Hospital patients' perceptions of using a technology-based intervention to participate in their nutrition care: a qualitative descriptive study

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ABSTRACT

Background & Aims: Promoting patient participation in health care is a worldwide health care priority. When patients participate in their nutrition care during hospitalisation, they are more likely to meet their dietary needs. Patient participation is a potential solution to hospital malnutrition, for which inadequate dietary intake is the major modifiable risk factor. Our team developed a health information technology (HIT) intervention aiming to improve patients' dietary intakes during hospitalisation by engaging them in their nutrition care. The aim of this study was to explore patient perceptions and acceptability of the intervention.

Methods: This qualitative descriptive study was conducted at a tertiary teaching hospital in Australia. Participants were a subset of patients from a larger feasibility study, selected using maximum variation purposive sampling to include a broad representation of patients in terms of age, gender and experience with technology. All patients had used the HIT intervention to participate in their nutrition care in hospital, through nutritional goal setting and dietary intake monitoring. A semi-structured interview guide was used to collect qualitative data on patients' perceptions of the intervention, focusing on acceptability. Data were analysed thematically.

Findings: Eight patients participated in interviews, from which two main themes emerged. The first captured patients' experiences and perceptions of using technology to participate in their nutrition care. Patients found it easy to use, useful and valuable, but still valued interaction with researchers and hospital staff. The second theme portrayed the spectrum of participation,

from simply learning about nutrition, to self-monitoring and evaluating, to changing behaviour. Participants enjoyed gaining new knowledge and awareness around nutrition. Most self-monitored their food intake and evaluated their goals, and some changed what foods they ordered based on what they had learned.

Conclusions: Patients responded positively to the intervention, likely because they found it valuable and easy to use. These findings are promising for potential future use of HIT to engage hospital patients in care. Future research should investigate the effects of HIT interventions on patient-centred outcomes in hospital.

Keywords: Health information technology; nutrition care; patient engagement; patient participation; self-management.

INTRODUCTION

Patient engagement, or participation, means active involvement in one's own health care; for example in intellectual or physical health care activities or through information exchange (1). It is recognised as a core aspect of safe and quality health care by national and global health organisations (2-4) and is associated with improved health outcomes (5) and increased patient safety and satisfaction with care (6). Nutrition is an area in which patients are likely to feel comfortable participating, as food and eating are familiar to everyone. Preliminary research shows that patient participation in nutrition care is a feasible and likely effective strategy for improving dietary intakes in hospital (7, 8). Inadequate dietary intake is the major modifiable risk factor for hospital malnutrition, a long-standing issue that affects 20-50% of inpatients and results in poor outcomes for patients and hospitals (9-11). Patient participation in nutrition care therefore warrants further investigation as a potential solution to this serious issue. However, only a few studies have examined the effects of involving patients in their nutrition care in hospital (7, 8, 12).

Our team developed an intervention to engage patients in their nutrition care whilst in hospital, through self-monitoring of dietary intake and participation in guided nutrition goal setting (8, 13). When piloted in paper format (using paper food charts and printed nutritional goals pages), patients were very accepting of the intervention and reported: having an increased awareness of nutrition; feeling encouraged and motivated to eat more; and feeling responsible for their own nutrition in hospital. With the introduction of a new technology at our local hospital, we adapted the original paper-based intervention to an electronic foodservice system. Patients can now record their dietary intake and monitor their personal nutrition goals via a patient portal, accessible through personal bedside computer screens. Details of the intervention and its development can be found elsewhere (13).

Health information technology (HIT) has advanced drastically in recent years. Electronic health monitoring devices, applications, websites and other platforms are commonplace among community-dwelling adults (14). A systematic review of 170 studies found technology-based health interventions had positive effects on patient engagement, health behaviours and health outcomes, such as weight loss, exercise tolerance and blood glucose control among patients with a range of conditions (15). However, most studies were community-based and there have been calls to undertake similar research in hospital settings, where research on using HIT to

engage patients in care is in its infancy (16, 17). To our knowledge, there are no published studies describing the use of technology to engage patients in their nutrition care. Further, many other HIT interventions lack rigour in the development and piloting stage, particularly around the user experience of HIT interventions. A realist review of inpatient HIT interventions found insufficient use of IT theory in intervention development and evaluation, particularly around the assessment of usability (an important predictor of acceptance of HIT interventions), which was often rudimentary (17).

