

Health Informatics Integration for Multidisciplinary Nutrition Care Teams

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ABSTRACT

The systems of nutrition care have undergone radical transformation, changing the manual-based systems into the sophisticated digital and data-based ones. The previous models used to be highly dependent on handwritten records of the diet, subjective memory of the patients and team-only nutrition decisions, which tended to lack consistency and follow-up. With the advent of electronic platforms, nutrition practice is changing as it incorporates electronic health records (EHRs), automated screening devices, mobile dietary tracking apps, and AI-based decision support systems. These innovations facilitate real-time tracking, a better evaluation of diet, and a flow of information between clinical teams. Nutrition interventions have become more customized, responsive, and outcome-oriented with data analytics and predictive tools, which improve disease management and preventive care. With the continuing development of informatics, nutrition services are being increasingly transitioned to personalized, technology-enhanced systems that would facilitate patient-centered, effective, and evidence-based nutritional services in healthcare environments.

Keywords: Health Informatics, Multidisciplinary, Nutrition, Care Teams.

INTRODUCTION

Health informatics is now a consideration in the modern healthcare delivery system, representing the planned gathering, examination, and utilization of health information to enhance patient results and healthcare processes. Healthcare professionals have been able to effectively support patient information, aid evidence-based decision-making, and organize care in clinical settings using the integration of advanced informatics platforms, including electronic health records (EHRs), clinical decision support systems, and telemedicine interfaces[1]. Regarding nutrition care, health informatics enables one to accurately track the nutritional condition of patients, their nutrition and metabolic requirements, which serves as a data-grounded basis of personalized intervention and longitudinal follow-up.

The place of nutrition in patient care remains dynamic and there is an overwhelming acceptance of the influence of nutrition on the prevention of diseases, the management of acute and chronic conditions and recovery. The validated informatics tools have become a vital source of nutritional evaluation, thus allowing clinicians and dietitians to recognize risk of malnutrition, optimise enteral and parenteral feeding schedules and objectively monitor therapeutic responses[2]. Interdisciplinary integration of nutrition care is quite extensive and requires cooperation among physicians, nurses, dietitians and pharmacists and other allied health professionals. This integration is supported by health informatics platforms that provide the means of real-time communication, assignment of tasks, and recording of nutritional care plans in shared digital setting. The collaboration platforms render it possible to apply the standardised nutrition protocols, monitor compliance, and timely adjust to the clinical changes or complications.

The current literature emphasizes the fact that nutrition support teams, led by informatics, have been known to reduce adverse events, length of stay, and overall patient satisfaction, which is why the connection between digital innovation, teamwork, and the quality of provided nutritional care is crucial. Also, informatics tools encourage interdisciplinary nutrition science education and research through the provision of repositories of anonymized patient data, through the promotion of outcomes research, and through supporting the use of continuous quality improvement efforts. With the ever-expanding technology, patient-centered nutrition care will be increasingly supported by health informatics when it comes to acute, post-acute, and community health settings[3]. The obstacles of interoperability of data, user training and privacy management are also critical issues, yet current research studies are optimistic that incorporation of health informatics in multidisciplinary nutrition care teams is a paradigm shift in enhancing personalized, efficient, and high quality nutrition assistance in present-day healthcare systems. This review shows the significance of nutrition care systems and multidisciplinary and health informatics care and real-life application.

2. Evolution of Nutrition Care Systems

The modern phenomenon of the replacement of the manual nutrition tracking with the digital platform is a critical step in the efficiency and clinical effect of the nutrition management. Traditionally based on paper logs or subjective recollection, manual approaches are much more susceptible to errors and do not allow an effective longitudinal follow-

