



Original article

Multi-site implementation of nutrition screening and diagnosis in medical care units: Success of the More-2-Eat project



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SUMMARY

Background: Improving the detection and treatment of malnourished patients in hospital is needed to promote recovery.

Aim: To describe the change in rates of detection and triaging of care for malnourished patients in 5 hospitals that were implementing an evidence-based nutrition care algorithm. To demonstrate that following this algorithm leads to increased detection of malnutrition and increased treatment to mitigate this condition.

Methods: Sites worked towards implementing the Integrated Nutrition Pathway for Acute Care (INPAC), including screening (Canadian Nutrition Screening Tool) and triage (Subjective Global Assessment; SGA) to detect and diagnose malnourished patients. Implementation occurred over a 24-month period, including developmental (Period 1), implementation (Periods 2–5), and sustainability (Period 6) phases. Audits (n = 36) of patient health records (n = 5030) were conducted to identify nutrition care practices implemented with a variety of strategies and behaviour change techniques.

Results: All sites increased nutrition screening from Period 1, with three achieving the goal of 75% of admitted patients being screened by Period 3, and the remainder achieving a rate of 70% by end of implementation. No sites were conducting SGA at Period 1, and sites reached the goal of a 75% completion rate or referral for those identified to be at nutrition risk, by Period 3 or 4. By Period 2, 100% of patients identified as SGA C (severely malnourished) were receiving a comprehensive nutritional assessment. In Period 1, the nutrition diagnosis and documentation by the dietitian of 'malnutrition' was a modest 0.37%, increasing to over 5% of all audited health records. The overall use of any Advanced Nutrition Care practices increased from 31% during Period 1 to 63% during Period 6.

Conclusion: The success of this multi-site study demonstrated that implementation of nutrition screening and diagnosis is feasible and leads to appropriate care. INPAC promotes efficiency in nutrition care while minimizing the risk of missing malnourished patients.

Trial registration: Retrospectively registered [ClinicalTrials.gov](https://clinicaltrials.gov) Identifier: NCT02800304, June 7, 2016.

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Abbreviations: BCW, Behaviour change wheel; CNST, Canadian nutrition screening tool; COM-B, Capability, opportunity and motivation; EMR, Electronic Medical Record; IDNT, International Dietetics and Nutrition Terminology; INPAC, Integrated Nutrition Pathway for Acute Care; M2E, More-2-Eat; ONS, Oral nutritional supplement; PAR, Participatory action research; PDSA, Plan-Do-Study-Act; RD, Registered dietitians; RN, Registered nurses; SGA, Subjective global assessment; TDF, Theoretical Domains Framework.

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Introduction

Malnutrition is common in acute care patients and has been shown to be a costly problem as it delays recovery, lengthens hospital stay, and can result in readmission [1–3]. Poor food intake in hospital regardless of nutritional status also negatively impacts recovery and lengthens stay [1]. Lack of detection and treatment of malnutrition, and barriers to food intake (e.g. inability to reach tray, lack of food available outside of mealtimes) are key nutrition care gaps [4,5]. Improved care processes from admission to discharge that shift the culture of nutrition care from reactive to proactive, and include a multidisciplinary team, have been recommended [6–8]. Best practices include screening for detection, early treatment, and monitoring of nutritional status [9–11]. Although screening has been widely recommended as the key action to start a cascade of improved practices in hospital [9,10,12,13], implementation of screening and other nutrition care practices also continues to be deficient in Canada and internationally [4,11,12,14–18]. The nutritional improvements, cost-savings [12] and shorter length of stay attributed to treating malnutrition [13] cannot be achieved unless patients are screened and diagnosed to identify those in need of treatment [19]. Research has demonstrated that the use of valid screening tools is associated with timely nutrition care practices and interventions [17], such as referral to a dietitian.

Despite the cost of malnutrition on patient and healthcare outcomes, and international consensus regarding the need for malnutrition screening, there is little literature on the systematic implementation of screening protocols and how this increases screening rates [16,20,21]. Research is still needed to demonstrate whether screening leads to other best practices such as diagnosis and treatment of malnutrition, and how screening and other best practices can be implemented and sustained [20]. The first aim of this manuscript is to describe the change in rates of detection and triaging of care for malnourished patients in 5 hospitals that were implementing an evidence-based nutrition care algorithm, and to demonstrate if these improvements can be sustained in the short-term. A secondary aim was to demonstrate that increased detection of malnutrition can lead to increased nutrition treatment to mitigate this condition when the algorithm is followed [22]. Finally, the key strategies used by sites to integrate nutrition care practices are described to provide examples for others considering institution of this care algorithm.

