Evidence-Based Approach for Identification of Malnutrition and Prevention of Skin Breakdown

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Abstract

Problem: Geriatric patients have an increased risk for skin breakdown due to advanced age, immobility, comorbidities, and poor nutrition. As malnutrition contributes to impaired skin integrity, patients may experience ulceration, infection, and pain. Administrators within a long-term care (LTC) facility expressed concerns about undetected malnutrition or the risk of malnutrition leading to skin breakdown. The incidence rate of skin breakdown in January of 2020 was 6.37%.

Purpose: The purpose of this quality improvement (QI) project was to implement and evaluate use of the Mini Nutritional Assessment (MNA) for patient admissions/readmissions within a LTC setting, for early recognition of malnutrition and prompt intervention to prevent skin breakdown.

Methods: Implementation relied on Lewin's Change Theory, utilizing evidence to manifest and sustain change. Strategies/tactics included meetings with administrative and nursing staff to review current processes for patient admission and dietary evaluation, training nursing staff on use of the MNA, and implementation of an improved communication system for dietary referrals. The project was implemented at a 130-bed LTC facility and clinicians included 12 nurses, 2 providers, and 1 dietician. Inclusion criteria included all admissions/readmissions. Implementation data was collected at weekly intervals using electronic reports and chart audits. Protection of confidentiality/privacy included collection of anonymous data. Data was analyzed using run charts to evaluate trends and variation in MNA use.

Results: Over 14-weeks of implementation, 38 patients were admitted/readmitted to the LTC facility. The MNA was completed for 32 (84.1%) of patients, and 18 (56.3%) of those patients were identified as being malnourished or at risk for malnutrition. Run chart analysis indicated no

shifts, trends, astronomical data points or abnormal variation in runs. Prior to implementation of the practice change, the rate of compliance in utilizing the MNA increased from 0% at baseline to vary weekly between 40% and 100%, indicating initial adoption of the screening tool by nurses.

Conclusions: The MNA provided an effective means for establishing nutritional status in order to prompt early nutritional intervention to prevent skin breakdown. The MNA has the potential to enhance prevention efforts, reduce costs associated with in-house acquired wounds, and minimize factors contributing to patient decline.

Introduction

There is an increased risk of skin breakdown among geriatric patients due to advanced age, frailty, immobility, various comorbidities, and poor nutrition. Skin damage is more likely to be present in malnourished patients, where dietary intake and body mass index (BMI) are strong predictors malnutrition (Berlowitz, 2019). Patients may subsequently experience complications such as ulceration, infection, and pain, all in the arena of increased healthcare costs and risk of mortality. The Agency for Healthcare Research and Quality (2014) reported that approximately 2.5 million patients in the U.S. are treated for pressure ulcers annually and costs range between 9.1 to 11.6 billion dollars; approximately 60,000 patient deaths each year have been linked to pressure ulcers. One study demonstrated that removal of payment for in-house acquired pressure ulcers resulted in a statewide loss upwards of 62 million dollars from third parties, and 47 million dollars from Medicare (Meddings et al., 2015).

Geriatric patients are considered to be a vulnerable population, among which comorbidities, including poor appetite and weight loss, and a lack of resources may be prominent. Administrators within a particular long-term care (LTC) facility reported that the current interventions to reduce the incidence of pressure ulcers, and support risk recognition and communication of changes in nutritional intake were less than effective. Specifically, the incidence rate of skin breakdown in January of 2020 was 6.37%. The purpose of this QI project was to implement and evaluate utilization and the effectiveness of the MNA® Mini Nutritional Assessment (see Appendix A) for patient admissions and readmissions within a LTC setting for early recognition of malnutrition and prompt intervention to prevent skin breakdown. The anticipated outcome of the project was 100% utilization of the MNA in order to establish and support nutritional status and skin integrity.

Literature Review

This literature review presents justification for implementation of the MNA for early recognition of malnutrition and prompt intervention to reduce skin breakdown. Evidence was found to support reliability, validity, relevance, applicability, as well as general benefit of MNA utilization. Melnyk's levels of evidence were used in rating evidence (Melnyk & Fineout-Overholt, 2015; see Appendix B), and a synthesis of research using the Newhouse (2006) system for determining ratings for quality was found to provide sound rationale for use of the MNA (see Appendix C).

Concerning reliability, Lin et al. (2019) conducted a quasi-experimental study examining the test-retest reliability of the MNA, finding high reliability with an intraclass correlation coefficient (ICC) of 0.91 (highly reliable) (95% CI, 0.85-8.94). This study was rated at level IV with an overall quality rating of B, given the non-randomized nature, sample homogeneity, and appropriate exclusion criteria. In reference to the validity of the MNA, Isautier et al. (2019) performed a systematic review and meta-analysis of various nutritional screening tools used in community-dwelling older adults, finding that the MNA-Short Form (MNA-SF), and MNA-SF versions 1 and 2 had high sensitivity and specificity in detecting malnutrition or the risk of malnutrition. Validated against the MNA-Long Form, researchers reported an average sensitivity and specificity of 0.95 (95% CI, 0.75-0.99) and 0.95 (95% CI, 0.85-0.99) for the MNA-SF, 0.85 (95% CI, 0.80-0.89) and 0.87 (95% CI, 0.86-0.89) for the MNA-SF version 1, and 0.85 (95% CI, 0.77-0.89) and 0.84 (95% CI, 0.79-0.87) for the MNA-SF version 2 (Isautier et al., 2019).

