Development and Implementation of an Integrated Digital Module for Hospital Diet and Kitchen Services: Experience from a Tertiary Care Teaching Hospital

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Abstract*—The healthcare industry is increasingly adopting digital technologies to improve efficiency, accuracy, and quality of patient care. This study describes the implementation and evaluation of an HMIS Diet & Kitchen Module in a tertiary healthcare facility to replace the existing manual and telephonic diet order system, which was associated with communication gaps, transcription errors, delayed meal delivery, and increased staff workload. The Plan–Do–Study–Act (PDSA) cycle was used as a quality improvement framework for systematic implementation. During the planning phase, workflows and system requirements were identified, followed by pilot testing in selected wards with automated diet order transmission to the kitchen. User feedback, error rates, and turnaround time were analyzed before hospital-wide rollout. Following implementation, manual and typographical errors reduced significantly, communication between nursing and kitchen services improved, and diet processing became faster and more accountable. The module enhanced patient safety, traceability, and operational efficiency while reducing staff burden.

Index Terms - Health Management Information System (HMIS), Diet & Kitchen Module, Plan–Do–Study–Act (PDSA) Cycle, Nutrition Management, Quality Improvement, Hospital Workflow Optimization, Patient Safety, User Satisfaction.

I. INTRODUCTION

The healthcare industry is undergoing a significant and progressive transformation driven by the integration of digital technology. This shift extends beyond daily operations, profoundly influencing clinical practice, administrative efficiency, and the advancement of scientific knowledge. Healthcare systems need to use digital technology for innovative solutions to improve healthcare delivery and to achieve improvement[i]. Using digital applications, process optimization can be achieved by increased efficiency and therefore a reduction in costs in the healthcare system. Improved processes can in turn achieve an increase in quality in the treatment of patients[ii] The transition from traditional, paper-based methods to sophisticated healthcare management and information systems is central to this change, providing rich datasets essential for research and improved decision-making. This broader process, known as digital transformation, refers to the strategic application of digital technologies to not only streamline workflows but also to ultimately benefit society through enhanced patient care and public health outcomes. Health Management Information System is a comprehensive, integrated information system designed to manage the administrative, financial, and clinical aspects of healthcare delivery in a hospital or health facility. It collects stores, processes, and reports data across all departments to support evidence-based decision-making, improve patient care quality, enhance operational efficiency, and ensure compliance with national health information standards.[iii]

The All-India Institute of Medical Sciences (AIIMS) Mangalagiri is an autonomous public medical institute that have been declared by an Act of Parliament 1956 as Institute of National Importance established under the Ministry of Health & Family Welfare, Government of India under the Pradhan Mantri Swasthya Suraksha Yojna (PMSSY). AIIMS

Mangalagiri was established in 2019 with an aim of correcting regional imbalances in quality tertiary level healthcare in the country and attaining self-sufficiency in graduate and postgraduate medical education and training. AIIMS Mangalagiri has a comprehensive Hospital Management Information System (HMIS) since inception. AIIMS Mangalagiri has been utilizing a comprehensive Hospital Management Information System to collect, analyse, and use health-related data for effective planning and decision-making. From the institute's inception, key modules such as Outpatient Department & In Patient Department management, Laboratory services, and Inventory systems have been successfully integrated into the digital workflow. As part of continued expansion, new HMIS modules are currently under development—one of the most significant among them being the HMIS Diet & Kitchen Module.

II. RECENT LITERATURE

Studies indicates that Hospital Management Information Systems improve workflow efficiency, data management, and interdepartmental coordination, thereby strengthening overall hospital operations[iv]. Evidence also suggests that hospital information systems are associated with improved usability outcomes, particularly in terms of efficiency and error reduction, which are critical for safe and timely service delivery[v]. In hospital foodservice, systematic reviews of electronic bedside meal ordering systems have demonstrated positive effects on patient dietary intake, patient satisfaction, reduced plate waste, and cost optimization compared with traditional paper-based systems[vi]. Similarly, electronic meal ordering systems have been shown to improve meal-order accuracy, reduce food waste, and enhance operational efficiency in nutrition services[vii]. Collectively, these findings support the integration of a digital diet and kitchen module within HMIS as a practical strategy to minimize manual errors and improve service efficiency in tertiary care hospitals.

III. OBJECTIVES

1. To develop and implement an integrated digital module for managing hospital diet and kitchen services in a tertiary care teaching hospital.
2. To evaluate the effectiveness of the digital module in improving accuracy, efficiency, and coordination of diet orders, meal preparation, and distribution services.
3. To assess the institutional experience regarding the challenges, benefits, and overall impact of digital transformation in hospital diet and kitchen service delivery.