up of nutritional interventions and dietary intake[4]. Digital applications, such as mobile apps and automated dietary assessment tools, allow capturing real-time data and increasing the accuracy of data and facilitating engagement by ensuring that nutrition self-monitoring is convenient and interactive to patients and providers. [5]It appears that there is emerging evidence that these digital solutions support more comprehensive, behaviorally informed, dietary interventions with built in feedback and reminders that may be used to maintain adherence to nutrition goals. One of the important trends of electronic nutrition care is the combination of electronic health records (EHRs) and nutrition tracking systems. Integrating validated malnutrition screening instruments directly into EHRs to enable clinicians to automate risk assessment, activate clinical alerts, and record interventions with accuracy never before seen. This trending capability in nutrition metrics over time, and the capability to activate clinical decision support, and decrease transcription errors, has led to proven workflow efficiency and patient safety, as demonstrated by a large reduction in nutrition-related errors and improved coding and reimbursement results after the implementation of EHR.(Figure 1) Data-driven diet planning is an algorithm-based approach that takes advantage of sophisticated analytics, artificial intelligence (AI), and machine learning algorithms to combine huge volumes of patient data such as dietary consumption, clinical history, metabolic status, and genetic markers to plan highly customised nutrition plans[6].

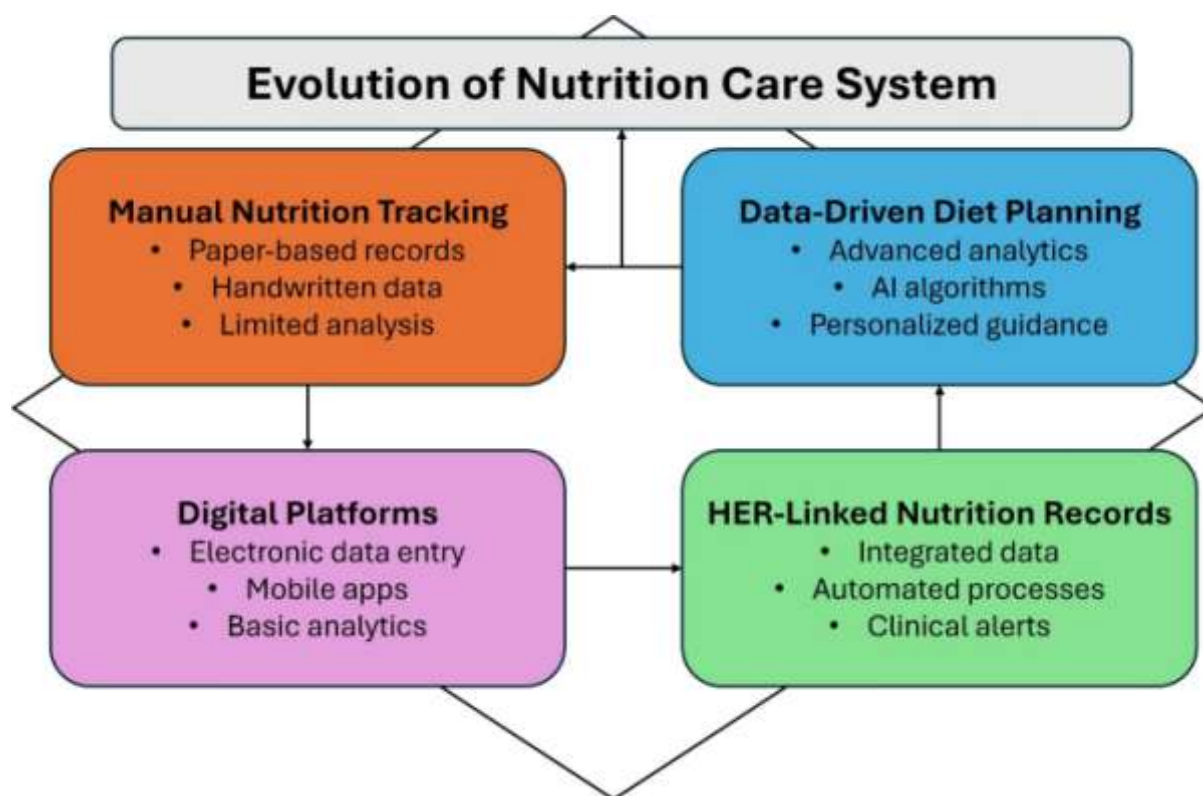


Figure 1: Transition of Nutrition Care Systems from Manual to Data-Driven Models

Smart systems can dynamically change nutrition advice in response to real-time physiological data, which can best serve to maintain the optimal state of metabolism and avoidance of diseases like diabetes or heart disease. These systems enable both individual and population-driven actionable insights and have been rapidly incorporated into clinical workflows and help dietitians and multidisciplinary teams provide more precise, outcome-oriented nutrition care. With the growing role of digital platforms in nutrition care, continuing research indicates that strong privacy control, interoperability, and professional regulation are necessary in order to use technology-enabled nutrition tracking and nutrition planning safely, effectively, and equitably.

3. Multidisciplinary Nutrition Teams and Their Roles

The multidisciplinary nutrition teams have become the cornerstone of providing a high-quality and holistic nutritional care in medical institutions. Such teams usually include dietitians, physicians, nurses, pharmacists, catering personnel and more and more IT specialists who streamline the inclusion of digital nutrition data. Every field has its unique specialties: dietitians are the primary individuals in the assessment and every nutrition plan development, physicians control clinical indications and the general work with patients, nurses are engaged in monitoring the consumption of various nutrients per day, conducting nutritional screening and providing coordination of care, pharmacists interact with nutrient-drug interactions and provide the safety of parenteral nutrition, and IT specialists help to work with digital platforms, documentation, and data analysis. Multidisciplinary cooperation needs to have well-defined roles, mutual decisions, and continuous communication. Clear role definition and roles prevention of care gaps are supported by regular team meetings, co-designing of interventions and sharing of digital records. [7]The mutual comprehension of