Methods

The nutrition care algorithm

The Integrated Nutrition Pathway for Acute Care (INPAC) is an evidence and consensus based pathway focused on malnutrition care and prevention in hospitals [23]. It was designed to be feasible, using the Canadian Nutrition Screening Tool (CNST) that requires no objective measures [24], followed by a standardized diagnostic tool, the subjective global assessment (SGA) [25]. Use of the SGA rules out false positives, while helping the clinician to diagnose nutritional status (A = well nourished, B = mild/moderately malnourished, C = severely malnourished). INPAC recommends to initially triage nutritional care based on SGA; specifically, a comprehensive nutritional assessment should be conducted for patients requiring Specialized Nutrition Care (mainly SGA C patients, but also those with enteral/parenteral nutrition, transferred from critical care etc.) [23]. Most SGA B patients may be treated with Advanced Nutrition Care practices focused on ensuring that sufficient and adequate nutrition is provided and consumed by the

patient (e.g. oral nutritional supplement [ONS] either at meals or a small amount of nutrient dense ONS at medication times [med-pass], food preferences, increased energy and protein food offerings and multidisciplinary care). The INPAC triage process is designed to promote efficiency in dietetic care while minimizing the risk of missing malnourished patients. Other aspects of INPAC include monitoring of nutritional status (food intake, body weight), ensuring that all patients have access to food, and discharge planning for malnourished patients [23].

The More-2-Eat study

The More-2-Eat (M2E) study is an evaluation (Clinical Trials Registration NCT02800304) of the implementation of INPAC in medical units in five Canadian hospitals in four provinces [26]. Sites are described in detail in a prior publication [27], but in brief were 150–1100 bed hospitals, while units ranged from 27 to 50 beds, with some offering specialized programs (e.g. respiratory, Accountable Care Unit, acute stroke). Participatory action research (PAR) methods were used to integrate screening at admission, diagnosis with SGA, and triaging of multidisciplinary nutrition care based on nutritional status. The study was conducted over a 24-month period, including developmental (9 months), implementation (12 months), and sustainability phases (3 months). Baseline evaluation collected during the developmental phase identified several gaps in practice [27,28]. M2E used a pre-test, post-test time series design to document changes in practice over time as a result of the implementation of INPAC. The protocol provides details on all study procedures, measures and the theoretical basis for implementation [26].

Ethics

Ethics clearance for M2E was obtained from the University of Waterloo Research Ethics Board (ORE #20590) and from the ethics committees at each of the five participating hospitals (Niagara Health Ethics Board, Ottawa Health Science Network Research Ethics Board, Health Research Ethics Board of the University of Alberta, Regina Qu'Appelle Health Region Research Ethics Board, Concordia Research Ethics Committee). Ethics review boards did not require patient consent for completion of INPAC audits (described below), although some hospitals were required to post notification to patients and family that health record audits were being completed, for the opportunity to opt out of the data collection.

INPAC audits

The developmental phase included key activities to set-up the project (e.g. research agreements, ethics, identification of site research associates and implementation teams and baseline data collection etc.). Included during this phase was the completion of four INPAC audits over a relatively short time frame (~4–6 weeks). During the 12-month implementation phase, INPAC audits were completed twice per month, and eight audits were completed during the three-month sustainability phase (Fig. 1). This resulted in a total of 36 audit days completed per site. The audit form tracked the nutrition care process for all patients on each unit on a site-defined pre-selected INPAC audit day; a separate audit form was completed for each patient on each audit day.

To complete the INPAC audits, trained research associates, employed by the hospital as dietitians or nurses, accessed the health records of all patients on the unit on a single day and reviewed written documents. They were trained to identify key documents on the health record that would be reviewed to track

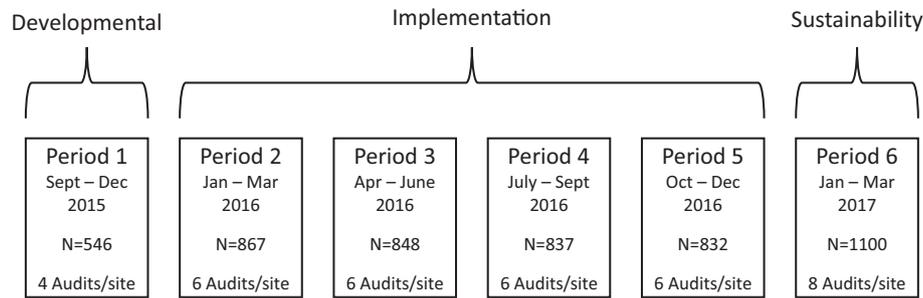


Fig. 1. Overview of the More-2-Eat study time frames and INPAC audit data collection.

nutrition care processes, and were asked to use these same documents throughout the study to ensure consistency. Nutrition care activities that had occurred since admission to the unit were abstracted from the record to complete the INPAC Audit. Information collected included: screening; nutrition risk status; referral for, and completion of, SGA; SGA result; completion of a dietitian comprehensive exam; nutrition diagnoses provided by the dietitian on the chart; use of Standard [e.g. medications for nausea] and Advanced [e.g. food preferences, medpass, high energy/protein foods] Care Practices; and food intake and weight monitoring. The audits were typically collected over an eight-hour shift for each research associate and entered into RedCAP™ (a secure online system for managing data) for immediate data transfer to the research centre leading the project (University of Waterloo). In addition to nutrition care activities, demographic data of the patient were recorded (e.g. age in years, sex, admission diagnosis). Admission diagnosis categories included: cardiovascular, gastrointestinal, respiratory, musculoskeletal, neurological, infection, genitourinary, metabolic, sensory organ, trauma, haemopoietic, musculoskeletal, cancer, mental health, autoimmune, and other.