IV. METHODOLOGY

The HMIS Diet & Kitchen Module is designed to streamline and modernize nutritional care within the healthcare facility. It was outsourced to a third-party vendor, and the diet request is completely manual through phone. By digitalizing the processes related to patient diet planning, tracking, and delivery, the module aims to ensure that nutritional needs are met accurately, safely, and efficiently. The system incorporates a predefined library of diets and recipes, ensuring consistency and quality in meal planning. It also enhances patient safety by automatically checking for allergies, dietary restrictions, and potential drug-diet interactions. In addition, the automation of diet ordering and meal distribution significantly reduces manual errors and improves operational efficiency.

A key strength of the module lies in its data management capabilities. It maintains a complete dietary history for each patient, supporting better clinical decision-making and nutritional assessment over time. With core functions such as diet prescription, meal planning, inventory tracking, and detailed reporting, the Diet & Kitchen Module integrates seamlessly into the existing HMIS ecosystem. By transforming traditional paper-based workflows into a digital, data-driven system, the HMIS Diet & Kitchen Module is poised to enhance both patient nutrition and overall hospital operations at AIIMS Mangalagiri. Inclusion and Exclusion criteria for the study is included in Fig1.

Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
1.All inpatients admitted during the study period who received dietary services through the HMIS Diet & Kitchen Module. 2.All digitally generated diet orders processed through the HMIS Diet & Kitchen Module.	1.Outpatients, attendants, and visitors not receiving dietary services through the inpatient HMIS workflow. 2.Patients who were discharged, transferred, or expired before initiation of diet services. 3.Incomplete or duplicate diet orders. 4.Manually processed diet orders outside the HMIS workflow.

Fig1: Inclusion and Exclusion Criteria of Diet & Kitchen Module Implementation

V. PDSA CYCLE STRUCTURE

The Plan–Do–Study–Act (PDSA) Cycle is a widely used quality improvement model that enables organizations to test changes on a small scale, evaluate their impact, and refine processes before full implementation. Developed from the work of W. Edwards Deming and first described by Shewhart, the PDSA framework promotes iterative learning, data-driven decision-making, and continuous improvement in healthcare settings[viii]. It is frequently used in hospitals to streamline workflows, improve patient safety, enhance documentation processes, and guide systematic adoption of new digital systems. Implementation of new initiatives must adhere to established quality improvement methodologies, like Plan–Do–Study–Act (PDSA) cycle, to promote structured deployment, measurable outcomes, and sustainability.

At AIIMS Mangalagiri, the PDSA Cycle structure was adopted to guide the introduction and implementation of the HMIS Diet & Kitchen Module, ensuring the transition from a manual, error-prone diet management process to a standardized digital workflow. Using the PDSA approach as showed in Fig 2, allowed the team to systematically plan module development (Plan), pilot-test it in a controlled environment (Do), analyse feedback and discrepancies (Study), and refine the system before hospital-wide rollout (Act). This structured, evidence-based method supported user engagement, minimized implementation risks, and facilitated sustainable improvements in accuracy, accountability, and efficiency of diet management.

Fig 2: Integration of the Deming Plan–Do–Study–Act Cycle for the HMIS Diet & Kitchen Module

a. Plan - Planning Phase

Before the introduction of the HMIS Diet & Kitchen Module at AIIMS Mangalagiri, the diet management process was entirely manual. In routine practice, the in-charge nursing officers prepared handwritten lists of patient diet requirements and sent them to the vendor through WhatsApp approximately four hours before each meal. The hospital followed a standard meal schedule—breakfast at 8:00 AM, lunch at 1:00 PM, and dinner at 7:00 PM. Any new admission occurring between these times was similarly communicated to the vendor via WhatsApp Messenger. At the end of every month, the vendor compiled all diet requests and submitted a consolidated bill for payment. Since this system operated without any digital record-keeping, there was no reliable way to track diet orders, verify accuracy, or generate meaningful reports. Important details such as the number of diets served daily, types of diets prescribed, special remarks, and monthly consumption trends could not be systematically monitored. The absence of standardized reporting and tracking led to frequent manual errors, lack of accountability, and challenges in ensuring patient satisfaction.

To overcome these issues and reduce errors by at least 50%, AIIMS Mangalagiri initiated the development of a dedicated Diet Module within the HMIS. The objective was to establish a consolidated digital platform for recording, processing, and reporting patient diet requirements. All stake holders including Doctors, Nurses, Administrators, Vendor collaborated to design the module. After collecting user inputs and workflow requirements, a trial version was developed and demonstrated to stakeholders. This prototype automated the retrieval of patient details, displaying ward-wise information such as age, sex, and CR number. A dropdown menu

allowed nurses to select the prescribed diet type, while an additional remarks field enabled the entry of any special instructions. By digitalizing the diet ordering process, the module significantly reduces manual workload, minimizes documentation errors, and enhances traceability. The improved workflow not only supports accurate meal planning but also strengthens reporting and monitoring, ultimately contributing to better patient care and operational efficiency. The Following options are available in the module.