Regarding relevance and applicability, Kaiser et al. (2010) performed a retrospective pooled analysis of previously reported datasets on the MNA and the prevalence of malnutrition in older adults. The researchers found higher rates within rehabilitation (50.5%), hospital

(38.7%), and nursing home settings (13.8%), with 46.2% of patients noted to be at risk for malnutrition. Cereda et al. (2016) performed a systematic review and meta-analysis of risk assessment in a variety of settings using the MNA. They reported that malnutrition and the risk for such was notably associated to patient setting and level of dependence in terms of care requirements ($p < 0.001$), where LTC and sub-acute/rehabilitation settings had higher rates of malnutrition; 28.7% (95% CI, 21.4-36.0) and 29.4% (95% CI, 21.7-36.9), respectively. The study performed by Kaiser et al. (2010) was rated at level V with an overall quality rating of B, given weaker study design, low internal validity, adequate sample size, and appropriate search strategy. However, the study by Cereda et al. (2016) was rated at level V with an overall quality rating of C due to the systematic review of non-interventional studies and the PRISMA criteria and power analysis were not present. These two studies were also similar in featuring MNA implementation across various settings.

With regard to general benefits, Feldblum et al. (2011) performed a randomized controlled trial testing whether individualized nutritional treatment during and after discharge improves nutritional outcomes and reduces mortality, concluding that MNA scores were significantly higher for patients receiving individualized dietary treatment along with scheduled follow-up (3.01 ± 2.65 vs. 1.81 ± 2.97, $P = .004$), and overall, patients receiving standard care were noted to have a significantly higher mortality rate (11.6%, $p = .046$). Yatabe et al. (2013) performed an observational cohort study and report that the development of pressure ulcers (PUs) correlated with an MNA score of <8 (sensitivity and specificity of 97% and 42%), being more sensitive than a combination of Subjective Global Assessment and Braden Scale interpretations. Multiple logistic regressions found a significant association between MNA scores and PU development in all participants following adjustments for BMI and age (95% CI,

0.546-0.937) ($p = 0.01$). Both studies received an overall quality rating of B for their adequate sample size and appropriate exclusion criteria, consistent measurements and clearly represented statistical analysis. However the study by Feldblum et al. (2011) was rated at level II as it had a randomized, controlled designed adding strength to internal validity.

Several researchers have endorsed utilization of the MNA for evaluating nutritional status in older patients, having global relevance and features specific to this population, and allowing for early identification of nutritional deficits. Individualized attention to nutrition may help to reduce mortality, as the validated MNA tool may help predict the risk of developing pressure ulcers, and further help determine treatment goals. This review supports implementation of the MNA, as there is a clear need for nutritional assessment upon patient admission/readmission.

Theoretical Framework

Lewin's Change Theory was selected to provide structure and guidance for project implementation, allowing for a practical examination of workplace culture, the forces expected to accompany change, and how to manifest and sustain change. This theory describes change as a dynamic force which may include resistance; as participants are being guided towards change using a "driving force", push-back will likely occur (Butts & Rich, 2018). For example, some staff may challenge the notion of change perhaps through a sense of increased burden. Theory concepts include *unfreezing*, where attitudes are explored with the goal of reaching consensus that change is needed; *moving*, entailing adoption of a new practice; and *refreezing*, reflecting the transformation of change into a new norm and the return of balance (Butts & Rich, 2018). Lewin's (1958) explains that changes intended to improve group performance are often temporary, therefore objectives should include sustainability of the desired level of attainment.

Specific to this project, *unfreezing* focused on motivating change by whom through reflection on current practices, *changing* encompassed adoption of the MNA within the admission process, and *refreezing* was focused on sustaining change through the review of benefits associated with the MNA, such as early identification of malnutrition to help prevent skin breakdown. The concepts within Lewin's Change Theory were used to leverage practice change through several planned implementation strategies and tactics, inclusive of meetings with administrative and nursing staff to review the current process for patient admission and dietary evaluation, training of staff and change champions for MNA adoption, clinical supervision of MNA utilization, interval data audits and reports, and finally normalization among staff through inclusion of the MNA in unit-based training and administrative support.

Methods

The population base for this project encompassed patients within a 130-bed LTC facility in an urban area, with an average occupancy of approximately 71%. The target population was suitable given the prominence of older adult and geriatric patients with increased risks of malnutrition and skin breakdown. Inclusion criteria were all admissions and readmissions, and there were no exclusion criteria given site priorities. The implementation team consisted of 12 nurses (LPNs, RNs, and 2 supervisors), 2 providers, and 1 dietician. Nurses were educated on the MNA and trained in its use through instructional learning modules, printed references, and video presentation (see Appendix D). The MNA was used for new patient admissions and readmissions, for early recognition of malnutrition and prevention of skin breakdown (see Appendix E). Within an hour of a patient's admission, the assigned nurse reviewed medical records, performed the standard facility admission assessments as well as the MNA. The MNA was then scored and interpreted, and findings shared with the patient. If the MNA score was <12

(malnourished or at risk for malnutrition), providers were notified and an order for dietary referral obtained. An improved communication system was developed for dietary referrals. A dietary order and communication form was completed, placed in the patient's chart, sent to the dietician, and the MNA was placed in the chart as well as the dietary communication binder. The dietician performed a daily review of the communication binder, performed visits, subsequent treatment, and monthly follow-up.