Feedback

In addition to tracking progress with implementation of nutrition care activities, INPAC audits were summarized centrally at the end of each month, and reports were provided to sites to use for feedback to unit staff on their care behaviours. This feedback loop is a key strategy recommended by the Theoretical Domains Framework (TDF) and Behaviour Change Wheel [29,30] when implementing new practices.

Site mentorship for change management

During the developmental phase, site champions (clinical nutrition managers or senior dietitians) developed site implementation teams (key stakeholders from various departments and representatives of unit staff) to support changing practice. As well, champions discussed the INPAC activities with senior management to increase awareness of the impact of malnutrition on greater hospital operational matters like length of stay, readmission rates and patient flow, and how these can be mitigated with timely nutrition care. These champions and teams were educated by the research centre on the Model for Improvement [31], how to consider drivers of behaviour (i.e. what motivates staff; Capability, Opportunity, Motivation, of Behaviour (COM-B)) [29,30], and to use Plan-Do-Study-Act (PDSA) cycles to support development and embedding of practice change into the routine [31]. A key starting point for implementation was building a nutrition culture [8] and raising awareness among the team that there was a need for change in practices [27,31]. INPAC audits completed during the developmental phase were a key mechanism to help the unit team recognize that improvements in practice were required. Resources to

raise awareness (e.g. power point presentations on prevalence and cost of hospital malnutrition) and key reminders (e.g. posters on removing barriers to food intake) were created centrally, while local champions and teams adapted these materials to fit the local context, and developed unique materials to support implementation of nutrition care activities. Implementation resources are publicly available (<http://m2e.nutritioncareincanada.ca/>).

In-person SGA training was conducted by a member of the central research team at study sites with unit dietitians as well as diet technicians and other personnel, such as nurses. Monthly teleconferences were completed with research champions/associates and the research centre for mentoring/coaching and reviewing monthly INPAC audit reports. Along with the individual site reports, at the request of the sites, amalgamated reports that tracked data from baseline, identified the progress of all sites by name in order to support fruitful discussion on what was working well. These routine meetings promoted accountability and sharing among sites, validating implemented practices, and offering ideas on different approaches that could be used for successful implementation. Additionally, site champions/research associates completed written scorecards that outlined various implementation activities. These scorecards and audio-recorded meetings were used to identify the key strategies that supported implementation of INPAC practices.

Statistics

INPAC audit data by site and audit period were downloaded from RedCAP™ to Excel and uploaded to R statistical software, version 3.4.1 [32]. Using bed number, date of admission, and patient characteristics, individual patients who had been on the unit for more than one audit were identified and duplicate records removed to avoid overestimation of prevalence of nutrition care activities. The greatest number of duplicates was found in the developmental phase with baseline INPAC audits, as four audits were completed consecutively over a relatively short time frame [27]. Success with implementation (i.e., fidelity) was defined as 75% of patients receiving admission screening; 75% of at risk patients receiving an SGA assessment for diagnosis; and 100% of severely malnourished patients (SGA C) receiving a comprehensive dietitian assessment. These rates of screening and diagnosis are consistent with the documented prevalence of performance indicators used by the Netherlands since 2010 when mandatory screening was initiated [21]. Graphs and descriptive analyses (mean, standard deviation [SD]; proportion) by site and time period were completed to answer the research questions. Time frames roughly categorized by quarter were used to display data to demonstrate change over time (Period 1: Sept–Dec 2015; Period 2: Jan–Mar 2016; Period 3: April–June 2016; Period 4: July–Sept 2016; Period 5: Oct–Dec 2016; Period 6: Jan–Mar 2017). Developmental phase was Period 1, while the sustainability phase was Period 6.

Results

Over five thousand ($n = 5030$) individual patient audits were completed during the study periods (Period 1 $n = 546$; Period 2 $n = 867$; Period 3 $n = 848$; Period 4 $n = 837$; Period 5 $n = 832$; Period 6 $n = 1100$). The average age of participants was 73.2 (SD16.3) with 48% male (Table 1). The most common primary admission diagnosis was respiratory at 25.5%, with other prevalent diagnoses being cardiovascular, 'other', infection, and neurologic, each accounting for between 10% and 11%. As noted in the baseline data [27], variance in proportion of conditions across sites was due to specialization of medical units. From baseline through to the sustainability phase, the proportion identified to be at malnutrition risk with the CNST were relatively consistent (37% Period 1, low of 29% in Period 3) with an overall prevalence of 31%; note prevalence of risk is based on those who were screened which was not 100% as seen in Fig. 2. Some variation in prevalence was noted across sites, with site B identifying 39%, on average, of admitted patients to be at risk, while site C had the lowest prevalence of risk at 25%. Further details on patient descriptors are provided in Table 1.

Figure 2 displays the change in admission nutrition screening over the six time periods overall (Fig. 2a) and by site (Fig. 2b) while Fig. 3 (Fig. 3a and b) similarly shows change in use of SGA to diagnose malnutrition. The upward trends observed in both figures for admission screening and post-screening SGA performed over time, respectively, are quite apparent. For admission screening, the average trend over time is 10.3% greater per time period. For SGA post-screening, the average trend over time is 15.2% greater per implementation time period. In each case, the majority of the gains were observed by Period 3. A chi-squared statistical test looking at the percentage of change comparing either Period 1 to Period 6 or Period 2 to Period 6 in terms of percent change was highly statistically significant ($p < .001$), i.e., the gains in uptake in both admission screening and post-screening SGA over time were highly statistically significant in the study sample.

