provided by SMART hospitals are:

- **A better patient experience**. Patients will primarily spend their visit with caregivers, and less time with intake, waiting for physicians who are behind schedule, or dealing with follow-up issues because of poor documentation. Errors and delays related to prescriptions, physician

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[1] Based on a Medical Group Office Management System Survey of 300 physicians, 93% currently use a computer-based patient scheduling system and 95% use an electronic billing and coding system.

orders, patient records, and reimbursement will be reduced. Additionally, there will be a focus on patient empowerment through patient education, increased patient interaction and greater emphasis to keep the patient out of the hospital via telehealth and wellness programs.

- **Higher quality of care.** Providers will meet a higher standard of patient care. Complete and accurate patient files will decrease opportunities for mistakes, omissions, or duplicated treatments. Within the hospital itself, there are systems to reduce errors and increased implementation of decision support systems to enhance the care provided to patients.

- **Enhanced productivity.** Physicians and other medical staff will spend more of their time providing face-to-face care because office workflow is less disrupted due to increased automation. They can see more patients, spend more time with patients, or devote saved time to other productive activities.

- **Improved office efficiency.** Healthcare organizations are able to eliminate duplication of effort and administrative delays. Less administrative staff time and space are devoted to records management, and less manual data entry reduces the risk of errors. Healthcare organizations agree that EMR systems, Web-based information systems, computerized physician order entry (CPOE) systems, and other IT-related solutions may be able to reduce the frequency of errors and improve overall accuracy. [1]

3. SMART SERVICES CATALOGUE

AWTG Ltd is pleased to present our SMART Hospital Services Catalogue, which lists all SMART technologies/services available today. The following table provides a brief description and overview of these services and solutions. Please note that some services are conceptual and can't be purchased as an off-the-shelf product. For example, a Health Information Exchange (HIE) is a service that would have to be custom built based on individual hospital requirements.

A more detailed and comprehensive service description for each SMART service can be found in the Appendix B.

SMART Services	Description
Clinical Decision Support	Clinical decision support (CDS) systems provide clinicians, staff, patients, and other individuals with knowledge and person-specific information, intelligently filtered and presented at appropriate times, to enhance health and patient care. They also help reduce human errors and enhance decision making and treatment process.
e-MAR	e-MAR is a combination of technologies that ensures that the correct medication is administered in the correct dose at the correct time to the correct patient. It can be implemented in a number of ways – the most popular one being Bar-code eMAR
e-ICU	An e-ICU uses telecommunications technology to diagnose and treat patients in the ICU remotely. It is a concept rather than an all-encompassing product suite containing – Pre-op, post-op and peri-op solutions.
e-Prescription	E-prescribing refers to secure bi-directional electronic information exchange between prescribing providers, pharmacies, payers, directly or through an intermediary network.
Communication network	A communications network is a communication system that allows two or more systems and their peripheral devices to be connected in order to exchange data and information. It uses Technologies such as Wi-Fi, DAS, RFID, Real time location systems, paging etc. to unify communication and ensure security and enable M2M and IoT functionalities to operate within a hospital.
ERP	A business process management software that allows an organization to use a system of integrated applications to manage the hospital and automate many back office functions related to technology, patient & supply chain information, services, human resource management, materials management, financial management and resource planning
Hospital Financial Management System	Enterprise Financial Management Solutions helps in gaining visibility into business-critical information, strengthen financial discipline and governance best practices, and realize efficiencies by automating and standardizing key business processes.
RFID System	Radio Frequency Identification (RFID) is a method for remotely storing and retrieving data using devices called RFID tags or transponders and readers.
Tele-health	Collection of means or methods for enhancing health care, public health, and health education delivery and support using telecommunications technologies. It encompasses a broad variety of technologies and tactics to deliver virtual medical and education services.
Population Health Management	Population Health Management is the aggregation of patient data across multiple health information technology resources, the analysis of that data into a single, actionable patient record, and the actions through which care providers can improve both clinical and financial outcomes
Video Conferencing and Telephony	Set of telecommunication technologies which allow two or more locations to communicate by simultaneous two-way video and audio transmissions.