Process measures consisted of the proportion of all newly admitted or readmitted patients who had the MNA completed, as well as those eligible patients who received dietary referrals based on the identification of malnutrition or their risk for malnutrition. Structure measures during implementation consisted of the percent of nurses trained in use of the MNA. Strategies and tactics used in conduction of the project were inclusive of meetings with administrative and nursing staff to discuss the potential for decreased revenue associated with malnutrition and in-house acquired wounds, an email memorandum executed by the administration outlining the practice change, training of staff and change champions, clinical supervision of MNA utilization, individual recognition and luncheons, and adoption of an improved communication system for dietary referrals. During implementation, strategies and tactics were adjusted to provide additional training sessions with reinforcement from champions for an influx of PRN and agency nurses due to staffing challenges amidst the COVID-19 pandemic. Implementation data was collected at weekly intervals using electronic reports for extraction of admission/readmission figures and chart audits for tracking staff performance and adoption of the MNA (see Appendix F). Data was analyzed using run charts to evaluate shifts, trends, astronomical data points and frequency of runs in adoption of the MNA by nursing staff and progress toward goals.

A project summary was submitted to the University of Maryland Baltimore Human Research Protections Office for a Non-Human Subjects Research (NHSR) determination. Measures taken to protect human subjects, confidentiality and privacy included collection of anonymous patient data and a separate file for de-identified staff; all project data was stored in a locked cabinet at the project site. Permission was granted by the authors to use the MNA® Mini Nutritional Assessment for this project (see Appendix G).

Results

Over the 14-week course of the project, 38 patients were admitted to the LTC care facility (including readmissions), with a range of 1 to 6 patients per day, and a mean of 2.7 patients per week. Among the admissions and readmissions, there were 18 males and 20 females, ranging from 43 to 90 years of age, with an average age of 68.8 and median age of 69. Eleven (28.9%) patients were admitted with existing wounds. While there were fluctuations in MNA utilization during the implementation period, 32 (84.1%) of the patients were assessed using the MNA on admission/readmission. Additionally, 18 (56.3%) of those patients were identified as being malnourished or at risk for malnutrition, all of whom received dietary referrals.

Following implementation, run chart analysis was performed for MNA utilization among nurses (see Figure 1). There were no shifts or trends noted, and astronomical data points were also absent. There were 8 sequences of runs, which was within the normal variation for 14 data points. Overall, the analysis of the run chart indicated random variation. However, it was noted there was 0% compliance in utilizing the MNA at baseline, and after implementation the rate varied weekly between 40% and 100%. Unintended consequences included an increase in workload among nurses performing the MNA, in addition the increased number of dietary

referrals received by the dietician in a short time. On the other hand, the unexpected benefit of minimal push-back from staff was noted and conducive to the project.

Discussion

In support of early recognition of malnourished patients, or those at risk for malnutrition, there was evidence of initial adoption by the LTC facility staff of completing the MNA. Utilization of the MNA for admissions and readmissions was designed to enhance the facility's existing process for patient intake. The process included provider notification for dietary referral in patients assessed to be malnourished or at risk for such, and dietician notification and daily review of the communications binder, leading to evaluation and subsequent treatment with follow-up. Interpretation of the data suggested that the implementation strategies and tactics employed provided moderate support for the process measure of MNA completion for admissions and readmissions.

In comparing project results to findings from the literature supporting use of the MNA, it was found that 56.3% of patients assessed with the MNA were malnourished or at risk for malnutrition, which exceeded the 28.7% rate of malnutrition in LTC facilities reported by Cereda et al. (2016). These results highlight the association between malnutrition and level of dependence in terms of care requirements. It is also important to note that throughout implementation of this project, 11 patients were admitted with wounds, which suggested that they were at a high risk for being malnourished. Yatabe et al. (2013) found a significant association between MNA scores and pressure ulcer development, promoting more support for MNA use to prevent skin breakdown.

While the project demonstrated initial adoption of the MNA, there were some limitations. The project was implemented amidst the on-going COVID-19 environment, which resulted in a

decreased rate of patient admissions to the facility, impacting the number of patients that could be assessed using the MNA. Limitations also included a fluctuating capacity to train staff in MNA utilization, given the variable use of external agency or PRN staff in covering voids associated with the pandemic (such as staff illness and call-outs). Consequently, time constraint was another limitation which affected staff training and opportunities for them to perform the intervention, as adjusted staffing ratios resulted in an increased work-load.

Conclusions

The MNA has been found to be an effective means for establishing nutritional status in patients in order to prompt early nutritional intervention to prevent malnutrition and subsequent skin breakdown. MNA utilization upon patient admission/readmission was found adopted by facility staff. Current strengths of the project included enhanced communication between nurses, providers, and the dietician, identification of benefits associated with MNA use, and the enactment of periodic training sessions and meetings to support optimal staff performance. With administrative and clinical support, and involvement of champions to continue MNA utilization for all admissions/readmissions, sustainability may be further upheld.

This project may also provide a base and momentum for future QI projects, and sustainability may be advanced with MNA inclusion into a facility's electronic medical record. The MNA has demonstrated initial acceptance by the nursing staff and relevance to early identification of malnutrition, and prompt intervention and management to ultimately prevent skin breakdown. The practice change of MNA inclusion within a standard admission process has the potential to enhance prevention efforts, reduce costs associated with in-house acquired wounds, and minimize factors contributing to patient decline or deterioration of their existing conditions.