As per the United Kingdom's Medical Research Council, complex health interventions, defined as interventions with several interacting components, should undergo appropriate feasibility and pilot testing, including assessment of user acceptability (18). In-depth exploration of the user's experience is vital for understanding if, why and how such interventions work (or not), and how they may be integrated into routine care. This is especially true for HIT interventions. This study aims to explore patients' perceptions (with a focus on acceptability) of the NUTRI-TEC intervention (Engaging patients in nutrition care using technology). Their perspectives are valuable not only for future implementation of NUTRI-TEC, but will also provide insights into the use of HIT for engaging patients in their care in hospital settings.

METHODS

Study overview

This qualitative descriptive study was conducted to explore patients' perceptions of using the NUTRI-TEC intervention to actively participate in their nutrition care at the hospital bedside. The primary outcome was acceptability; hence, interviews focused on participants' satisfaction and experiences with using the intervention. This study received ethical approval from relevant hospital (reference number masked) and university (reference number masked) Human Research Ethics Committees and all participants provided written informed consent to take part in the study. The study is reported in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines (19).

Setting and sample

This study was conducted in four wards (renal, respiratory, orthopaedic and vascular/medical) in a large, metropolitan tertiary teaching hospital in Queensland, Australia. Participants were a

subset of patients recruited to the NUTRI-TEC feasibility study, screened for eligibility using the feasibility study's inclusion criteria (outlined below). Research assistants (RA) approached eligible patients to explain the interview component of the study and gained verbal consent (in addition to written informed consent for the feasibility study) from those willing to participate in interviews. Maximum variation purposive sampling was used to select interview participants from the main feasibility study cohort to ensure wide representation of patients in terms of age, gender, diagnosis and experience with using technology.

Inclusion criteria: (a) able to provide informed consent (≥ 18 years old and cognitively intact); (b) able to communicate in English (verbally and in writing); (c) at risk of malnutrition (aged ≥ 65 years and/or score of ≥ 2 on Malnutrition Screening Tool); and (d) and expected to stay in hospital ≥ 4 days from recruitment. In addition to these criteria, nursing staff provided verbal assessments of each patients' ability to participate (considering their medical condition), which recruiters used to exclude patients who were, for example, too unwell.

Exclusion criteria: (a) previous participation in the study or refusal to participate; (b) dying or palliative; (c) not receiving nutrition orally; or (d) history of an eating disorder.

Intervention

The intervention is described in detail elsewhere (citation masked); but in summary, RAs who were registered dietitian engaged patients in the following activities:

- a) Brief nutrition history (using the Subjective Global Assessment tool);
- b) Brief education on the importance of meeting nutritional requirements in hospital; and
- c) Training on how to use their Personal Entertainment System (bedside computer) to order meals, enter their food intake after each meal, and view and monitor their personal nutrition goals.

Follow up sessions were completed daily for the first week after recruitment, and second daily for the second week after recruitment, until the study end-point (study day 14, hospital discharge or death, whichever occurred first). These sessions included a brief review of the patient's nutrition intake and goals (guided nutritional goal-setting) with the patient, answering any questions the patient had, and/or assisting them with the technology if required.

Data collection

Patient demographics (age, gender, ward, diagnosis, and hospital length of stay) were collected from electronic medical records. A semi-structured interviewing technique was used to allow interviewers the freedom to probe further on issues of interest while still providing guidance to avoid digression from the topic (20). A semi-structured interview guide was developed based on a theoretical framework for assessing acceptability of healthcare interventions (see Table 1) (21). The framework outlines seven constructs of acceptability: affective attitude, self-efficacy, burden, opportunity costs, ethicality, intervention coherence and perceived effectiveness. The interview guide was piloted with health professionals and lay people, and minor revisions were made based on feedback. Interviews were conducted by four trained RAs with experience in semi-structured interview techniques. Patients were interviewed after they had been enrolled in the study (and participated in the intervention) for at least four days. Interviews were conducted at the hospital bedside (in private or double rooms), at a time of convenience to the patient. Interviews were audio recorded and transcribed verbatim for analysis.