the roles can be also improved by joint training and interprofessional education. When the teams learn about the contribution of one another, they are able to plan, implement and evaluate nutritional care plans synergistically to achieve better results. The multidisciplinary nutrition team uniquely involves the contributions of the professionals whose roles are determined by their experience and duties as well as interactions with patients. The main players are the dietitians who conduct comprehensive nutritional evaluation, devise specific treatment strategies, and provide specific dietary counseling. They apply their knowledge of medical nutrition therapy to prescribe the right enteral or parenteral nutrition, modify chronic disease plans and train patients and staff on evidence-based nutrition practices. Dietitians also help to follow-up and revise interventions, which lead to better patient-centered care and cost-reduction in primary care and specialized teams.

The physicians can organize the comprehensive medical management, evaluate the indication of the nutritional interventions, and ensure complications or comorbidities of nutritional status. They work together in screening and referrals, interpretation of laboratory data, and incorporate nutrition therapy into the larger treatment plans. The family medicine and hospitalist doctors become especially significant in early diagnosis of malnutrition and a smooth interdisciplinary collaboration, adopting a biopsychosocial approach to assist patients in their recovery and management of chronic illnesses[8]. Nurses perform a wide spectrum of nutritional activities, which involve risk screenings, care plans, and anthropometric and intake monitoring. They play a critical role in direct education of patients and their families, malarial prevention and treatment of adverse effects of malnutrition, and dietary modification to clinical dynamics. Nurses serve as observers at the front line and also provide records of their outcomes and inform the multidisciplinary team on the progress of their patients, thereby supporting a continuum of nutrition care and health education in hospitals and community settings.

Pharmacists are critical contributors who have the opportunity to review the prescriptions against drug-nutrient interactions, optimize the pharmaceutical regimens in accordance with nutrition therapy, and aid in the prevention of drug complications associated with polypharmacy. They work hand in hand with the physicians, nurses and dietitians in order to securely administer nutritional supplements especially to patients under parenteral or multifaceted medication regimens. Nutrition teams are becoming increasingly integrated with IT experts and informatics professionals who help to integrate and manage digital health records, nutrition databases and analytic platforms that form the basis of objective evaluations, care planning and outcome measures. Their proficiency guarantees their interoperability, security of their data, and effective communication between all the team members, which leads to a smooth transfer of manual documentation into digital and data-driven nutrition care.