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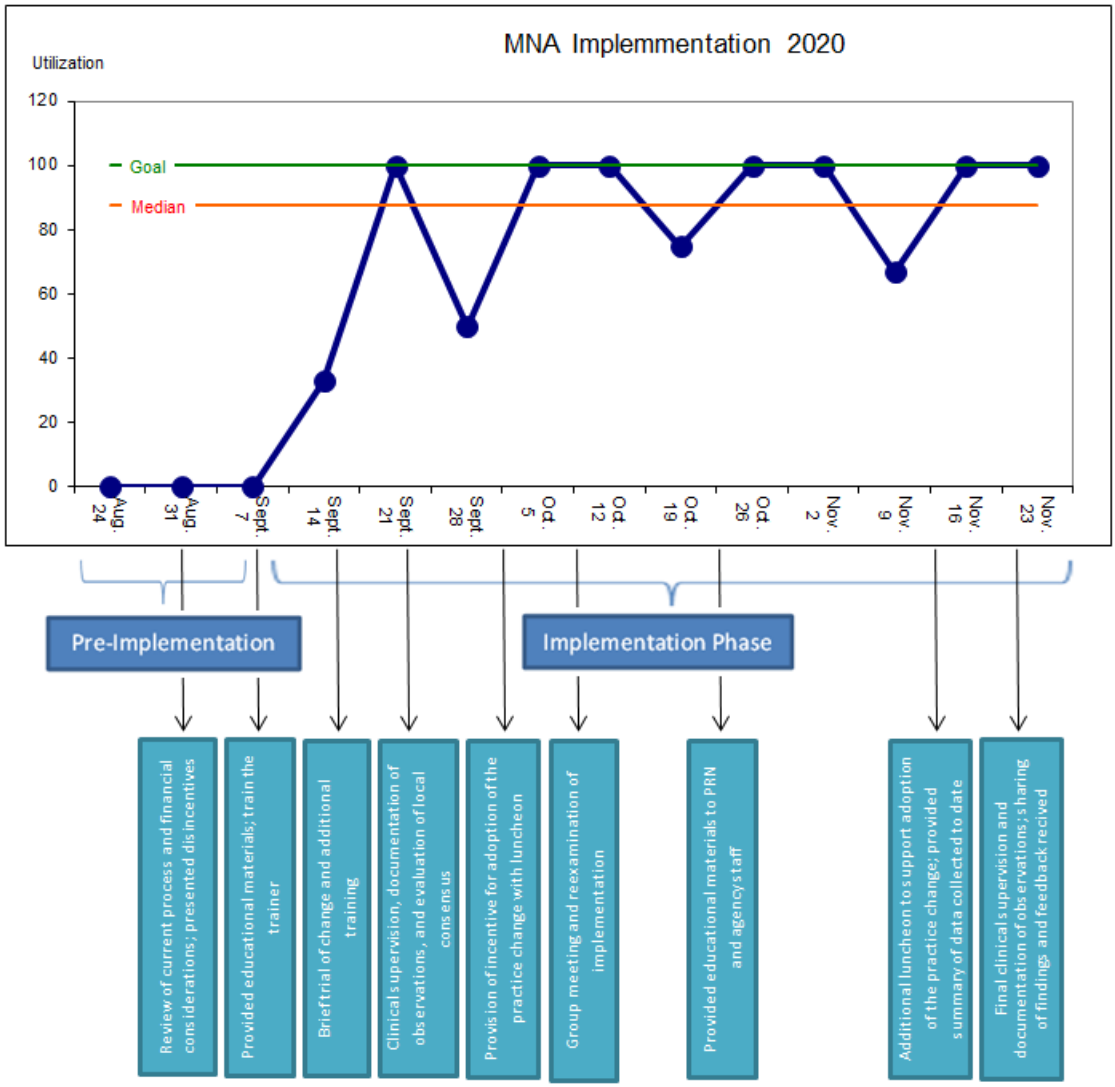
Figure 1.
Adoption of the Mini Nutritional Assessment (MNA)



Note. The above run chart features complete implementation data of MNA utilization by nurses for admissions and readmissions.

Appendix A

Mini Nutritional Assessment (MNA)

Nestlé Nutrition Institute

Mini Nutritional Assessment
MNA®

Last name: First name:

Sex: Age: Weight, kg: Height, cm: Date:

Complete the screen by filling in the boxes with the appropriate numbers. Total the numbers for the final screening score.

Screening

A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
0 = severe decrease in food intake
1 = moderate decrease in food intake
2 = no decrease in food intake ☐

B Weight loss during the last 3 months
0 = weight loss greater than 3 kg (6.6 lbs)
1 = does not know
2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
3 = no weight loss ☐

C Mobility
0 = bed or chair bound
1 = able to get out of bed / chair but does not go out
2 = goes out ☐

D Has suffered psychological stress or acute disease in the past 3 months?
0 = yes 2 = no ☐

E Neuropsychological problems
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems ☐

F1 Body Mass Index (BMI) (weight in kg) / (height in m^2)
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater ☐

IF BMI IS NOT AVAILABLE, REPLACE QUESTION F1 WITH QUESTION F2.
DO NOT ANSWER QUESTION F2 IF QUESTION F1 IS ALREADY COMPLETED.

F2 Calf circumference (CC) in cm
0 = CC less than 31
3 = CC 31 or greater ☐

Screening score ☐☐
(max. 14 points)

12-14 points: Normal nutritional status
8-11 points: At risk of malnutrition
0-7 points: Malnourished

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For more information: www.mna-elderly.com

Appendix B

Evidence Review Table

Evidence review for implementation of the Mini Nutritional Assessment (MNA)