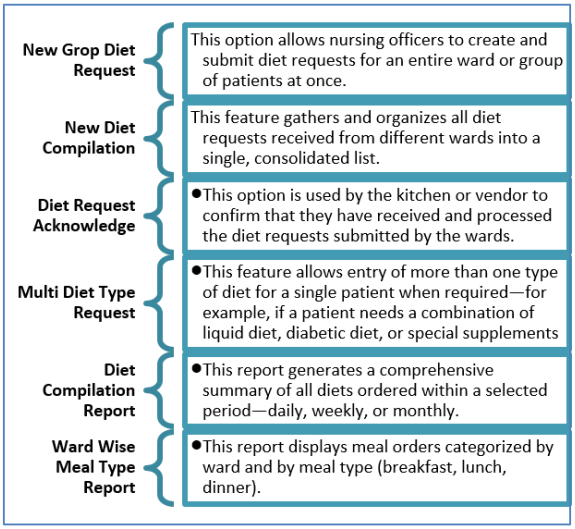

Fig 3: Customized options created along with stakeholders at HMIS Diet & Kitchen Module in AIIMS Mangalagiri

b. Do - Implementation Phase

To evaluate the practicality and feasibility of the new HMIS Diet Module, a pilot implementation was conducted in one of the surgical wards, which maintains an average daily census of around 70 patients. An online training session was organized for the nursing officers to familiarize them with the process of entering diet requests through the module. Additionally, training was provided to the food supplying vendor to enable them to generate diet reports and view ward-wise diet requests in the system. The trial version was implemented for a period of one month. However, since the existing manual system was continued during this phase, staff were required to perform both handwritten diet entries and digital entries simultaneously. This dual workload created resistance among the nursing staff, who expressed concerns that the new system was reducing their patient interaction time and increasing their screen time. During the initial phase, several technical issues also emerged, including mismatches between manual records and computer-generated reports. These challenges highlighted the need for further refinement of the module before full-scale implementation.

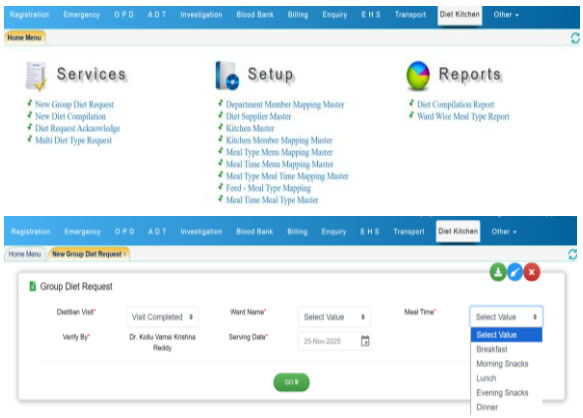

Fig 4: HMIS Diet & Kitchen Module in AIIMS Mangalagiri

c. Study - Evaluation Phase

After the pilot phase in the surgical ward proved successful, the HMIS Diet Module was scaled up across the entire hospital. Payment for patient diets was transitioned to be based on the system-generated reports, replacing the earlier manual billing process. A comparative analysis of data from before and after full implementation showed a significant reduction in manual and typographical errors—around 60% fewer errors overall. Nurses reported a markedly more satisfactory workflow, instead of composing diet orders via WhatsApp and handwriting, they could now update each patient's diet in just 2–3 minutes and with a single click. The vendor also welcomed the change. They noted that the digital system dramatically simplified their job: they no longer needed to manually sort diet types, and generating daily reports had become much easier and faster.

The reduction in error rate aligns with findings from other clinical nutrition software implementations — for instance, computerized diet systems have been shown to reduce recording and calculation errors from 12% to ~1.5%.[ix] Digitizing the workflow not only improves accuracy but also saves staff time, allowing them to focus more on patient care rather than paperwork.[x] Such systems also enhance transparency and accountability in billing and reporting, because all data are traceable and auditable

d. Act - Refinement & Next Steps

Based on user feedback, several enhancements were introduced to the HMIS Diet Module after its initial

rollout. The software now remembers a patient's previously saved diet and suggests it automatically for each shift. This removes the need to manually select the diet type every time. A "Special Remarks" column was added to capture any specific instructions. The in-charge nursing officer role was given special prominence in the UI. Users (nurses, ward in-charges, administrators) were given the ability to download diet reports, enabling them to verify and reconcile data from their side. To maintain sustainability of the module, the hospital instituted continuous monitoring and weekly audits. Nursing, administrative, and dietary teams reviewed diet orders, tracked discrepancies, and validated the consistency of entries. These routine checks help ensure data quality, encourage accountability, and reinforce adoption of the system.