Three (sites A, D, E) achieved the goal of 75% of admitted patients being screened by Period 3 with the remaining two achieving a rate of 70% by end of the implementation period. Site C had screening at baseline (with a different tool) but by the end of implementation had a similar rate of screening as site B, which had no baseline screening. It is also worth mentioning that three sites (B, C, D) experienced a decrease in rate of screening during the sustainability phase (Jan–Mar 2017), although this drop was marginal (<5%).

Table 1
Descriptive statistics of INPAC Audits and Patients by Sites.

Characteristic	All sites	Site A	Site B	Site C	Site D	Site E
Audits completed (#)	5030	1127	860	1087	988	968
Sex, Male (%)	48.0	42.1	49.2	49.3	54.9	45.6
Mean age (yrs)	73.2	75.4	72.1	73.4	66.8	75.9
First listed medical diagnosis ^a (% of audits for the site)						
Respiratory	25.5	16.5	13.1	9.9	70.9	12.5
Cardiovascular	10.9	5.2	6.1	13.3	4.4	24.2
Gastrointestinal	8.6	13.6	11.0	10.1	0.7	4.9
Infection	10.5	11.1	0.6	9.1	4.6	9.5
Neurological	10.0	2.0	7.7	29.3	0.9	7.3
Other ^b	34.5	51.6	61.5	28.3	18.5	41.6
At risk post screening ^c (%)	31.7	36.1	38.8	25.2	32.1	26.2

^a First listed diagnosis on INPAC audit.

^b Other diagnoses include: genitourinary, metabolic, sensory organ, trauma, hemaopoietic, musculoskeletal, cancer, mental health, autoimmune, and other.

^c Denominator is number screened in each phase; total $n = 3466$ (~70% of all patients with INPAC audits; 32% of all patients in period 1 vs. 83% of all patients in period 6).

Key behaviour change strategies which supported implementation of screening included: adding screening questions to existing unit admission forms; educating staff on the importance of screening; discussion at staff huddles to encourage routine screening on a regular basis; using screening data to generate ideas from the unit team on how to improve the process; and reviewing data at monthly champion telephone meetings and unit meetings to benchmark and compare to other sites. Details by site of these techniques are provided in Table 2.

Overall, a 75% rate of SGA completion or referral was accomplished between Periods 3 and 4 for those identified to be at nutrition risk (Fig. 3a). All but one site achieved a 75% rate of SGA referral or completion by Period 3 with the remaining site (E) achieving a rate of 75% by Period 4. At baseline, no sites were using SGA and there were gaps in care with respect to comprehensive dietitian assessment for patients identified to be at risk [27]. Screening, typically completed by nurses, included a two-step process of screening and referral. It was important for sites to educate staff and monitor on completion of both steps when embedding within the routine. Key behaviour change techniques that supported referral to a dietitian included: flagging automatic referrals to the dietitian for those identified to be at risk; use of the Electronic Medical Record (EMR) to automate referral; as well as referral priority lists for SGA completion. Of note, the SGA rate of completion dropped during the summer months, potentially due to summer vacation with reduced coverage by SGA-trained dietitians, but returned to peak levels by December 2016. There was a marginal drop-off in rate of SGA completion during the sustainability phase from January–March 2018.

By Period 2, dietitians completed a comprehensive nutritional assessment for all (100%) patients identified as SGA C. This rate stayed relatively stable until the sustainability phase where there was a decrease to 89% of patients. This high level of fidelity is explained by dietitians completing SGA, and then continuing on with assessment immediately if the patient was identified to be SGA C. One site (site B) also included a highly trained diet technician in SGA assessment and had a well-defined process in place to ensure triaging and follow through with either the dietitian (SGA C patients) or diet technician (SGA B patients). During the sustainability phase there was a change in process at site B regarding availability of dietitians and diet technicians, which explains almost all of the overall drop-off seen in sites during this phase.

Some sites chose to automatically complete a comprehensive assessment for SGA B patients, while others left this decision up to the clinician completing the SGA. The proportion of SGA B patients receiving a comprehensive dietitian assessment increased to 80% by Period 3, which declined over each subsequent phase to a low of 53% during the sustainability phase. This drop may be explained by clinicians gaining confidence on the process and relying on other multidisciplinary INPAC care processes that were being instituted in the latter parts of the implementation to meet the needs of some SGA B patients (e.g., initially some sites decided to assess all SGA B patients until medpass was instituted). It was anticipated that with the introduction of INPAC there would be a reduction in the comprehensive assessment done by dietitians for patients identified by screening as being not at risk. However, results suggest that some patients who were not at malnutrition risk or were SGA A, continued to receive a comprehensive dietitian assessment with rates being relatively stable at 18–24% across the sites over the six time periods. This stability may indicate that these patients truly needed a referral for reasons other than malnutrition or that we were unable to change in-grained referral patterns.