Citation: Calvo, I., Olivar, J., Martínez, E., Rico, A., Díaz, J., & Gimena, M. (2012). MNA® Mini nutritional assessment as a nutritional screening tool for hospitalized older adults; rationales and feasibility. *Nutricion Hospitalaria*, *27*(5), 1619–1625. https://doi.org/10.3305/nh.2012.27.5.5888					Level IV
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"The aim of our study was to evaluate the use of the MNA® Mini Nutritional Assessment in hospitalized older adults for rapid evaluation of nutritional risk."	Prospective cohort study.	**Sampling Technique**: Convenience. **Eligible**: Patient admissions to 3 medical units over 2 months. **Excluded**: Participants with "chronic kidney failure, liver disease, or tumoral disease were excluded as a group with higher nutritional risk." **Accepted**: 106 patients age 65 or older. **Intervention**: 106 patients age 65 or older.	**Control**: Not applicable to this study. **Intervention**: Utilization of the MNA upon patient admission to each medical unit. **Intervention fidelity**: Data collection within 48 hours of patient admission, obtained by the same investigator for consistency.	**Dependent Variable**: Nutritional risk. **Measurement tool (reliability), time, procedure**: The MNA was performed in addition to anthropometric measures; dermatologic, hematologic, and subjective assessments were also included. The MNA was found to have a sensitivity and specificity of 95% and 64% respectively, and predictive value of 80%. Measurement was initiated within 48 hours of patient admission, MNA scores were obtained, followed by integumentary assessment and blood collection for "for the	**Statistical Procedures(s) and Results**: The Chi-square and ANOVA tests were performed, with significance established at $p < 0.05$; the MNA identified 22% of participants as being malnourished, 55% found to be at risk for malnutrition, and 24% had a stable nutritional status. MNA scores had a negative correlation with age ($r2 = -0218$, $p = 0.025$) and linear correlation with body mass index (BMI) ($r2 = 0.203$, $p = 0.037$).

		Power analysis: Not reported. **Group Homogeneity**: Homogenous sample based on demographic attributes.		white blood cell count and albumin, cholesterol, folic acid, phosphorus, magnesium, zinc and vitamins A, C, D, E andB12 measurements."	
Citation: Cereda, E., Pedrolli, C., Klersy, C., Bonardi, C., Quarleri, L., Cappello, S., Turri, A., Rondanelli, M., & Caccialanza, R. (2016). Nutritional status in older persons according to healthcare setting: A systematic review and meta-analysis of prevalence data using MNA®. *Clinical Nutrition (Edinburgh, Scotland)*, *35*(6), 1282–1290. https://doi.org/10.1016/j.clnu.2016.03.008					Level V
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"We aimed to provide a quantitative synthesis of prevalence data on malnutrition and its risk as assessed by the Mini Nutritional Assessment across different healthcare settings."	Systematic review with meta-analysis.	**Search strategy**: A search of the PubMed database was conducted by two authors for non-interventional studies published in full-text through December of 2014; the search was conducted using key terms such as "nutrition", "assessment", and "mini nutritional assessment". Additional articles were also identified through a manual search of the European e-Journal of Clinical Nutrition and	**Control**: Not applicable to reviews of descriptive and qualitative studies. **Intervention**: Utilization of the MNA within different healthcare settings. Among included studies, the MNA was used in community, home-care, hospital, LTC, and rehabilitation/sub-acute care settings for patients over the age of 60. Points were	**Dependent Variable**: Nutritional status/condition of malnutrition. **Measurement tool (reliability), time, procedure**: The full form MNA was utilized within included studies to identify and score malnourished patients across various settings. Heterogeneity in terms of the prevalence of malnutrition was examined through meta-regression and stratified analysis; estimates concerning the role of patient	**Level of Measurement**: Meta-analysis was performed for the inclusive studies concerning nutritional status and the levels of dependence associated with several patient settings. **Outcome Data**: Researchers pooled prevalence data of malnutrition and risk of malnutrition among selected articles using DerSimonian-Lairdrandom-effect

		Metabolism. **Eligible**: Original research studies that utilized the full MNA tool. **Excluded**: Studies that were based on use of the MNA short-form, a modified version of the MNA, and versions that had not been validated. Studies with participants under the age of 60 were also excluded. **Accepted**: 283 studies were included for qualitative assessment and 240 selected for the analysis; there was a total patient population of n = 113,967, where inclusion in the meta-analysis required the number or percentage of malnourished participants had to be established.	assigned to each study based on quality, in terms of population, random sampling, sample size, exclusion criteria, and response rate using the proposed tool by Loney et al. **Intervention fidelity**: Not applicable to this design. .	setting on nutrition were also calculated, in terms of establishing levels of dependence.	model. Meta-regression of all accepted studies indicated that malnutrition and the risk for malnutrition had an explicit association with patient levels of dependence within specific settings ($p < 0.001$). **Conclusions**: Researchers found that while the prevalence of malnutrition had significant variations among different settings, the MNA showed that LTC and sub-acute care/rehabilitation settings were prone to have higher rates of malnutrition, 28.7% (95% CI, 21.4-36.0) and 29.4% (95% CI, 21.7-36.9) respectively.

		PRISMA: The data within this systematic review was reported to agree with PRISMA guidelines. **Power analysis**: Not applicable to this design.			
Citation: Feldblum, I., German, L., Castel, H., Harman-Boehm, I., & Shahar, D. R. (2011). Individualized nutritional intervention during and after hospitalization: The nutrition intervention study clinical trial. *Journal of the American Geriatrics Society*, *59*(1), 10–17. DOI: 10.1111/j.1532-5415.2010.03174.x					Level II
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"To test the hypothesis that individualized nutritional treatment during and after discharge from acute hospitalization will reduce mortality and improve nutritional outcomes."	RCT	**Sampling Technique**: Randomized, based in 4 medical units. **Eligible**: Hospitalized patients over the age of 65, with recent weight loss and risk for malnutrition. **Excluded**: Patients with a "current diagnosis of cancer, cognitive impairment (Mini Mental State Examination (MMSE) score <23), an inability	**Control**: Patients received standard care, a single visit from a dietician, and no planned interventions after discharge. **Intervention**: Patients received dietician-provided individualized treatment and 3 scheduled visits at home following their discharge. **Intervention fidelity**: Both the control and	**Dependent Variable**: Patient mortality, nutritional outcomes, and overall health status. **Measurement tool (reliability), time, procedure**: Measurement of the dependent variable was performed using the MNA, dietary intake recall, and biochemical testing at baseline and 6 months following the intervention. Measurements were conducted by investigators blinded to the intervention group,	**Statistical Procedures(s) and Results**: The Kahn's method was employed for statistical analysis, using SSPS, and comparison between groups was performed using the t-test. The Chi-square test was used to compare proportions, and a general linear model was used to evaluate changes over the trial. At the conclusion of the study, MNA scores were significantly higher for the group receiving the