Electronic Medical Record	Refers to the systematized collection of patient and population electronically-stored health information in a digital format. There are a number of digitalized health records that can be shared among multiple facilities. It is a concatenation of Hospital cases and charts, EHR and other ancillary and specialty services that enables Health information exchange (HIE) between health care organizations.
Patient Engagement	In simple terms refers to engaging patients in their own health to achieve better outcome. It is used to describe everything from patient portals to social media strategies, from tracking vitals with wearable devices to patients actively participating in wellness programs.
Identity and Access Management	Identity access management (IAM) system is a framework for business processes that facilitates the management of electronic identities. It ensures that the right individual can access the right resources at the right time for the right reason.
Data Management	The development and execution of architectures, policies, practices and procedures in order to manage the information lifecycle needs of an enterprise in an effective manner.
Biometric Identification	Hospitals can use the biometric identification technology to automatically identify individuals using their physiological patterns.
Cardiology Information System	A single platform with a single storage solution which allows for retrieval and analysis of cardiology-centric images and patient history. Can be integrated with other enterprise system to establish a single point of entry for all hospital personnel.
Real Time Location System	Real-time Location system automatically identifies and tracks the location of objects or people in real time using tags and readers.
Medical Grade Backbone Network	A backbone network represents the top of the network hierarchy of carrier network and it can provide the healthcare industry, the framework required to meet healthcare's unique needs for interoperability, security, availability, productivity, and flexibility.
Building Management System	Computer-based control systems (software and hardware) installed in buildings that control and monitor – either locally or remotely – the building's Energy, mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems and security systems, by collecting data from a series of sensors installed.
Dietary Information System	This system uses data gathered from patients and hospital ERP to generate useful nutritional indicators and assist dieticians with diet related assessment and care of patients.
Emergency Response Management Solution for Ambulance	This system refers to an ambulance-to-hospital based telemedicine system that uses mobile technology by providing real time patient information to the hospital via wireless communication enabling remote diagnosis and primary care, and reducing rescue response time.
PACS	Picture archiving and communication system (PACS) is a medical imaging technology which provides economical storage and convenient access to images from multiple modalities
Chronic Care Management	Chronic Care Management (CCM) is defined as the non-face-to-face services provided to patients who have multiple (two or more), significant chronic conditions. It includes oversight and educational activities conducted by care professionals to assist patients with chronic conditions.
Data Warehousing	A data warehouse is constructed from multiple heterogeneous sources. They store current and historical data and are used for creating analytical reports for health care providers throughout the hospital.
Laboratory Information Management System	A Laboratory Information Management System (LIMS) is software that allows you to effectively manage samples and associated data to improve lab efficiency.

4. SMART SERVICE PRIORITISATION RATIONALE

Based on our deep knowledge and understanding of the SMART healthcare sector and our experience of delivering to healthcare providers, we have developed our own rational for the prioritisation of difference SMART services so that we may deliver the maximum and ensure early benefit realisation from your SMART Hospital vision. This section outlines the logic and rationale behind the prioritisation of the services based on the conversations and information shared by the hospital with AWTG to date.

A SMART hospital is a complex combination of systems which can be grouped in a multitude of different ways. One possible logical grouping of these SMART solutions and services would be to group according to functional area. However, an issue arises as a number of systems fall across multiple functional areas as well as systems that are reliant on pre-requisites belonging to another functional area.

Rather than functional areas, AWTG recommend to group the SMART solutions and systems based on the motivational focus of the transformation. In this way it will be easier for the hospital to measure deliverables and outcomes for each selected SMART services. For example, if a SMART service is chosen from the **'Cost Savings'** category, then it would be easy to measure the success of this service against the motivational reason that the service was selected in the first place. So at the end of the service implementation plan and once fully operational, the hospital should ask the question 'Has this service delivered cost savings?'