This cross-functional partnership is the key to successful nutrition support, and it has been demonstrated that collaborative and clearly defined roles have a substantial positive impact on patient outcomes and the efficiency of the system. Nonetheless, a number of communication obstacles and co-ordination dilemmas still exist. These are professional boundaries, variability in engagement into leadership, absence of uniform digital workflows, and the absence of consistent management assistance. An example of this is when nurses complain that the frontline role in nutrition monitoring is not fully acknowledged, whereas dietitians can occasionally experience the problem of not obtaining full patient information provided by other professionals[9]. These barriers are enhanced by the inadequate communication skills, high workload, disparity in health literacy, and low use of technology. In order to overcome them, it is essential to have a committed clinical leadership, integrated information systems, and a culture of mutual respect and support, which will ensure the constant flow of information and utilize the full potential of multidisciplinary model of nutrition care.

4. Role of Health Informatics in Integrative Nutrition Care

Health informatics is a key ingredient in integrative nutrition care as it offers a conceptual framework that connects nutrition workflows to state-of-the-art data management and communication technologies. This integration helps clinicians make faster and more accurate decisions by transforming complicated data into practical information, including real-time monitoring of nutrient delivery and notification of nutrition target violation, improving the accuracy of care and its timeliness. Health informatics enabled data sharing that is critical towards continuity and coordination among care providers. Seamless exchange of nutrition-related information amongst physicians, dietitians, nurses, pharmacists and IT specialists is provided by interoperability the efficiency of healthcare disparate information systems communicating with one another.

Interoperability standards and protocols assure that nutrition data are stored and transmitted without loss or distortion to assure that nutrition data are accurately documented, coded and transmitted across care settings to enable collaborative care planning despite the care setting. Informatics tools that provide shared electronic care plans, task notifications, and secure personal messaging further improve clinical coordination by aligning team activities on patient-specific nutrition objectives. Moreover, health informatics supports the evolution of population health approaches in nutrition by aggregating de-identified data for research, quality improvement, and public health monitoring[10]. Artificial intelligence and machine learning integrated into informatics platforms allow the derivation of predictive analytics and personalized nutrition recommendations based on large datasets. These capabilities transform nutrition care from reactive to proactive, leveraging evidence-based guidelines while adapting to individual patient complexities. However,

challenges remain, including ensuring data privacy, overcoming technical barriers to full interoperability, and fostering user acceptance among clinicians, all of which are active areas of research and policy development aimed at optimizing integrative nutrition care through informatics.

5. Key Informatics Tools and Platforms

The most common informatics tools and platforms that are vital in integrative nutrition care are electronic health records (EHRs), clinical decision support systems (CDSS), mobile nutrition applications, and tele-nutrition platforms. EHRs can be viewed as a universal digital archive of patient data that allows the formal recording of nutrition screening, evaluation, treatment, and outcomes in care organizations. They support interdisciplinary handoff because they offer a centralized access to nutrition-related information, computerized notifications on risk of malnutrition, and simplified the process of ordering complex nutrition in the form of enteral or parenteral nutrition. Adoption of EHR-based nutrition features have shown accuracy of nutrition delivery, safety, through reduction of errors, as well as, clinical and administrative efficiency. Clinical decision support systems are an add-on to EHRs that offer evidence-based suggestions, interactive dashboards, and individual care-path. As an illustration, CDSS based on behavior science help clinicians in collaborative goal setting of the diet and chronic disease management by processing patient data and instructing the nutritional counseling in real-time. These systems enhance confidence and compliance to nutrition guidelines by clinicians and it saves time during clinical encounters.