		to be interviewed, language difficulties, or an unwillingness to provide informed consent." **Accepted**: 259 patients age 65 or older. **Control**: 181 patients; 58/181 withdrew and 21/181 expired. **Intervention**: 78 patens; 9/78 withdrew and 3/78 expired. **Power analysis**: Not reported. **Group Homogeneity**: Researchers report on the heterogeneity of the population's state of health and food choices, supporting the need for individualized treatment.	intervention groups were evaluated using the MNA, the nutritional intervention was supported by "Nutrition Screening Initiative (NSI), a project of the American Academy of Family Physicians, the American Dietetic Association, and the National Council of Aging" recommendations; intensity was determined by the degree of malnutrition and presence of other health problems, and the goals for patient treatment were based on MNA scores.	also including scores for cognitive and functional status, as well as depression. Monthly contact was established over the telephone to support participation, and follow-up evaluations were performed at 3 and 6 months; no reliability data provided.	intervention (3.01 ± 2.65 vs. 1.81 ± 2.97, P = .004). Concerning biochemical measurements, 22.9% of control group participants had an albumin level of <3.5, compared to 9.7% of intervention group participants (p = .03), and mortality was found to be significant higher in the control group (11.6%, p = .046).
Citation: Isautier, J. M., Bosnić, M., Yeung, S. S., Trappenburg, M. C., Meskers, C. G., Whittaker, A. C., & Maier, A. B. (2019). Validity of nutritional screening tools for community-dwelling older adults: A systematic review and meta-analysis. *Journal of the*					Level V

American Medical Directors Association, *20*(10), 1351. DOI: 10.1016/j.jamda.2019.06.024					
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"The aim of this systematic review was to summarize the validity of nutritional screening tools to detect the risk of malnutrition in community-dwelling older adults."	Systematic review with meta-analysis.	**Search strategy**: A search of PubMed, EMBASE, CINAHL, and Cochrane databases was conducted by two authors using key terms such as "malnutrition", "community-dwelling", and "screening" for articles published from 2001 to 2018. **Eligible**: Articles featuring validation studies of all nutritional screening tools which had been verified against a reference standard. **Excluded**: Studies with populations consisting of fewer than 50% of community-dwelling older adults and screening tools which included laboratory values.	**Control**: Not applicable to reviews of qualitative studies. **Intervention**: "Meta-analyses were performed on the diagnostic accuracy of identified nutritional screening tools validated against the Mini Nutritional Assessment-Long Form (MNA-LF)." **Intervention fidelity**: Not applicable to this design. .	**Dependent Variable**: The validity of nutritional screening tools. **Measurement tool (reliability), time, procedure**: Measurement of the dependent variable included evaluation of cutoff points for malnutrition or the risk of malnutrition, sensitivity and specificity, positive predictive value, negative predictive value, area under the curve (AUC), and correlation coefficient and kappa. Validity of a screening tool was deemed "good" if sensitivity and specificity were ≥80%, AUC was ≥0.8, the correlation coefficient was ≥0.75, or with kappa ≥0.6.	**Level of Measurement**: Meta-analysis was performed for the studies included in this review. **Outcome Data**: Using the MNA-LF as a reference standard, researchers reported an average sensitivity and specificity of 0.95 (95% CI 0.75-0.99) and 0.95 (95% CI, 0.85-0.99) for the Mini Nutritional Assessment-Short Form (MNA-SF), 0.85 (95% CI, 0.80-0.89) and 0.87 (95% CI, 0.86-0.89) for the MNA-SF version 1, and 0.85 (95% CI, 0.77-0.89) and 0.84 (95% CI, 0.79-0.87) for the MNA-SF version 2. **Conclusions**: Researchers concluded that the MNA-SF, MNA-SF version 1, and MNA-SF version 2

		Accepted: 35 articles were included for qualitative assessment and 9 were selected for meta-analysis; there was a median sample size of 283 participants, with a median age of 74 years. **PRISMA**: The data within this systematic review was reported to follow PRISMA guidelines. **Power analysis**: Not applicable to this design.			"showed good sensitivity and specificity to detect community-dwelling older adults at risk of malnutrition validated against the MNA-LF", providing evidence to support using a cutoff of <11 points for detecting the risk of malnutrition in older adults.
Citation: Kaiser, M. J., Bauer, J. M., Rämsch, C., Uter, W., Guigoz, Y., Cederholm, T., Thomas, D. R., Anthony, P. S., Charlton, K. E., Maggio, M., Tsai, A. C., Vellas, B., & Sieber, C. C. (2010). Frequency of malnutrition in older adults: A multinational perspective using the mini nutritional assessment. *Journal of the American Geriatrics Society*, *58*(9), 1734–1738. DOI: 10.1111/j.1532-5415.2010.03016.x					Level V
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"The aim of the present study was to pool existing international data on the MNA from high-quality trials (published in peer-reviewed journals) in	Retrospective pooled analysis	**Search strategy**: A search of the PubMed database was performed for trials that utilized the MNA.	**Control**: Measurements of BMI, c-reactive protein, and triceps skin folding. **Intervention**:	**Dependent Variable**: The prevalence of malnutrition in elderly patients. **Measurement tool (reliability), time, procedure**: The MNA	**Level of Measurement**: From the combined data sets, descriptive statistics were provided, along with narrative discussion.