Service Selection Motivational Categories

The list below outlines the motivational categories for each SMART service listed:

- **Satisfaction** – Increasing patient satisfaction is becoming a key driver for the adoption of new technologies by healthcare practices as they move towards more patient-centric healthcare models. New systems of healthcare are putting the patient at the centre, wrapping whole packages of support around their needs. This requires new models and new technology to better connect the care people receive from the healthcare system.

- **Process Optimization** – Financial constraints and shrinking health budgets require more hospitals be more efficient as well as optimize asset utilization across the board. Technology solutions in the healthcare workspace provide for simplified workflow, a reduction in waste and most
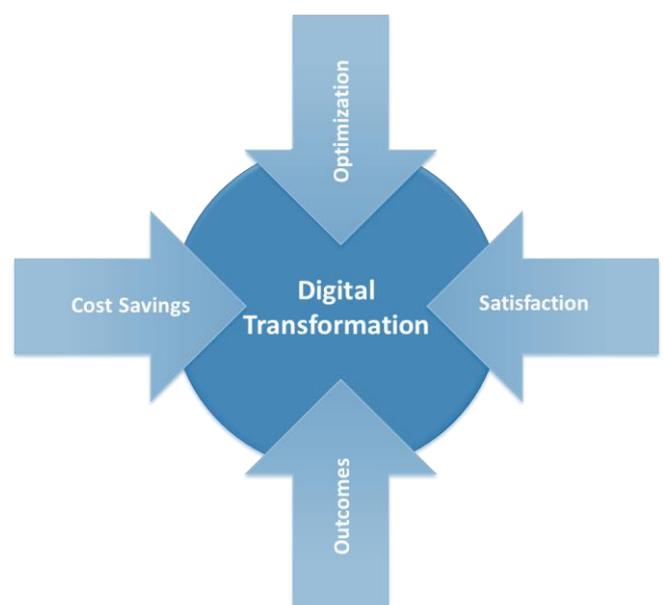
importantly improve caregiver efficiency.[2]

- **Cost Savings** – The cost of healthcare in some countries is growing at twice the inflation rate[3]. Both customers and hospital stakeholders are being forced to evaluate costs resulting in a drive to invest in solutions that reduce the cost of delivery of healthcare. Delivering cost savings is essential for long-term financial sustainability at both the local and national level.

- **Clinical Outcomes** – Today, there is a greater focus on clinical outcomes from both hospitals as well as government agencies. New SMART digital solutions are needed to provide solutions in the reformation of the current healthcare model to provide better clinical outcomes and lower readmission rates.

Enabling and Higher Level Advanced Service Classification

To help S to further simplify the selection of SMART solution/services, AWTG have additionally classified the available services as either **Enablers** or **Higher Level Advanced Services**.

- **Enabler** are essential components that are required in order to deliver one or more higher level Advanced SMART service/solution. For example, a data storage and warehousing system is a key Enabler for the more Advanced SMART services of Electronic Data Exchanges, Population Health Management, Outcomes and Quality Management and a number of other systems. What this means in a practical sense is that you can't go straight to implementing a Population Health management service without first implementing a data storage/warehousing system.

- **Higher Level Advanced Services** – Advanced services are those that deliver the very high *Recognized value* (outcomes are easily recognizable against industry KPI's like average patient stay, average cost of care, etc.) but are dependent on one or more Enablers to be in place before this service can be implemented.

The classification of the solutions into Enablers and Advanced Services helps to identify those systems and solutions that need to be in place as a high priority as they form the pre-requisites for multiple higher level Advanced Services.