Reflexivity: RAs who collected data kept field notes of observations, interactions, responses and/or emotions pertaining to participants that were deemed contextual to study findings, and discussed with the lead author. RAs included three female PhD candidates and one male RA, who were all qualified dietitians with experience in semi-structured interviews (but were not members of the research team). All four RAs collected data in the main pilot study; hence, they were likely to have met and conversed with participants prior to conducting interviews. The author who led data analysis (SR) kept an audit trail of the analysis process, alongside reflective notes to flag any theoretical (or other) assumptions that could influence interpretation of data. This author was a female research fellow and qualified dietitian with experience in qualitative analysis from >10 other studies. This author designed the intervention but had no relationship with participants. During data analysis, SR engaged in regular discussions with the other two members of the research team (AM, WC); both professors of nursing with extensive experience in qualitative analysis, who did not have contact with participants; and RAs who collected data. Throughout analysis, SR referred back to study aims to maintain focus; and was aware of/ reflected on how her role and prior knowledge and/or experiences may influence data analysis.

Data analysis

Interview data were analysed using inductive thematic analysis (22). The lead author read and reread transcripts, highlighting relevant quotes. Codes were developed based on participants' verbatim statements and grouped according to similarity, ensuring all data were captured. Groups of codes were further analysed and refined to concisely describe the phenomenon of interest, thus becoming sub-themes. Sub-themes were then grouped under broader themes. This was an iterative process, with the lead researcher re-reading transcripts several times to further refine themes as they emerged and discussing with the research team. Several methods were used to achieve trustworthiness for the qualitative analysis process. Credibility was optimised via maximum variation purposive sampling, to select patients with various experiences, thus increasing the likelihood of 'shedding light on the research question from a variety of aspects' (23). Ensuring themes and sub-themes accurately reflected the data (i.e. no relevant data were excluded or irrelevant data included) was done by seeking agreement among the research team and including representative quotations from transcribed text. Transferability, or 'the extent to which findings can be transferred to other settings or groups' (23), was facilitated by giving clear descriptions of the study setting, culture and context; the selection and characteristics of participants; and methods of data collection and analysis.

FINDINGS

Eleven patients participated in interviews, including seven men and four women with a median age of 75 years (IQR 68–80 years; range 60–83 years). Participants' diagnoses were reflective of the ward they were recruited from and included renal (pyelonephritis), respiratory (infection, lung cancer), orthopaedic (septic hip, joint replacement, bone fracture) and vascular conditions (diabetic foot infection). Patients remained in the study for a median of 9 (IQR 8–12) days and stayed in hospital for 11 (IQR 8–14) days. According to the Subjective Global Assessment (24) tool (SGA), seven patients were well-nourished (SGA A) and four were mildly-to-moderately malnourished (SGA B). Interviews were approximately 15 minutes long on average (range 10–36 minutes). Two themes and several sub-themes emerged from the data (see Table 2).

Theme 1: Using the NUTRI-TEC intervention

In this theme, participants' views on and experiences with the NUTRI-TEC intervention were described, encompassing their overall satisfaction and their perceptions on its usefulness/value, usability and the human interaction required for engaging meaningfully with the technology.

a) Satisfaction and value: Overall, patient responses to NUTRI-TEC were positive. Many enjoyed using the program and found it helpful as P4 did: *“I really enjoyed it, very beneficial... it’s very educational because I didn’t know you had this program set up before”* and as P1 said, *“it has helped me and it could help other patients.”* Patients found it useful and valuable, saying it was a *“very good idea”* and would make things *“easier for patients in the future”*. Patients said they did not find it burdensome or stressful to participate in the study, and it did not interrupt their daily activities. In fact, many said it gave them something to do as they were often bored in hospital.

“...it also gives me another interest, because it’s pretty debilitating when you feel a bit better, sitting in a room with nothing to do except read a book! I think it stimulates your brain, which needs doing.” P6

Most patients said they were happy to participate and/or would participate again; some even expressed a desire to use the program at home. Some saw opportunities for the program to be used to track other nutrients, for example carbohydrates (e.g. for diabetes) or electrolytes.