To address the second aim of the project which is to determine if the improved diagnostic process led to more or different forms of nutritional care, other INPAC audit data on dietitian recorded

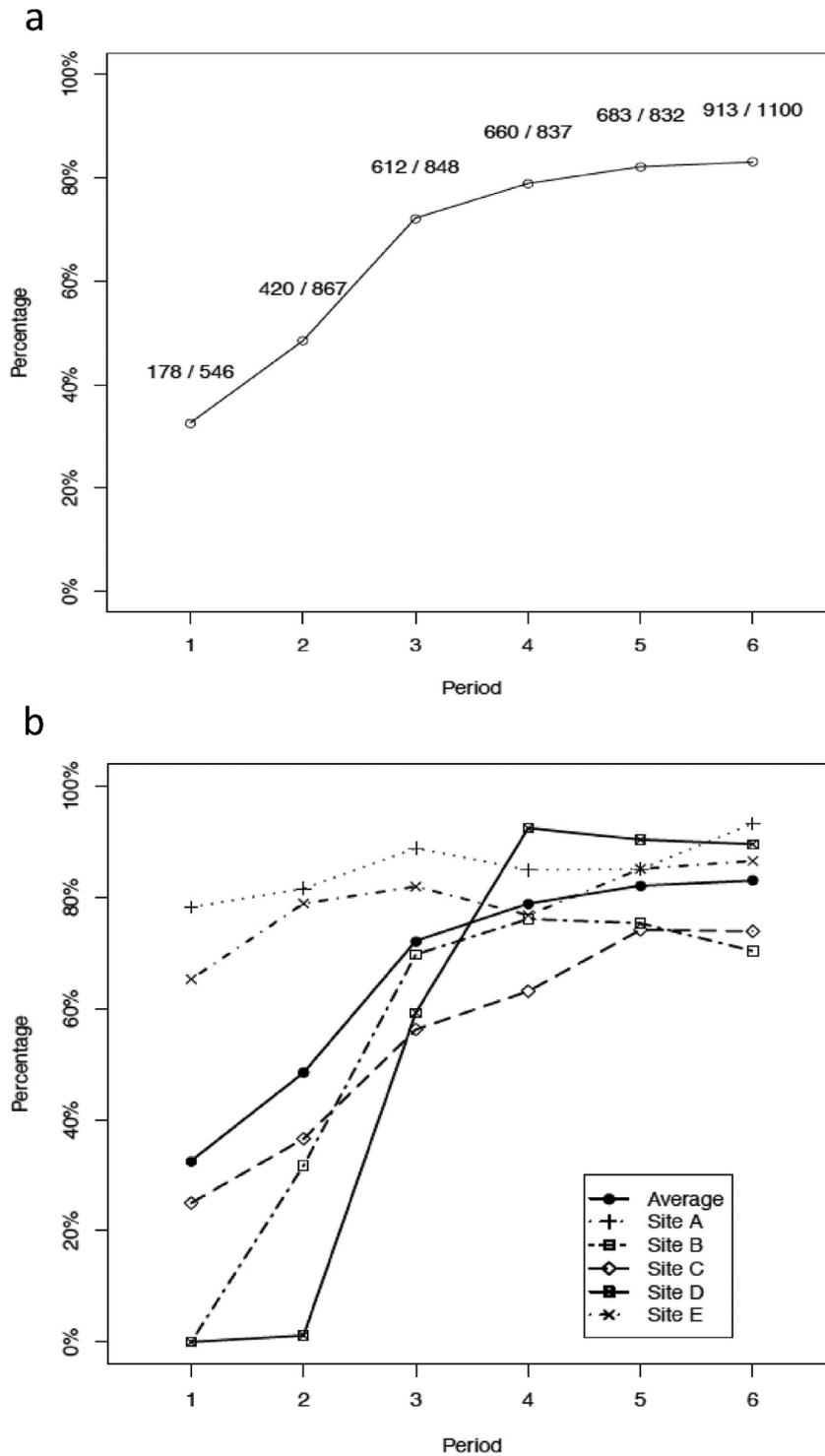


Fig. 2. a: Overall percentage of patients screened at admission across all sites by study time period. b: Site-specific percentage of patients screened at admission by study time period.

nutrition diagnoses as per Nutrition Care Practice (e.g. malnutrition), Advanced Nutrition Care strategies (e.g. medpass), and on Standard Nutrition Care practices were analyzed (see Table 3). In Period 1, the dietitian nutrition diagnosis and documentation of ‘malnutrition’ was a modest 0.37%. This steadily increased to over 5% of all audited health records by the end of the study. Other nutrition diagnoses noted on the chart by dietitians were stable over

the time periods. During the implementation and sustainability phases, the overall use of any Advanced Nutrition Care practices increased from 31% during Period 1 to 63% during Period 6. These practices included: a nutrient dense diet; liberalized diet; preferred foods; high energy/protein milkshakes/drinks or ONS; medpass of ONS; and snacks between meals. Many of these strategies were already routine in sites and could be requested by physicians and