By adding auto-detection and remarks fields, the system becomes more aligned with real-world workflows, which increases usability and reduces resistance. Downloadable reports foster transparency. When staff and vendors can verify data independently, trust in the system increases. Continuous monitoring and audits help detect anomalies early (missing orders, mismatches, or repeated errors), enabling corrective actions. This is aligned with best practices in HMIS implementations, where data quality assessment is essential for meaningful decision-making. Engagement of stakeholders, regular feedback loops, and structured audits contribute to long-term sustainability. Research shows that to sustain digital health systems, consistent stakeholder involvement, monitoring, and dedicated budget lines are critical[xi]. Based on the feedback from the users we have added auto detect of diet type once it is saved in previous shit so there is no need to select diet every shift and improved software interface by adding more options like special remarks column and in charges also given option to download diet reports to verify from their end. To maintain sustainability of the module continuous monitoring and weekly audits were done.

VI. STRENGTHS AND LIMITATIONS

A major strength of this study is the successful implementation of an HMIS-based Diet & Kitchen Module using the PDSA quality improvement framework in a real-world tertiary care setting, demonstrating measurable improvements in efficiency, error reduction, accountability, and interdepartmental coordination. The study also addresses an underreported yet critical domain of hospital digital transformation—nutrition service management. However, the findings are limited by its single-center design, lack of a control group, and emphasis on short-term operational outcomes rather than long-term sustainability or patient-centered clinical outcomes. In addition, the intervention's effectiveness may be influenced by the availability of institutional digital infrastructure and staff readiness.

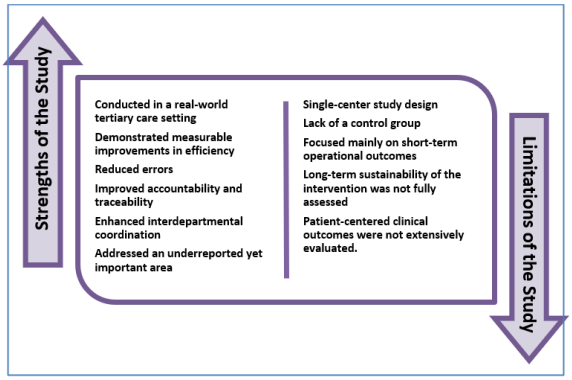

Fig 5: Strengths and Limitations of the Diet & Kitchen Module Implementation

VII. RECOMMENDATIONS

To further enhance the efficiency and sustainability of the HMIS Diet & Kitchen Module at AIIMS Mangalagiri, several recommendations are proposed. Regular refresher training for nursing staff, dieticians, and vendors should be conducted to strengthen user competency and minimize documentation errors, as workforce training is a key factor influencing digital system adoption[xii]. Providing mobile or tablet-based interfaces in wards can ease the documentation burden and facilitate real-time diet updates, supporting WHO's guidance on point-of-care digital tools[xiii]. Integrating the module with doctors' prescriptions, allergy information, and electronic medical records promotes coordinated and safer nutritional care, consistent with recommendations for clinical decision support integration. Automated alerts for new admissions, diet modifications, allergies, and NPO status can further reduce errors and enhance patient safety, in line with WHO patient safety standards[xiv]. Maintaining a standardized, periodically updated diet library in consultation with clinical departments ensures consistency in clinical nutrition workflows[xv]. Expanding data analytics through dashboards will strengthen administrative planning and monitoring, as encouraged by HMIS implementation frameworks in India. Vendor workflow integration, including the

ability to update meal preparation and delivery status, will improve traceability and accountability, aligning with digital health workflow optimization principles. Continuous feedback through monthly review meetings supports iterative improvement, consistent with the PDSA framework advocated by the Institute for Healthcare Improvement[xvi]. Finally, sustaining weekly audits and discrepancy checks will preserve data accuracy and promote long-term system reliability, reflecting core principles of quality improvement and data governance[xvii].

VIII. CONCLUSION

The healthcare sector is undergoing rapid digital transformation, improving clinical care and administrative efficiency through technology-driven solutions. At AIIMS Mangalagiri, the adoption of HMIS since 2019 has enabled data-driven decision-making and streamlined hospital operations. To further enhance patient dietary services, a digital HMIS Diet & Kitchen Module was developed to replace the manual, error-prone WhatsApp-messenger based system. Using the PDSA Cycle, the module was planned, pilot-tested, evaluated, and refined before full-scale implementation. The pilot phase highlighted issues such as dual workload and technical mismatches, which were addressed through iterative improvements. After hospital-wide adoption, manual and typographical errors reduced by nearly 60%, and workflows for nurses and vendors became faster and more accurate. Automated diet suggestions, a special remarks column, and options for downloading reports improved usability and transparency. Continuous monitoring and weekly audits were instituted to sustain data quality and system reliability. Overall, the digital module significantly strengthened patient dietary management and operational efficiency at AIIMS Mangalagiri.

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