“I liked using the program. I would like to use it at home every day, because it means I would know I was getting the nutrition...so I know if I don’t have a lot of protein for lunch I can have it for dinner... especially if you’re recovering from something... [also] I can look at my potassium because I have low potassium.” P7

b) Usability: Patients said the program was very simple, quick and easy to use, especially once they had been shown how to use it: *“it wasn’t [difficult] once you showed me what to do”* (P4); and *“I don’t think you can get much simpler than that, really”* (P5). One thought it was *“self-explanatory”* (P9). Even patients who were initially apprehensive about using the technology found it easy. Many said they were confident in using the program to order meals and track their intakes, and indicated their confidence quickly increased over time and with continued use and familiarity.

“I found it very simple, once you showed me. It tells you if you made a mistake. You can wipe out and start again. And I’m not very good with computers, so for me to say it’s easy...” P7

“Very, very easy. Out of a score of 10, I would give it a 9... [and] once you understood how to do it, you bump it up to a 10 real quick... I’ve had no problems at all.” P11

Some patients found the touch screen difficult, becoming frustrated when they hit the wrong button. One patient said it wasn’t always convenient to complete intake tracking immediately after their meal, and later couldn’t remember how much they ate. Others said it was difficult to participate when they were feeling unwell. Some suggested improvements such as pictures to help patients, or more open dialogue boxes to make notes for their clinicians.

“...when you’re not feeling well it can be a bit difficult I would think, but when you’re feeling a lot better, as I am, it just makes it easier.” P6

c) Human interaction: Patients enjoyed the human interaction along with the intervention; that is, regular contact with the researchers and hospital staff who spoke to them each day about nutrition. They liked being able to speak with someone about food and eating; and overcoming symptoms/barriers to eating, and appreciated enquiries from staff about how their meals were. Patients valued dietitians’ input and thought they were well-trained, helpful, good at explaining and were engaged with patients. Patients particularly liked the daily interaction with RAs, who answered questions about the program, provided assistance with intake tracking and talked patients through their daily goals and intakes. Some patients relied on the RAs to help them with using the program:

“[Intake tracking was] not difficult at all, the problem was remembering to do it each day. I probably didn’t do it some days, when you came around...I thought you would be entering the data on the computer [for me].” P3

Most patients said they felt comfortable asking questions of RAs and were happy to see them each day. One patient was appreciative that *“when I ask questions, I get answers”* (P10). Some patients said their family members assisted them with meal ordering, intake tracking and goal monitoring. While some patients indicated high levels of family involvement and concern, others said their families were not often available to assist them in hospital.

“No, they [family] were not here when I had to [intake track]. My daughter originally showed me how to put my meals in but then you did as well.” P4

Theme 2: The spectrum of participation in nutrition care

Overall, patients spoke positively about participating in their care. They liked to be involved in ‘what was happening’ and thought participation helped them to progress. As one patient put it, *“it makes me feel better that I’m actually having input into my own medical problem”* (P11). Some patients expressed being actively involved in their health care and decision-making, while others took a more passive approach, trusting in health care professionals (HCPs) to do what was best for them. Other patients spoke about having a joint role with HCPs in their care. Some patients thought being in hospital limited their ability to participate, while others thought the NUTRI-TEC program helped them gain more control. According to patients, participation seemed to encompass learning and awareness, evaluating and monitoring, and changing behaviour.

a) Learning and awareness: Generally, patients expressed positive views towards nutrition. They described its importance for healing/recovery, brain function, energy, physical strength and general health; for example: *“you have to have a well-balanced daily intake”* (P4) and *“If I eat healthy, I will stay healthy. If I eat the right foods, then it will give me enough energy”* (P1). Patients often spoke eagerly about how much they learned from participating in the study and seemed to place high value on the information provided:

“Self-education was probably a plus... you learn what the value of your meals are... what protein and energy are all about and looking at your food...it should be taught.”
P5

“I really enjoyed it and learnt something from it...it’s things that people need access to. Because people in my age bracket, we were not taught any of those things.” P7

Patients enjoyed learning about nutrition in general, as well as their own nutrition needs, the nutrition content of hospital foods (e.g. *“I gained insight into some foods, their calories and things”* P9) and whether they were meeting their nutrition goals. Some also acknowledged the differences in nutritional requirements during illness: *“You need more protein and vitamins when you’re not well as when you’re young...and healthy”* (P4).