Mobile nutrition apps help in self-monitoring, education and change in behavior among patients. Meta-analyses demonstrate that interventions based on apps could be successfully used to enhance nutrition-related practices, metabolic activities, and weight-related results[11]. Such characteristics of apps as goal-setting, feedback loops, and social support mechanisms increase patient compliance and sustained compliance with nutritional advice. Tele-nutrition systems provide remote dietary counseling and personalized nutrition treatment through video, audio, or text. Tele-nutrition has been in the limelight because of its accessibility as well as affordability particularly in the treatment of chronic conditions like diabetes and hypertension.[12] The studies indicate that the tele-nutrition is associated with the positive effects on nutrition adherence and health, which is why tele-nutrition can be defined as an option to traditional face-to-face visits without any issues related to continuity of care. Together, these informatics implementations form an online ecosystem that facilitates data-driven, personalized nutrition care, improves interdisciplinary coordination, and patient-centred outcomes in a variety of health care settings.

6. Data Collection and Analytics in Nutrition Care

Individual nutrition care relies on data collection and analytics to use various sources and sophisticated computational approaches. Patient-reported outcomes (PROs) represent the opinions that people have on symptoms, dietary compliance, quality of life, and obstacles to nutritional objectives. Such self-reported data would be a useful source of subjective data complemented by objective clinical data and serve to personalize nutrition counseling to the needs and preference of patients and increase their engagement and satisfaction. Wearable electrochemical biosensors are one of the types of biometric sensors that can be used to monitor the nutritional biomarkers of amino acids, vitamins, metabolites, and lipids in sweat or interstitial fluid in a continuous and non-invasive manner.

Dynamic physiological data has provided real-time metabolic profiling that can be used in identifying early nutritional imbalances, personalize the dietary intake, and guide timely interventions in the absence of intermittent lab tests. Microfluidic sensor-based wireless and microfluidic sensor technologies together with telemedicine platforms are changing the scope of nutrition monitoring to everyday life. The biochemical and dietary data required to assess and research diet accurately and enable metabolomics studies are organized in nutritional databases, which are compiled by using food composition tables, biomarker ontologies and metabolomics datasets.

A combination of heterogeneous datasets and a correlation of food intake with metabolic reaction allows these databases to assist the creation of the precision nutrition algorithms that can be based on personal differences in nutrient metabolism, and the risk of diseases. They are the basis of combining conventional dietary documents and the state-of-the-art omics information to conduct a holistic nutrition analysis. Predictive analytics integrates these diverse data sets using machine learning and artificial intelligence algorithms to identify persons who are at risk of being nutritionally deficient or developing related diseases. [13]The validated clinical and genetic data are trained to stratify the patients and predict outcomes allowing early and specific dietary interventions. Predictive system progressively provides adaptive and individualized nutrition advice by continually integrating patient-specific biomedical, behavioral and environmental data, positioning care at the proactive end of care instead of the reactive end. This data collection/advanced analytics synergy is reinventing personalized nutrition as a highly sensitive clinical discipline.

7. Ethical, Legal, and Data Privacy Considerations

The management of sensitive dietary information in the framework of integrative nutrition care creates serious ethical, legislative, and data privacy concerns that need to be stringently considered. The dietary information is a branch of the overall health record, so it may have detailed personal habits, health conditions, and even genetic information, so its confidentiality is paramount. Confidentiality is achieved by ensuring that only authorized personnel access the data, this is through the use of strict role-based access, encryption and closed digital ecosystems which ensured no

unauthorized breach of the data and no data leakage. The core of ethical handling of nutrition-related data is patient consent. Patients should be informed about the need to be transparent about the data collection methods and purposes of use as well as the possibility of sharing them with multidisciplinary teams or other parties[14]. The process of informed consent must make the patients aware of their rights and allow them to consent or dissent to share the data without undermining their care.

Moreover, continuous monitoring of consent, particularly in the changing nature of technologies and using data, honors patient autonomy and trust in the health system. Regulation and legal frameworks of health information, including the Health Insurance Portability and Accountability Act (HIPAA) of the United States, the General Data Protection Regulation (GDPR) of Europe, and other local laws ensure that data handling, storage and transmission are tightly regulated.