one large database and to provide information on the prevalence of malnutrition in older persons on a larger scale."		**Eligible**: Research studies that preferably utilized the full MNA and had a clearly identified setting. **Excluded**: Studies performed before the year 2000. **Accepted**: 24 studies from 12 different counties, including a total of 4,507 participants, from hospital, LTC/rehabilitation, and community settings, over the age of 65. **PRISMA**: Specification for PRISMA criteria not reported. **Power analysis**: Not applicable to this design.	Evaluation of nutritional status using the MNA within hospital, rehabilitation, and community settings. **Intervention fidelity**: Not applicable to this design.	was utilized to assess nutritional status of patients within the specified settings; anthropometric and dermatologic measurements were also included.	**Outcome Data**: Overall, malnutrition was found to have a prevalence of 22.8%, and 46.2% of participants were found to be at risk for malnutrition, with higher rates within specific settings such as rehabilitation (50.5%), hospital (38.7%), and nursing home (13.8%). **Conclusions**: Researchers concluded that the significance and prevalence of malnutrition was identified using the MNA across various settings, with the exception of community settings which were found to have the lowest rate; the MNA was found to have global relevance with specific regard to elderly patients, allowing for early identification of malnutrition.

Citation: Lin, S.-C., Lin, K.-H., Lee, Y.-C., Peng, H.-Y., & Chiu, E.-C. (2019). Test-retest reliability of the mini nutritional assessment and its relationship with quality of life in patients with stroke. *PLoS ONE*, *14*(6), 1–8. https://doi.org/10.1371/journal.pone.0218749					Level IV
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"This study aimed to examine test-retest reliability of the MNA and its relationship with QOL in patients with stroke."	Quasi-experimental study (with a "repeated-assessments design").	**Sampling Technique**: Convenience. **Eligible**: Patients with a history of chronic stroke. **Excluded**: Participants with medical instability with a potential for readmission, patients with a nasogastric tube, and significant cognitive deficits. **Accepted**: 59 patients. **Control**: Not applicable to this study. **Intervention**: 59 patients.	**Control**: Not applicable to this study. **Intervention**: Implementation of the MNA and WHO Quality of Life-BREF (WHOQOL-BREF) assessment. **Intervention fidelity**: The MNA and WHOQOL-BREF assessments were performed by a dietician; assessment and demographic data was collected upon the initial visit, and again in 1 week.	**Dependent Variable**: Nutritional status and association with quality of life. **Measurement tool (reliability), time, procedure**: Measurement took place using the MNA and WHOQOL-BREF assessments at baseline and again in 7 days, to establish test-retest reliability for consistency; a face-to-face format was used for assessment in this study.	**Statistical Procedures(s) and Results**: Pearson correlation coefficients (*r*) were employed to evaluated any associations among the MNA and WHOQOL-BREF assessments; a linear regression analysis was also performed using SPSS for further detail. The MNA was found to have high test-retest reliability with an intraclass correlation coefficient (ICC) of 0.91 (95% CI, 0.85-8.94). The MDC (minimal detectable change) reported was 2.1, being 8.2% and noted as acceptable; following linear regression the MNA was reported to have a significant association to the WHOQOL-BREF (r^2 = 0.104; p =

		Power analysis: Not reported. **Group Homogeneity**: Homogenous sample based on demographic data.			0.008).
Citation: Yatabe, M. S., Taguchi, F., Ishida, I., Sato, A., Kameda, T., Ueno, S., Takano, K., Watanabe, T., Sanada, H., & Yatabe, J. (2013). Mini nutritional assessment as a useful method of predicting the development of pressure ulcers in elderly inpatients. Journal of the American Geriatrics Society, 61(10), 1698–1704. DOI: 10.1111/jgs.12455					Level IV
Purpose/ Hypothesis	Design	Sample	Intervention	Outcomes	Results
"To determine the usefulness of the Mini Nutritional Assessment (MNA) and plasma amino acid analysis in predicting the formation of pressure ulcers (PUs) in inpatients."	Prospective, observational cohort study	**Sampling Technique**: Convenience. **Eligible**: Consecutive patient admissions to intermediate and acute care units. **Excluded**: Participants with incomplete data and existing PUs. **Accepted**: 422 patients. **Control**: Not applicable to this study.	**Control**: Not applicable to this study. **Intervention**: Implementation of the MNA, Subjective Global Assessment (SGA), Braden Scale, and biochemical testing. **Intervention fidelity**: The MNA and SGA were performed by 2 nutritionists, and a registered nurse with wound certification performed Braden Scale assessments;	**Dependent Variable**: Nutritional status and PU formation. **Measurement tool (reliability), time, procedure**: Measurements were performed using the MNA, SGA, Braden Scale, and biochemical testing; the MNA was reported to have a sensitivity and specificity of 97% and 42% respectively in the prediction of PUs. Measurements were performed following admission, and physical examination of patient skin was performed	**Statistical Procedures(s) and Results**: Statistical analysis was performed by researches without direct involvement in data collection; unpaired t-tests were used to analyze differences between groups who did and did not develop a PU. Pair-wise tests and multiple regression analysis were conducted with an established significance of $p < .05$. 7.1% of patients were reported to have developed a PU, along with lower BMI and notably lower plasma arginine levels.