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[2] *The good news is that a broad range of digital solutions is making healthcare less expensive and more accessible. In fact, last year private sector hospitals and pharmaceutical companies globally realized $67 billion in digital value, according to a recent* Cisco analysis

[3] *The PwC Health Research Institute found that the combined healthcare spending in the US rose 6.8 percent in 2015 and expects it to climb at a slightly slower clip of 6.5 percent in 2016 while the U.S. Bureau of Labour Statistics quoted the inflation of the broader consumer price index remains and will remain well south of a 2 percent annual pace. Healthcare spending around the globe continues to rise at unsustainable rates, consuming an ever-increasing slice of the world's economy. As measured by the percent of GDP healthcare, costs rose from 8.2 to 9.4 percent from 2000 to 2009. [5] The burden of chronic diseases is rising in both developed and developing nations, fastest among lower-income countries, populations and communities, where they impose large costs in human, social and economic terms. [6]*

5. SMART SERVICE PRIORITIZATION

To enable the hospital to sort through the SMART service options available, AWTG created a detailed valuation model to score each service based on the value that it can deliver new SMART hospital development. Further details of this model can be found in Appendix B. The result of the valuation exercise are presented in the table below which classifies each SMART services as either Short Term, Medium Term or Long Term investment priorities.

Higher Level Advanced Services		
Short Term	**Medium Term**	**Long Term**
EMR Modules Phase 1 – *CPOE, Patient Health Information, ADT, Patient Registration, Clinical Summaries, Patient Electronic Access, Medication Reconciliation (Problem List, Medication- Allergy List, Active Medication List)*	EMR Modules Phase 2 – *Radiology, Laboratory, Pharmacy, PACS, Clinical Decision Systems (Clinical Protocols), CDSS (error checking), Nursing/ Clinical Documentation, e-Prescription*	Full EMR – *Data Sharing, Data Warehousing, Data continuity with Ambulatory, ER and OP.*
ERP	Asset Tracking	Population Management Solutions
	Electronic Medication Management Solutions	Remote Diagnostics and Tele-Medicine Solutions
	Patient Portals, Applications, Wellness, Engagement and Education Solutions	Chronic Disease Management Solutions
	Revenue Cycle Management Solutions	Wearable Technologies and Wellness programs
	Resource Scheduling Solutions	Operating Room Technologies
	Inventory and Asset Management Solutions	Infection Control
	E-Prescription and Pharma applications	Outcome and Quality Management

Enablers		
Short Term	**Medium Term**	**Long Term**
Communications, Tele and video-conferencing platform	Data Warehousing and Data Management Platforms	Electronic Data Exchanges
Wi-Fi and hospital connectivity	System and Data Interoperability/ Interconnection Frameworks	

Medical Grade Network		
Data Storage Systems		
M2M, IoT and Sensor Network and Platform		
Identity, Access Management and Security		
Building Management Systems		
RFID Infrastructure and Platform		

Short Term Priorities

The immediate priorities of a greenfield hospital are creating an ICT framework to support all future SMART services/ applications. Additionally, the higher level services targeted are geared towards data creation and collection rather than aggregation, processing and analysis. With this in mind, AWTG recommend the following enablers and high level advanced services.

Short Term High Level Advanced Services	Reason for Inclusion
EMR Modules Phase 1 – *CPOE, Patient Health Information, ADT, Patient Registration, Clinical Summaries, Patient Electronic Access, Medication Reconciliation (Problem List, Medication- Allergy List, Active Medication List)*	Deploying a complete EMR solution immediately is theoretically possible but is not recommended by AWTG as: • SEPAS is not completely codified and implemented. • The complete integration chain for data flow between healthcare stakeholders is not complete. Hence, it is beneficial to break EMR implementation into portions that focus on the singular hospital and its patients.
ERP	An integrated ERP system enables interactions of all organizational areas into a single database. This will eliminate the occasional loss of information and error-insertion. It integrates all departments and functions across a hospital in a single computer system that is able to serve all those different department's particular needs. Investing in a strong ERP platform will pay dividends in the medium and long term

Short Term Enablers	Reason for Inclusion
Medical Grade Network	A medical grade network is a fundamental requirement for a SMART hospital. Since it is a greenfield hospital, AWTG strongly recommends building in a strong network designed to handle the large amount of data, ensure security and reliability of information.