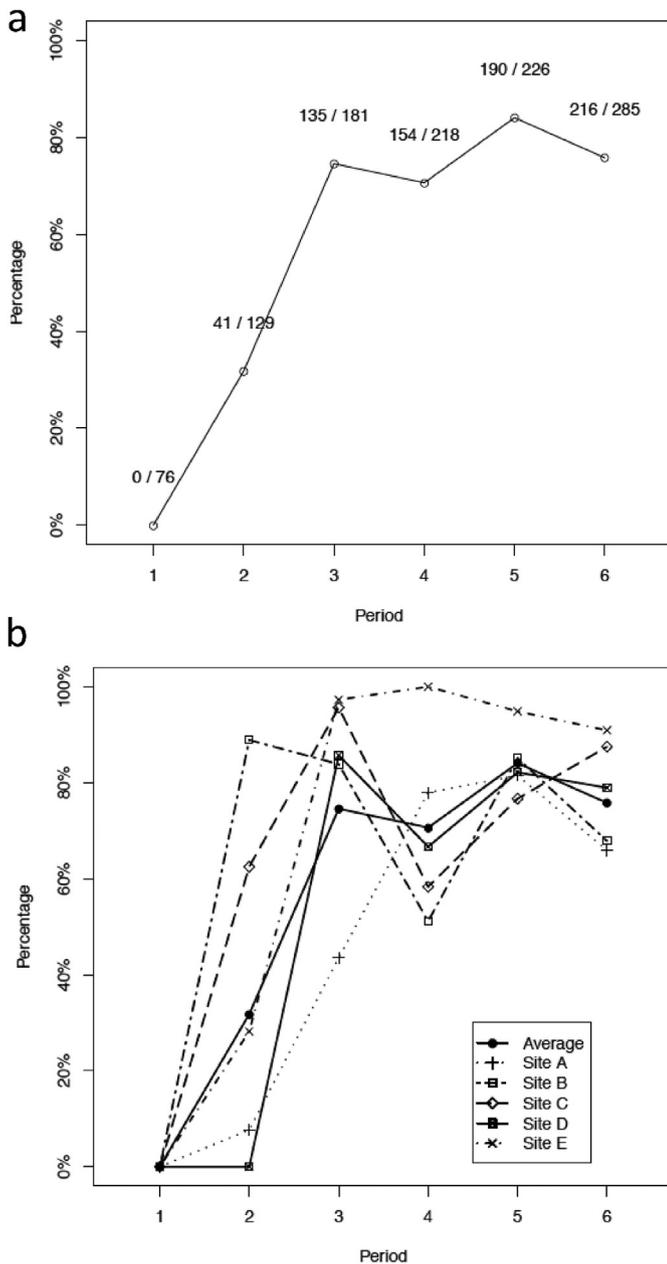


Fig. 3. a: Overall percentage of patients who were referred or completed subjective global assessment across all sites by study time period. b: Site-specific percentage of patients referred or completed subjective global assessment by study time period.

nurses, but the increased identification of patients provided Advanced Nutrition Care is consistent with the increased identification and diagnosis of malnutrition that resulted from INPAC implementation. Those practices with the largest increase over time were: preferred foods (Period 1: 15%, Period 6: 33%), medpass (Period 1: 2%, Period 6: 15%), snacks between meals (Period 1: 3%, Period 6: 10%), and 'other' (e.g. high energy/protein foods in ward stock, fortified foods, supplements between meals Period 1: 5%, Period 6: 21%). Strategies to support medpass use in sites are provided in Table 2, as this was a new Advanced Care Practice for sites that required development of new processes and procedures.

Standard Nutrition Care activities increased over the study period, but were not as striking as for Advanced Nutrition Care practices (Period 1: 80%; Period 6: 88%) (Table 3). Greatest increases were seen for: weekly monitoring of body weight (Period 1: 3%,

Period 6: 21%) and food intake monitoring (Period 1: 1%, Period 6: 32%), two practices identified in INPAC to support nutritional care interventions and triaging of patients. Other activities also increased (e.g. volunteer mealtime assistance, families encouraged to be present at meals; Period 1: 5%, Period 6: 25%).

Discussion

The M2E study demonstrated that implementation of improved nutrition care practices is not only feasible, but sustainable in the short term. A priori fidelity rates were achieved for screening, diagnosis with SGA, and completion of a comprehensive nutrition assessment. Further, treatment rates more than doubled with respect to use of any Advanced Nutrition Care activity. The success with implementation is consistent with reports based on mandatory screening programs [21] or superior to other screening implementation studies [20,33].

Success for M2E was predicated on a feasible and acceptable pathway and tools to support future implementation [23]. Rate of screening and reaching the goal of 75% of admitted patients appeared to be unrelated to having screening in place at the baseline period, although goal achievement was faster for sites with screening in place before the implementation of INPAC (e.g. site A). Training on INPAC and implementation of care activities raised awareness of when screening and referral to a dietitian should be completed [34]. Automation of the referral process post screening is another key strategy to support uptake [35], and inclusion of referral steps on admission forms or in electronic medical records promoted completion. In addition to feasible tools and processes, education and reinforcement of steps required to complete activities was required and consistent with frameworks for improvement [29,30].