Regular audits, data backups, and breach notification procedures, as well as training of staff on privacy standards, belong to compliance. The information of nutritional informatics needs to incorporate these regulatory needs in its design, so that the patients and institutions can be legally safe and to enable the safe interoperability of data between healthcare professionals. The use of ethics also involves the fair usage of information and technology without promoting biases that could harm specific groups of people. It is suggested that institutions and their leaders be more open with their algorithmic decision-making and be more inclusive in creating predictive analytics or AI-based nutrition interventions. This multidisciplinary model brings together privacy, patient rights, and social justice ideals and the current healthcare innovation in nutrition care.

8. Educational and Training Implications

Informatics literacy is becoming a highly essential skill-set amongst dietitians and other health-related professionals in integrative nutrition practices. Health informatics expertise can empower these professionals to use electronic health records (EHRs), decision support systems, and electronic nutrition tools effectively to effectively assess, intervene, and track outcomes of their patients. It also enhances interdisciplinary communication and the evidence-based practice through accessing modern research and patient data analytics. In response to such increasing demands, informatics education is being incorporated into the curriculum of nutrition and health sciences courses. The training will cover the basics of data management, health information systems, data privacy legislation and apply practical skills in the utilization of nutrition-specific software and mobile applications.

The design of the curriculum focuses on realistic learning situations that approximate multidisciplinary collaboration and decision-making in digital settings and train students to manage to the real-life clinical problems. Professional development and continuing education programs are relevant in sustaining and developing informatics skills in practising nutrition professionals[15]. Such services include workshops, webinars, certifications, online courses, which aim to emphasize new technologies, alterations in health IT rules, and new approaches to analytics including artificial intelligence in nutrition. Continued education helps dietitians and allied professionals to be abreast with the innovations that enhance the quality and safety of care delivered, as well as mitigating the challenges, including technology acceptance and digital equity. This informatics literacy strategic orientation enhances the ability of the workforce to provide integrated and data-driven nutrition care in various healthcare contexts.

9. Case Studies and Best Practices

Nutrition team models based on informatics have been effectively integrated in multiple hospital and community health organizations and have been shown to provide significant patient outcomes and quality of care provision. An example of this is the implementation of the computerized clinical decision support systems within the electronic health records (EHRs) in adult nutrition support at the intensive care units.

Research has documented that the systems minimize the errors made in performing calculations, reduce nutrition prescription time, and enhance the effectiveness and sufficiency of nutrient delivery, thereby causing a reduction in the loss of weight and the incidence of ICU-acquired infections among patients in the ICU. Computerized malnutrition screening programs led to steep rise in referrals to nutrition support teams that helped in providing earlier intervention and continuity of care.

The other example of the best practice is the introduction of a multidisciplinary nutrition care pathway (INPAC) within hospital environments where the site-specific adaptation, including the involvement of champions (usually nurses or dietitians), promoted an inclusive, multidisciplinary approach[16]. This model focused on the involvement of nurses in the daily nutritional care activities and exploiting their expertise to improve the nutritional culture in the hospital. With the application of Plan-Do-Study-Act (PDSA) cycles, the nutrition protocols were adjusted to the specific local environment and made more effective and sustainable in various care settings. Overall, these case studies highlight (Table 1) that successful implementation of informatics-driven nutrition care models depends on multidisciplinary collaboration, user-centered system design, ongoing training, and adaptation to specific organizational contexts. The results consistently show improvements in metabolic management, patient safety, and referral rates to nutrition support services, although evidence on impact on hospitalization length or mortality remains varied.