Wi-Fi and hospital connectivity	A large number of sensors, applications and services will utilize the hospitals Wi-Fi system. Ensuring continuous access and coverage, reliable bandwidth, and in certain cases location- and context-aware services becomes a priority for a greenfield hospital.
Communications, Tele and video-conferencing platform	Ensuring the capability of the hospital networks to adequately handle voice as well as video applications allows for improved workflow and productivity in any hospital.
Data Storage Systems	Due to the large amount of data generated by Healthcare IT applications, adequate storage is a key requirement. Additionally, hospitals are subject to a multitude of national, state, and local regulations, and must ensure compliance with all relevant regulations. AWTG recommends in building the storage architecture to meet the hospital's service vision.
M2M, IoT and Sensor Network and Platform	Depending on the future service vision, the sensor, M2M and IoT platforms and infrastructure should be planned and installed in advance of the services so as to avoid retro-fitting infrastructure at a later date.
Identity, Access Management and Security	Security is a key issue in the healthcare field and AWTG strongly recommends integrating a robust security and access control mechanisms into the development plans of the greenfield hospital.
Building Management Systems	Building management systems create stakeholder value by being energy efficient and eco-friendly. AWTG encourages the investment into energy saving platforms and building automation systems so as to provide long term cost saving.
RFID Infrastructure and Platform	A large number of healthcare applications are implemented using RFID technology. Installing the RFID infrastructure and platform for data gathering during the construction of the hospital will make it much easier to deploy future systems utilizing this technology.

Medium Term Priorities

In the mid-term, once the hospital begins running and all the systems and operations are bedded down, the focus of investment shifts towards enabling process optimization and improving treatment outcomes. In this phase, the enablers are geared towards building more interconnectivity and big-data analysis capabilities; while the high level advanced services are focused on improvements to treatment outcomes and process enhancements.

Medium Term High Level Advanced Services	Reason for Inclusion
EMR Modules Phase 2 – *Radiology, Laboratory, Pharmacy, PACS, Clinical Decision Systems (Clinical Protocols), CDSS (error checking), Nursing/ Clinical Documentation*	In the midterm, the EMR adoption path is focused on interconnectivity of ancillary departments – cardiology, radiology, laboratory etc., increasing use of clinical decision support systems and interactions with adjoining services like clinics, off-premises pharmacies, etc.
Asset Tracking	Asset tracking applications are useful for creating a number of

	process efficiencies as well as treatment outcomes. This could be in surgical equipment, resources, mobile equipment, medical records, availability etc. The exact applications can be tailored based on the needs of the hospital from its operating experience to fill gaps and inefficiencies.
Electronic Medication Management Solutions	Utilizing the ICT framework and data gathering investment of the previous phases, eMM and eMAR solutions can be utilized to deliver full value in ensuring medication management and administration to patients.
Patient Portals, Applications, Wellness, Engagement and Education Solutions	With the primary focus of core operations fulfilled in the first round of deployment, solutions can now be geared towards patient centric engagement and education applications which can fully utilize the systems already in place.
Revenue Cycle Management Solutions	With the data gathered from the first phase, analysis can be conducted to view the financial operations and the implementation of these solutions
Resource Scheduling Solutions	Utilizing the ICT framework and data already gathered, solutions can be incorporated for resource scheduling from operating rooms, clinics, appointments etc.
Inventory and Asset Management Solutions	With a stable ICT infrastructure, innovative solutions for inventory and asset management can be implemented that can tie into the core ERP solutions for better supply chain integration.
E-Prescription and Pharma applications	These services require EMR Phase 1 as a pre-requisite.

Medium Term Enablers	**Reason for Inclusion**
Data Warehousing and Data Management Platforms	As the data is currently being stored, the first steps for a big-data analytics and processing can take place by the creation of data warehouses and preliminary DataMarts.
System and Data Interoperability/ Interconnection Frameworks	The focus of these enablers to create an interoperability platform that is multi-modal, vendor-neutral and allow for data to flow freely across all departments of the hospital.