Educating staff is not enough to embed improvements into routine care [14]. Training and reinforcing change management principles [31] with champions and site implementation teams led to success in M2E. Site implementation teams and champions engaged their unit teams in making change by asking their opinion on where to start with respect to making improvements and how to make new processes work [36–39]. Time and effort spent in implementation leads to change, although continual renewal through refreshers, orientation of new staff, audit and feedback of data will need to be placed into the routine of champions or unit dietitians to sustain efforts. This need for continued follow-up was confirmed by the minimal drop off in screening and triage to comprehensive assessment rates for malnourished patients during the sustainability phase where such internal processes were in place as, external facilitation by the research team and monthly mentoring telephone calls were removed. A process for continued benchmarking and engagement of staff and management to sustain care practices is required to achieve success long term. A community of practice that supported each site with implementation, modeled on the work by the Canadian Patient Safety Institute [31], also supported implementation. Accountability of sites was enhanced when they knew that their data would be reviewed by other sites in the M2E study on a monthly basis through aggregate reports. Monthly coaching calls were an opportunity for sites to benchmark their progress, learn from each other, celebrate successes, and work through challenges, with support from their fellow site champions and the research team. The use of data to drive changes in practice was indispensable [30,31]. Frequent audit and feedback loops, facilitated by an external research team, supported INPAC implementation in these sites. Continuation of these key activities in a sustainable model needs to be considered in future knowledge translation activities.

Table 2
Key behaviour change techniques used by hospitals to implement screening, SGA and medpass

Screening	SGA	Medpass	
Site A	<ul style="list-style-type: none"> ➤ Developed work standard for screening ➤ Added CNST to EMR, turns pink if positive screen ➤ Education on importance ➤ Posters to raise awareness ➤ Frequent audits and feedback on progress 	<ul style="list-style-type: none"> ➤ Staff training, education and mentoring on importance of, and how to conduct SGA 	<ul style="list-style-type: none"> ➤ Mapped out progress and met with staff to discuss this process ➤ Staff tasted ONS to determine which flavours were most appealing ➤ Added to medpass order to health record and medication administration record ➤ Provided all equipment necessary for medpass to be made easily accessible
Site B	<ul style="list-style-type: none"> ➤ CNST added to nursing admission forms ➤ Training session on use of new CNST form ➤ Feedback of audit data on completion 	<ul style="list-style-type: none"> ➤ Staff training and mentoring throughout the hospital 	<ul style="list-style-type: none"> ➤ Feedback on data of ONS use to improve system ➤ Provided all equipment necessary for medpass to be made easily accessible
Site C	<ul style="list-style-type: none"> ➤ Education/training for staff on using CNST tool ➤ Added CNST to patient chart ➤ Team huddles to motivate staff to increase compliance 	<ul style="list-style-type: none"> ➤ Staff training ➤ SGA forms added to charts ➤ Feedback of audit on completion ➤ Used patient stories to motivate staff to complete 	<ul style="list-style-type: none"> ➤ Automatic offering of medpass to SGA B/Cs ➤ Provide all equipment necessary for medpass to be made easily accessible
Site D	<ul style="list-style-type: none"> ➤ Education on importance ➤ Feedback audit data on completion ➤ Posters/reminders ➤ Added CNST to “nutrition” section of patient chart 	<ul style="list-style-type: none"> ➤ Training video reviewed by staff ➤ Hands on training and mentoring 	<ul style="list-style-type: none"> ➤ RD procedure developed for implementing medpass ➤ Education posters on unit about medpass ➤ Provided all equipment necessary for medpass to be made easily accessible
Site E	<ul style="list-style-type: none"> ➤ Consensus meeting on standardization of screening ➤ Included check-off boxes for sign-off of staff after completion ➤ Feedback of audit data on completion 	<ul style="list-style-type: none"> ➤ Staff training ➤ Referral priority list developed for SGA ➤ Check box for completion to promote accountability ➤ Feedback of audit data on completion ➤ Embed SGA in regional nutrition assessment form 	<ul style="list-style-type: none"> ➤ Working group created for medpass ➤ Provided all equipment necessary for medpass to be made easily accessible ➤ Staff training, information sheet for easy reference ➤ Dietitians made first order treatment

Table 3
Percentage of Malnutrition and other Nutrition Diagnoses, Advanced Care and Standardized Care Strategies by Implementation Period.

Practice	Period 1 ^a	Period 2 ^a	Period 3 ^a	Period 4 ^a	Period 5 ^a	Period 6 ^a
<i>Screening at admission</i>						
At risk for malnutrition ^b	37	30	30	33	33	31
<i>Nutrition diagnosis based on subjective global assessment post screening</i>						
Mild/moderate malnutrition	–	22 ^c (3 ^d)	44 (8)	39 (10)	43 (12)	51 (13)
Severe malnutrition	–	11 (2)	11 (2)	17 (4)	27 (7)	23 (6)
<i>Nutrition diagnosis as per Dietitian dCharting of nutrition care process^d</i>						
Inadequate oral intake	8	10	10	9	11	7
Increased nutrient needs	1	2	1	2	2	1
Malnutrition	0.37	2	4.0	6	7	5
Inadequate protein-energy intake	0.2	0.5	0.4	0.2	1.0	0.3
Unintended weight loss	3	2	2	1	1	2
<i>Advanced care practices provided^d</i>						
None	69 ^a	57	51	50	47	37
Nutrient dense diet	6	6	7	8	7	7
Liberalized diet	1	3	2	3	3	3
Preferred foods	15	22	23	25	26	33
High energy/protein drinks	14	16	16	18	16	15
Medpass	2	2	3	7	15	15
Snacks	3	3	3	5	7	10
Other	5	14	18	12	14	21
<i>Standard care practices provided/addressed^d</i>						
Any practice	80	76	79	87	86	88
Family food encouraged	2	2	2	3	4	4
Vision/dentition	6	6	8	10	14	9
Eating position	15	5	10	15	17	22
Eating assistance	15	9	10	17	16	19
Pain control	52	53	54	65	54	54
Constipation/diarrhea	37	46	44	45	46	46
Nausea	30	34	33	38	31	31
Dysphagia diagnosed	11	11	12	12	15	12
Dysphagia diet	11	12	13	14	16	13
NPO/Clear fluid tracked	3	1	3	4	4	7
Hydration status monitored	9	4	2	4	2	3
Weekly weight	3	1	1	3	17	21
Food intake monitored	1	2	3	5	25	32
Other	5	7	13	12	14	25