Participants said recording their intake and viewing their goals made them more aware of their nutrition in hospital; as one patient put it: *“It helped me understand”* (P1). Others felt comfort

in knowing what was best for their recovery: *“I feel the main thing is knowing you’re eating the right type of food while I’m here [in hospital]. Things that can make you better quickly”* (P4). Many enjoyed having access to nutrition information and learning about

b) Evaluating and monitoring: Patients particularly liked the intake tracking and goal setting components of the intervention, saying these were easy to do and understand, and were very interesting: *“well it was interesting yes, I was surprised to find out I was only eating 60% of what I should be”* (P2). Others were interested in their progress towards their goals: *“...it was good to look at, especially if you didn’t finish your meal... to see if you had enough to eat, because I would like to know”* (P8). Many patients said these were the most engaging aspects of the intervention. Patients liked being able to evaluate their intake each day and monitor their progress towards their goal; they wanted to know how they were going and found it very motivating. As one patient put it, *“it makes you want to stay on track”* (P7). One patient visited the goal page after each meal; another thought their intake was improving each day and was proud of this achievement. Others said it helped them to decide what to order.

“The chart would have shown with the levels...if they weren’t going up as high as they were, then I would be like, well something here is not right. I need the right stuff to give me energy. So yeah, that was helpful.” P1

“I’m observant anyway, so I’m observing on the plate, but seeing it in writing... you actually have to take some time to think about it before you record it... It enables you to each day or so make an evaluation.” P6

Changing behaviour: Several patients described changing their behaviour, such as their menu choices, as a result of learning about the nutritional values of the hospital foods and their own nutrition requirements. For example, a few patients said they chose the meal option with the highest protein content after learning about its importance.

“I have changed; I actually choose food I would not have normally had... I had protein with every meal, which normally I would not have... I never thought much about food when I was in hospital...whereas this time I am looking at everything so I can get the best value out of it so I can heal quicker.” P7

Two patients reported not changing their meal orders as they already knew a lot about nutrition; whilst another said they would have changed their food choices if there was a wider menu. Some patients found it difficult to play a role in their nutrition in hospital and trusted in HCPs to manage their health:

“I just assumed that what they feed me is what I should be eating...I thought they would feed me what I needed rather than what I wanted off the menu.” P3

“I can’t get them to change their menu every day [but the intervention] made it much easier to choose from this and that... you can’t control what they bring you from the kitchen....[but] the system does give you more control, yes it does.” P4

Others expressed a responsibility for their nutrition whilst in hospital, or thought the program allowed patients and staff to work better together:

“If there’s some reason why your energy or your protein is sort of haphazard, well it gives you the opportunity to work it out between you both [patient and dietitian], and what we are going to do to improve it.” P11

“I think I have a role in that I discuss my thoughts about it [nutrition care plan] with the dietitian... so that’s an important role.” P9

DISCUSSION

This qualitative descriptive study explored patients’ perceptions of using a HIT intervention (NUTRI-TEC) to participate in their nutrition care during hospitalisation. Two broad themes emerged; one representing patients’ perceptions of the intervention itself and how they used it; and the other describing the different levels of participation in nutrition care using technology. These findings will provide important insights into understanding why and how the NUTRI-TEC intervention worked (or didn’t work) and how it might be integrated into routine care; as well as contributing to the scientific knowledge on a topic that has not been widely investigated in previous research. These insights into the mechanisms of action behind the intervention are particularly important to understand how participating in nutrition care may actually improve patients’ dietary intakes and consequently, their hospital recovery.