Long Term Priorities

In the long, the focus shifts to increasing the reach of hospital services. IN the future, as the economy develops and the population advances in ages, the hospital will be forced to serve larger areas and stretch its resources – this phase of development encourages the investment in tele-medicine, e-healthcare, chronic disease management etc. in order to reduce the strain on hospital resources and increase utilization of hospital resources – beds, staff time, etc.

Long Term High Level Advanced Services	Reason for Inclusion
Full EMR – *Data Sharing, Data Warehousing, Data continuity with Ambulatory, ER and OP*.	The long term EMR implementation is focused on integration with other hospitals, national healthcare infrastructure, insurance provider networks and satellite clinics.
Population Management Solutions	These solutions are focused on community needs and community healthcare and require a more connected national healthcare structure.
Remote Diagnostics and Tele-Medicine Solutions	Utilizing the ICT framework and conferencing capabilities, these solutions focus on reducing the needs of the patient to visit the hospital. This requires a number of external needs to be meet which are currently unavailable.
Chronic Disease Management Solutions	Once the country-wide ICT infrastructure is developed, chronic disease management is one area that allows for better patient satisfaction as well improved treatment outcomes with increased resource utilization.
Wearable Technologies and Wellness programs	As the hospital develops through various phases, one of the innovative methods to become a leader in the healthcare field is to develop wellness programmes using cutting edge technology geared towards keeping people outside the hospital. This can only be done if the majority of the SMART services are already in place.
Operating Room Technologies	Utilizing the ICT framework to its maximum, pre-op, peri-op and post-op processes can be improved, multi-purpose OR rooms and additional advancements can be added that will leverage the technologies already available.
Infection Control	With the focus on process improvements completed, small process changes can be implemented to improve infection control. While important, we have included it here as we view the technologies in the previous phases as greater MUST-HAVES.
Outcome and Quality Management	This can only be fully realized once the requirements of a data-warehouse, big-data analytics capabilities and a large pool of available data are fulfilled.

Long Term Enablers	Reason for Inclusion
Electronic Data Exchanges	This will only be possible with a completed EMR implementation for maximum effect.

6. CONCLUSION

Based on a robust and evidenced based methodology built upon the industry standard **HIMSS[4] STEPS™ framework**, AWTG has prioritised and classified each available SMART Hospital service into an easy to understand table with short term, medium term and long term prioritisation categories. Within each of these categories we have also provided the key enabling technologies and services to allow the hospital to make informed decisions when deciding on which SMART Hospital services, solutions and technologies to invest in.

Based on our proven capability, wide ranging experience and the quality of our people, we are confident that AWTG is the right partner for S to enable timely delivery of your SMART hospital development through the utilisation of strategically selected and fit for purpose SMART technology solutions:

- AWTG has extensive experience of large scale infrastructure development and rollout programmes, meaning that we can be confident of providing the highest quality management and advisory support to guide S through the entire programme and project lifecycle

- We have a proven track record of delivering large scale network infrastructure projects for local government bodies, healthcare establishments, large enterprises and venue operators.

- AWTG has detailed working knowledge of all the enabling technologies and infrastructure requirements needed to support SMART solutions and applications

- Our experts have a deep understanding of the core application requirements and service architectures needed to design and implement SMART technology solutions and services having worked on a large number of sensor based applications, RFID implementations, Location based services, M2M and IoT implementations.

- AWTG has worked with many top IoT and M2M leaders to benchmarking, research and trial the technology in different wired and wireless environment.

- AWTG has an ecosystem of partners from equipment fabricators and suppliers, software integrators, software manufacturers and solution providers to help enable S meet its technology and Smart Technology solution needs.