^a Values are % of patients for the time period rounded to whole numbers, except for malnutrition and inadequate protein-energy intake diagnosis where % < 1.^b Denominator is number screened in each phase; total n = 3466 (~70% of all patients with INPAC audits; 32% of all patients in period 1 vs. 83% of all patients in period 6).^c Denominator is number at risk post screening n = 1097; note not all patients had SGA post screening in earlier periods.^d Denominator is entire INPAC audit sample n = 5030.

Despite good uptake of screening and SGA and increased recording by dietitians of a malnutrition diagnosis using the Nutrition Care Practice and International Dietetics and Nutrition Terminology (IDNT) (<https://ncpt.webauthor.com/>), rates of the documented diagnosis were not consistent with prevalence SGA B and C categories. Barriers to dietitians documentation of malnutrition, such as lack of support from professional colleges, jurisdictions and hospitals, need to be overcome. Screening must be linked to the subsequent actions of diagnosis, triage, and early introduction of treatment that improves food intake in order to improve patients' recovery [9,14,17,40]. Advanced care strategies, and specifically medpass and ONS, are known to be used at low rates [41], but INPAC increased use in this study. Less change was seen in Standard Nutrition Care which was more complex to implement as it required involvement and coordination among many departments (e.g. nursing, food service, housekeeping), as well as consideration for the unionized environment. Further, some barriers are poorly identified (e.g. eating challenges) without formal assessment. Future work should consider developing tools and processes that specifically support changes in Standard Nutrition Care activities and discharge processes, which were just beginning to be addressed by M2E sites at the end of the implementation period.

Demonstrating cost-effectiveness of these core nutrition care activities is also required [42,43]. For example, a portion of not at risk and of SGA A patients continued to receive a comprehensive dietitian assessment. Understanding why these decisions were made and the potential resource implications requires further study. Although Randomized Control Trials (RCT) are recommended for implementing screening/assessment/treatment to demonstrate effectiveness [43], M2E shows that considerable tailoring and PAR methods, which are not conducive to an RCT, are needed for implementation, as each site had its unique context and priorities for change [37]. Moreover, denying nutritional screening or care to potentially malnourished patients poses an ethical dilemma for intervention research.

Study limitations

Several hospital employees were the research associates who completed INPAC audits, potentially leading to variability in tracking of practices. There was modest infusion of resources for this project to sites (\$80,000 CDN for 24 months) primarily for data collection, which was beyond these audits (see protocol, [26]), but also included some implementation costs. To promote scalability and sustainability, future work is required to demonstrate that fidelity to INPAC can be achieved with no external implementation funding. Tracking of the resource investment to implement INPAC is also needed.

Conclusion

This multi-site implementation based on over 5000 patient records demonstrated that implementation of nutrition screening and diagnosis are feasible and met fidelity targets, leading to a doubling of Advanced Nutrition Care strategies designed to mitigate hospital malnutrition. Screening is the initial step and it is recommended that screening be made mandatory by provincial and national policy, including accreditation for hospitals. Success was due to a feasible pathway and tools, using change management and quality improvement principles, as well as a community of practice that provided mentorship and support, coordinated by a central external facilitation team. Key resources have been captured

in a publically available INPAC Implementation toolkit (<http://m2e.nutritioncareincanada.ca/>). Future work is required to demonstrate the impact of INPAC implementation on patient reported outcomes and healthcare utilization.

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Statement of authorship

HK is the primary investigator and lead of this project, including conceptualization of design and research questions for the overall project and this manuscript. HK created all data collection instruments, mentored sites with data collection and provided overall project management and direction of the research. CL, RV, and TM are university researchers involved in data collection and analysis. YX, JD and LC conducted statistical analyses for this paper, with JD and LC as co-investigators contributing from the initial design phase. SO, and MSW are site champions involved in data collection data and implementing INPAC. SR, PB, LG, ML and JB are co-investigators and contributed to the design and interpretation of results. All authors read and approved the final manuscript.

Conflicts of interest

HK and LG are co-chairs of the Canadian Malnutrition Task Force, which received unrestricted educational grants from Abbott Nutrition and Nestlé Health Sciences. In the past three years HK and LG received honoraria for speakers' bureaus with: Abbott Nutrition, Nestlé Health Sciences, Fresenius Kabi and Baxter. All other authors have no conflicts to declare.

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