The activities described by patients were consistent with Sahlsten et al.'s concept analysis of patient participation in care (1) and Eldh et al.'s patient preferences for participation (25). First, mutually trusting relationships (1) and positive dialogue (25) between patients and HCPs were demonstrated in the current study, with patients stating they enjoyed and valued the rapport/interactions with research staff. Second, meaningful information/knowledge exchange between patients and HCPs (1, 25) occurred both verbally and via the NUTRI-TEC program, with the information provided by patients and HCPs complementary in improving care. For example, dietary intakes recorded by patients and nutrition requirements calculated by HCPs were used together by patients and staff to monitor nutrition goals and make dietary decisions. Third, surrendering of some power/control by HCPs (1) meant that patients were able to manage their own self-care (25) by taking responsibility for dietary decisions. Fourth, active engagement in health care activities (1) and taking part in planning care (25), such as recording dietary intakes, reviewing nutrition goals and ordering meals (with support from HCPs), allowed patients to participate as little or as much as they preferred. Patient participation in their nutrition care has been shown to improve dietary intakes among hospitalised patients (7, 8), which may be due to increased knowledge/awareness about nutrition (and their individual nutrition needs), more informed control over their dietary choices and/or increased self-efficacy among patients.

From participants' responses, it was apparent that participation in care wasn't all or nothing; rather, it occurred on a spectrum, or as others have described, a continuum (26). The most basic or passive way of participating in care in the current study was through learning and awareness. Patients valued the new knowledge they gained and became aware of their own nutrition needs. Moving along the spectrum, the next step in participation was self-monitoring and evaluation. Patients found it interesting and motivating to follow their progress towards their nutritional goals. At the most active end of the spectrum, some patients indicated they had changed their behaviour based on what they had learned from the intervention; some to the point of self-managing their own nutrition. Patients seemed to move along the spectrum sequentially from passive to active, each reaching a unique level of participation. That is, all patients discussed learning/awareness; most continued on to self-monitoring and evaluation; some went further and changed their behaviour; and a few said they self-managed their own nutrition. In theory, the further patients advance along the spectrum of participation, the more benefit they will be likely to see, as those who described changing their behaviour did this to improve their dietary intakes (e.g. increased their energy/protein intakes to meet their requirements).

This progression described by participants appears consistent with the information-motivation-behavioural skills (IMB) model, a generalisable and simple conceptual model depicting health behaviour (27, 28). The IMB model consists of three constructs on patient adherence to health interventions: 1) information: basic knowledge about a health condition and strategies for its management; 2) motivation: personal attitudes/beliefs about the relevance of and support for a health behaviour; and 3) behavioural skills: specific tools or strategies needed to perform the behaviour (27). The model suggests that information/knowledge is a prerequisite for changing behaviour, but alone is not sufficient to achieve change; patients must be motivated and possess the necessary skills. In the current study, gaining knowledge/awareness around nutrition was the first step on the participation spectrum, which all patients reported achieving (consistent with IBM construct 1: Information). In line with previous work (29), patients who saw nutrition as personally relevant/important for their health, or who thought NUTRI-TEC was interesting, useful or valuable, appeared more likely to progress towards the active end of the participation spectrum (as per IBM construct 2: motivation). These patients discussed how they engaged in self-monitoring/evaluation and behaviour change/self-management, reflecting high motivation due to perceived value of the intervention. Patients' motivation was also apparent through self-assessment/goal setting, which they described as the most engaging aspect of the intervention. Patients also spoke about the importance of staff support and interactions when using NUTRI-TEC, consistent with the IMB model construct 3: behavioural skills. Finally, patients found the NUTRI-TEC program very simple once they had been shown how to use it, highlighting how the skills patients acquired during the training allowed them to implement strategies and ultimately change their behaviour.

In this study, patients highlighted the importance of human interactions when using HIT. They appreciated regular contact with hospital staff and researchers, as they liked being able to ask questions about their nutrition and receive support and assistance with using the NUTRI-TEC program. This sentiment echoes findings from a realist review on using technology to engage hospitalised patients in health care, which found supporting patients in using HIT was critical to patients' engagement with, acceptance and use of technology (17). Patients expressed that HIT and HCPs had unique and complementary roles that were both important for participation in care. They didn't want HIT to replace HCPs; rather, they thought HIT could support HCPs in providing quality care (17). Another study exploring use of patient portals for health care engagement among older adults reported similar findings. Some participants suggested they