Study (Author, Year)	Setting	Informatics/Intervention Features	Population Focus	Outcomes/Results	Ref.
Llido et al. (2005)	Hospital	Clinical Decision Support (CDS), computerized screening	Adult inpatients	Increased nutrition support referral rate from 37% to 100%; increased nutrition service coverage	[17]
Berger et al. (2006)	Adult ICU	CDS, data integration of multiple nutrition sources	Critically ill adult ICU patients	Improved nutrient delivery (energy, protein); reduced weight loss in burn patients	
Paschidi et al. (2006)	Hospital	CDS, electronic alerts	Nutrition support patients	83% decrease in calculation time; 56% reduction in errors; 25% increase in early metabolic complication ID	
Skouroliahou et al. (2005)	Neonatal ICU	Computerized Provider Order Entry (CPOE), CDS	Preterm and sick-term neonates	Zero TPN order errors vs. 2.98% errors with manual calculation; reduced time for order completion	
Pachler et al. (2008)	Adult ICU	CDS for BG management	Adult ICU patients	Reduced mean blood glucose; decreased hyperglycemic episodes	
Fossum et al. (2011)	Nursing homes	Computerized screening, CDS	Elderly residents	Reduced malnutrition prevalence by 9% compared to control; no effect on pressure ulcers	[18]
Skouroliahou et al. (2009)	Hospital	Automated meal planning software	Adult hospital patients	88% error reduction in diet calculation/planning; decreased dietitian time spent on menu planning	[17]
Hoekstra et al. (2011)	Hospital trauma ward	Multidisciplinary program with nutrition informatics	Older hip fracture patients	Increased energy and protein intake during hospitalization; improved quality of life after 3 months	[18]
Robinson et al. (2002)	Medical unit	Multidisciplinary team feeding assistance program	Hospitalized elderly patients	Increased patient meal consumption with volunteer assistance	
Yinusa et al. (2021)	Hospital settings	Multidisciplinary collaboration supported by informatics	Adult inpatients	Improved nutritional care delivery processes; emphasized training, communication, leadership	

10. Future Directions and Research Opportunities

The informatics in nutrition directions are progressing towards greater use of the latest technologies to provide more accurate, individualized, and standardized nutrition services. The concept of artificial intelligence (AI) is becoming a game-changer, and AI-guided nutrition prescription tools that study large, complex data sets, such as dietary and clinical biomarker data and behavioral data, in real-time to produce customized nutrition plans are becoming a reality.[19] These systems use machine learning to constantly advance recommendations using feedback and results, increasing the rate of adherence and health outcomes. Genomics-focused dietary planning is an emerging opportunity in the field that combines individual genomic data with nutrition informatics to maximize the dietary recommendations based on physiological levels and disease vulnerability[20]. Electronic health records and decision support tools which include nutrigenomics and nutrigenetics data enable clinicians to go past population-wide recommendations to actually personalized dietary interventions based on genetic differences which affect nutrient metabolism, absorption, and utilization. The working is also going on to develop standardized nutrition informatics protocols to enhance similarity, interoperability, and quality of digital platforms and clinical workflows. Standardization entails the creation of universal data items, nutrition diagnosis and interventions coding systems, and evidence-based practices incorporated in the informatics tools[21]. This standardization is essential during multicenter studies, data aggregation, and scaling effective interventions without compromising patient safety and data confidentiality. Such research prospects point to a change to integrative, technology-enabled nutrition care that utilizes AI and genomics to maximize clinical accuracy and preventive health and represent a new paradigm of personalized nutrition medicine.

CONCLUSION

Health informatics integration into multidisciplinary nutrition care has significant advantages as it increases the clinical efficiency, quality of care and patient outcomes. Informatics that can be used is electronic health records (EHRs) and decision support systems that can synthesize all types of data on nutritional intake, clinical biomarkers, medication, and metabolic data to empower clinicians with more accurate, timely, and personalized nutrition intervention.

Integration minimizes mistakes, quickens the prescription and monitoring procedure, and raises early detection of malnutrition and metabolic complications, which leads to enhanced nutrition status and patient recovery particularly in the critical care setting. Multidisciplinary nutrition teams with health informatics integration is a groundbreaking change that can maximise the use of patient-centred nutrition care by augmenting data management and teamwork and implementing sophisticated predictive technologies. This holistic modality does not only enhance the clinical outcomes but also aids the medical systems to provide efficient, equitable, and scalable nutritional care interventions. To completely implement these benefits in practice, it will be necessary to continue innovating, educating, and following the ethical frameworks.

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