- AWTG is an active member of the RAIN RFID alliance with access to over 250 affiliated SMART solution providers

- AWTG has prior experience in advisory of large investment projects having created strategies, business cases, evaluations and feasibility studies for organizations in a number of disparate geographies including Iran and the wider Middles East region.
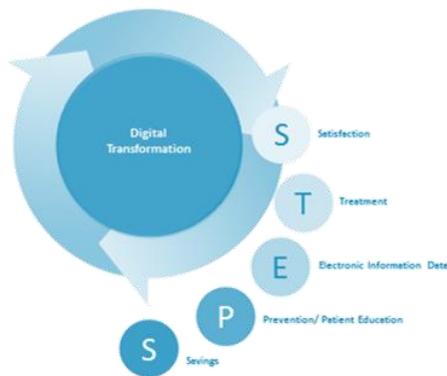
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[4] *HIMSS is a cause-based, not-for-profit organization focused on better health through information technology (IT). HIMSS leads global efforts to optimize health engagements and care outcomes using information technology.*

We stand ready to you help guide you through the full end to end delivery cycle, from planning and design, service and vendor selection through to service implementation, integration, testing and commissioning

APPENDIX A

Service Categorization Methodology

As there is no quantitative way to measure or evaluate the service outcomes/benefits, AWTG has created its own subjective framework for the evaluation of each of the services listed. The framework is based on HIMSS STEPS™ value optimization framework. AWTG's valuation model is used to help prioritise the SMART Hospital Services Catalogue into Short Term, Medium Term and Long Term investment priorities. Our model is based on the **HIMSS[5] STEPS™ framework**, which is an industry **leading evidenced based framework** built on the results of over **1600 cases** that HIMSS undertook of existing SMART Hospital Services implementation across the world where healthcare organizations have experienced value from SMART service solutions. The STEPS™ framework is built around the following five categories:

These categories form the basis with which we performed the SMART service valuation and prioritisation using the table structure outlined below. Each SMART service is put into the table below and then scored against each of the above categories. Within each category the SMART service is scored between 1 (low) to 5 (high) dependent on the contribution of that service to that category. So for example Smart Building management is a SMART Hospital service. It could be scored 1 for Satisfaction as it makes a low contribution to patient satisfaction, but is scored 5 for Savings as it has major impact on the ongoing costs. The results of the valuation exercise are given in the table below.

	Service Category Score (S_X)				
	Satisfaction	**Treatment**	**Electronic Information Data**	**Prevention / Patient Education**	**Savings**
Asset Tracking	1.7	2.3	2.7	0.0	2.3

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[5] HIMSS is a cause-based, not-for-profit organization focused on better health through information technology (IT). HIMSS leads global efforts to optimize health engagements and care outcomes using information technology.

Building Management System	0.0	0.0	0.3	0.0	3.7
Chronic Disease Management	3.3	1.7	0.7	3.0	2.7
Electronic Data Interchange	0.7	1.7	4.0	0.0	0.7
Electronic Health Record	3.0	4.7	5.0	2.0	2.7
Electronic Medication Management	2.7	2.3	2.7	3.3	0.7
Enterprise Resource Planning (ERP)	1.7	1.0	2.3	0.0	3.3
E-Prescription	3.7	1.0	2.3	2.0	2.3
Identity and Access Management	1.0	1.0	1.7	1.0	0.3
Infection Control	1.7	4.7	0.7	4.0	2.7
Inventory Management	0.7	1.3	3.3	0.0	2.0
M2M and IoT	2.3	1.7	3.0	1.7	1.7
Medical grade network	1.0	2.0	2.7	1.0	1.3
Operating room technology	0.7	4.3	2.0	0.3	1.0
Outcome and Quality Management	0.3	2.0	4.7	1.0	1.7
Patient Portals and Applications	4.7	1.0	1.7	3.3	1.0
Population Health Management	0.3	2.0	5.0	1.0	1.0
Remote diagnostics and tele-medicine	3.3	4.0	2.3	3.3	4.3
Resource Scheduling	2.3	3.3	0.0	0.0	2.0
Revenue Cycle Management	0.3	0.3	4.7	0.0	4.0
RFID	2.3	3.3	2.3	2.3	3.7
Storage Systems	1.0	1.7	4.0	0.0	1.7
System & Data Inter-connectivity	1.7	2.3	4.0	1.0	4.3
Video and Tele-conference facilities	3.3	1.3	1.3	1.7	2.3
Wearable Technologies & Wellness Programs	3.0	1.3	1.7	2.7	2.0
Wi-Fi and Hospitality Connectivity	2.7	2.0	1.0	1.3	2.0