were willing to adopt a patient portal if they had support and assistance, such as from a family member or caregiver (30). This was especially true for older adults who had less prior experience with computers and hence had lower confidence in their ability to learn to use HIT (30). In an early usability study of NUTRI-TEC, patients (up to the age of 80) said that being familiar with technology improved their confidence and ability, but was not essential for them to use the program (29). Similarly, in the current study, even patients who were initially apprehensive said the program was very easy to use once they had been shown how. This raises the question: are we underestimating the abilities of our patients, both in using technology and in participating in care? Certainly, evidence suggests that patients underestimate themselves. Both this study and previous work have shown that patients may avoid technology due to fear making a mistake or feeling stigmatised by a lack of knowledge (29, 30). In reality however, as this study shows, patients are capable of performing basic functions such as inputting information; as well as more advanced activities such as self-monitoring and assessment, and even self-management, using technology.

Ease of use and perceived usefulness are the two strongest predictors of HIT acceptance, as per the Technology Acceptance Model, which provides a theoretical framework to predict and explain HIT acceptance and use (31, 32). This may explain why patients in this study responded positively to the NUTRI-TEC intervention, as they found it easy to use and useful, valuable and helpful to them personally. Some patients even saw opportunities to use the program at home to track other nutrients specific to their own health conditions; such as carbohydrates (for diabetes) or electrolytes (for renal disease). Melenhorst et al. (33) and Irizarry et al. (30) also found that perceived benefits were strong motivators for adopting HIT among older adults; for example, when the HIT provided convenience in managing their health. This is supported by Rogers' theory on the diffusion of preventative innovations, in which relative advantage, that is, the degree to which an innovation is perceived as better than the idea it supersedes, is a predictor of innovation uptake (34). The fact that patients found NUTRI-TEC personally useful and valuable, and that some expressed a desire to use it even after hospital discharge, highlights the potential for this tool to empower patients to improve their eating habits both in hospital and in their everyday lives.

This study has some limitations. It was a small, single-site study of only eleven participants, aiming to explore patients' perceptions of the NUTRI-TEC intervention. While the sample size

seems small, we: a) used maximum variation purposive sampling to ensure a range of patients of different age, gender, medical condition and experience with technology were represented; and b) continued interviews until data saturation was reached (i.e. no new data were identified). Although we took these measures, there is still a possibility that not all views were represented. For example, we could not interview the nine patients who withdrew from the main feasibility study, so were unable to obtain an in-depth understanding of why they didn't want to continue participating. Four RAs were employed to recruit patients, deliver the intervention and collect data; hence, there is a chance that patients were interviewed by a RA they had met previously, which may have caused some to refrain from describing any negative perceptions of NUTRI-TEC. However, as several patients did discuss problems they had with using the technology in interviews, this was likely not an issue. Finally, the interviewers' and research team members' prior knowledge and experience may have influenced data collection and analysis, respectively. To counter this, we: 1) used RAs with experience in semi-structured interview techniques and provided them with further training for this study; 2) asked RAs to keep field notes during data collection to provide context to the lead author; and 3) engaged RAs in regular discussions with the lead author during data collection and analysis for reflexivity. Further, regular discussions were held among the research team during data analysis for rigour/trustworthiness of findings.

Conclusions

This study explored patients' perceptions of using a HIT intervention to participate in nutrition care in hospital. Patients responded positively to the intervention as they found it personally useful/valuable and easy to use, but still enjoyed interacting with researchers and hospital staff who assisted them with using it. Patients described a 'spectrum' of participation in nutrition care using the technology, ranging from simply learning about nutrition, to self-monitoring and evaluating, to changing their behaviour. This study shows promise for the use of HIT to engage hospitalised patients in care. Moving forward, researchers must ensure HIT interventions are underpinned by relevant theory, involve consumers in their development and undergo adequate usability, feasibility and acceptability testing. Future studies should evaluate the effects of HIT interventions on patient-centred outcomes among hospital inpatients, and determine their cost effectiveness. When using HIT with patients, HCPs should be aware that participation is likely to occur on a spectrum; that is, each patient will participate differently. It is important for HCPs to assess patients' baseline knowledge, skills and desired level of participation, and ensure

adequate support is provided to patients in using HIT. If used correctly, HIT has the potential to revolutionise health care to the benefit of patients, HCPs and health care organisations.

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