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These categories form the basis with which we performed the SMART service valuation and prioritisation. Furthermore, looking at the demographics, healthcare needs and current trends of the region using data available from the WHO [3] and UNICEF [4] to create the following weightages to be applied to each of the categories to generate an overall service score.

Value Category	Weightage (Wx)
Satisfaction	15%
Treatment/ Clinical	20%
Electronic Information/ Data	15%
Prevention and Patient Education	15%
Savings	35%

Finally, we have provided solution/services that are enablers with a multiplication factor as their value rises beyond their baseline values when mature systems are employed on top of them. The multiplier added based on the value of a multiplier

Service Type Category	Weightage (M_X)
Enabler	2
Mature Service	1

The final formulae used for ranking is as follows:

If

W_X = weightage of service X,

M_X = multiplier of the category of service X where X can be Satisfaction, Treatment, Electronic Information/Data, Prevention and Patient Education, or Savings,

And, S_X = Score of service X, then

$$\text{Value Score for each service} = (\textstyle\sum W_X * S_X) * M_X$$

Based on the formula described, we have evaluated each service/application category and calculated the value to be gained by implementing each service/application and estimating its baseline value to a hospital. Additionally, enablers, by their virtue of service as a platform for more

complex services are ranked higher than matured services. Should a matured service be deployed, its value would be increased above its baseline value to include a percentage of its component enablers, and its total value could increase to the cumulative total of the component services. For e.g. Asset management utilizing RFID would have a cumulative total of Asset Tracking + RFID Infrastructure and Platform to give a aggregated total of 7.93. The list below allows Sto look at investment priorities for the services based on the value generated on each service category and application.

The complete list of evaluated services is:

Service/ Application Category	Enabler/ Mature Service	Value Estimation Score
Electronic Health Record	Enabler	6.73
RFID Infrastructure and Platform	Enabler	6.00
Communications, Video and Tele-conference facilities	Enabler	4.07
Enterprise Resource Planning (ERP)	Enabler	3.93
M2M, IoT and Sensor Network Platforms	Enabler	3.93
Wi-Fi and Hospitality Connectivity	Enabler	3.70
Remote diagnostics and tele-medicine	Mature Service	3.67
Storage Systems	Enabler	3.33
System & Data Inter-connectivity	Enabler	2.98
Infection Control	Mature Service	2.82
Chronic Disease Management	Mature Service	2.32
E-Prescription	Mature Service	2.22
Revenue Cycle Management	Mature Service	2.22
Wearable Technologies & Wellness Programs	Mature Service	2.07
Electronic Medication Management	Mature Service	2.00
Patient Portals and Applications	Mature Service	2.00
Asset Tracking	Mature Service	1.93
Outcome and Quality Management	Mature Service	1.88

Identity and Access Management	Enabler	1.73
Resource Scheduling	Mature Service	1.72
Population Health Management	Mature Service	1.70
Operating room technology	Mature Service	1.67
Inventory Management	Mature Service	1.57
Medical grade network	Enabler	1.57
Building Management System	Enabler	1.33
Electronic Data Interchange	Mature Service	1.27

While this categorization, does help prioritization of the services, it does not naturally tend to help in formulating an effective implementation strategy for a new greenfield hospital. For e.g. while a Building Management System does not make the top contenders for implementation based on derived value, it is a very prudent technology investment for S as they are currently building the hospital.

With his in mind, AWTG has categorized the service catalogue presented into Short Term, Medium Term and Long Term investment priorities.