		Intervention: 422 patients. **Power analysis**: Not reported. **Group Homogeneity**: Homogenous sample based on demographic attributes.	hematological testing included was performed on admission and included "total protein, albumin, C-reactive protein, aspartate amino transferase, alanine amino transferase, cholinesterase (ChE), blood urea nitrogen, creatinine, triglyceride (TG), and fasting plasma glucose (Hitachi Autoanalyzer 7070, Hitachi High-Technologies Corp., Tokyo, Japan) and complete blood count (XT-1800i, Sysmex, Kobe, Japan)."	daily and the development of new PUs was evaluated at biweekly intervals using the DESIGN-R PU scale.	Using the MNA, only 5 patients were identified as being well-nourished, over 96% of patients who developed a PU had an MNA score of <8 (considered malnourished); MNA scores <8 were found to be more sensitive than combined interpretation of SGA and Braden Scale scores. Multiple logistic regressions found an independent and significant association between the MNA and PU development in all patients after adjustments were made for "age, sex, and BMI." With further adjustments for total protein and ChE for example, only the MNA displayed a significant association with developing a PU (95% CI, 0.546-0.937) ($p = 0.01$).

Appendix C

Synthesis Table

Synthesis of evidence for implementation of the Mini Nutritional Assessment (MNA)

Evidence Based Practice Question (PICO): Does early recognition of malnutrition in geriatric patients, through assessment upon admission and at monthly intervals reduce skin breakdown through timely intervention?			
Level of Evidence	**# of Studies**	**Summary of Findings**	**Overall Quality**
II	**1**	Feldblum et al. (2011) found that MNA scores were significantly higher for patients receiving individualized dietary treatment along with scheduled follow-up (3.01 ± 2.65 vs. 1.81 ± 2.97, P = .004), and overall, patients receiving standard care were noted to have a significantly higher mortality rate (11.6%, p = .046). Researchers summarize that individualized attention to nutrition resulted in lower mortality, improved nutritional status, and the validated MNA tool was successful in identifying nutritional status and the determination of treatment goals.	B, the randomized, controlled designed added strength to internal validity, and exclusion criteria were appropriate and sample size was adequate. While measurement was consistent, minimal consideration was given to heterogeneity. Conclusions were clearly stated, limitations were evaluation, and the study appears credible.
IV	**3**	Calvo et al. (2012) report the MNA to have a sensitivity and specificity of 95% and 64% respectively, identifying 22% of patients as being malnourished and 55% at risk for malnutrition. The MNA was found to be accurate and have predictive value, and routine use of the MNA on patient admission is recommended. Lin et al. (2019) report the MNA to have high test-retest reliability with an intraclass correlation coefficient (ICC) of 0.91 (highly reliable) (95% CI, 0.85-8.94); researchers conclude that the MNA is reliable and useful for repeat assessment of nutritional status, in terms of identifying	B, while this was a non-randomized study, there was a homogenous sample, exclusion criteria was appropriate, measurements consistent and analysis was appropriate. Conclusions and recommendation were clearly stated. B, given the design of the study and smaller sample size, homogeneity was established, exclusion criteria was appropriate and measurement tools and intervals were effective. Statistical analysis and results were conclusive, and overall the study appears to have credibility.

		changes, and supporting treatment plans and quality of life. Yatabe et al. (2013) found that the development of pressure ulcers (PUs) correlated with an MNA score of <8 (sensitivity and specificity of 97% and 42%), being more sensitive than a combination of SGA and Braden Scale interpretations. Multiple logistic regressions found a significant association between MNA scores and PU development in all participants following adjustments for body mass index and age for example (95% CI, 0.546-0.937) (p = 0.01). A summary of findings support the use of the MNA in predicting the risk of PUs and brining about necessary interventions.	B, this prospective, observational cohort study had an adequate sample of 422 patients, appropriate exclusion criteria, and included a reflection of additional tools. Measurements were consistent and statistical analysis clearly represented. Limitations were identified, conclusions were quite clear, and the study appears to have sound credibility.
V	**2**	Cereda et al. (2016) report that malnutrition and the risk for such was notably associated with levels of patient dependence within certain settings (p < 0.001), showing that LTC and sub-acute care/rehabilitation settings had higher rates of malnutrition, 28.7% (95% CI, 21.4-36.0) and 29.4% (95% CI, 21.7-36.9); researchers explain that the MNA is presently recommended by international guidelines and provides consideration of factors which may be responsible for "sarcopenia and frailty". In summary, there is a clear need for mandatory nutritional assessment and subsequent intervention, however amendment may be required to be effective within different in patient settings. Kaiser et al. (2010) found malnutrition to have higher rates of prevalence within specific settings such as rehabilitation (50.5%), hospitals (38.7%), and nursing homes (13.8%), with 46.2% of patients noted to be at risk for malnutrition; the MNA is regarded to have global relevance, allowing for early identification of nutritional deficits, specifically in elderly patients.	C, unfortunately this was a systematic review of non-interventional studies, so no controlled or randomized trials were involved. The search strategy and sample size was sufficient, however PRISMA criteria and power analysis was not present. While measurement was consistent and the MNA was successful in identifying malnutrition, researchers recommend further investigation. B, the design of the study supported internal validity, however PRISMA decision making criteria was not disclosed. Consistency was present and there was an adequate sample size, there was an appropriate search strategy, and limitations were discussed; overall appear credible.

		Researchers endorse the mini nutritional assessment (MNA) as a means for evaluating nutritional status in older patients, with features specific to this population.	

Appendix D

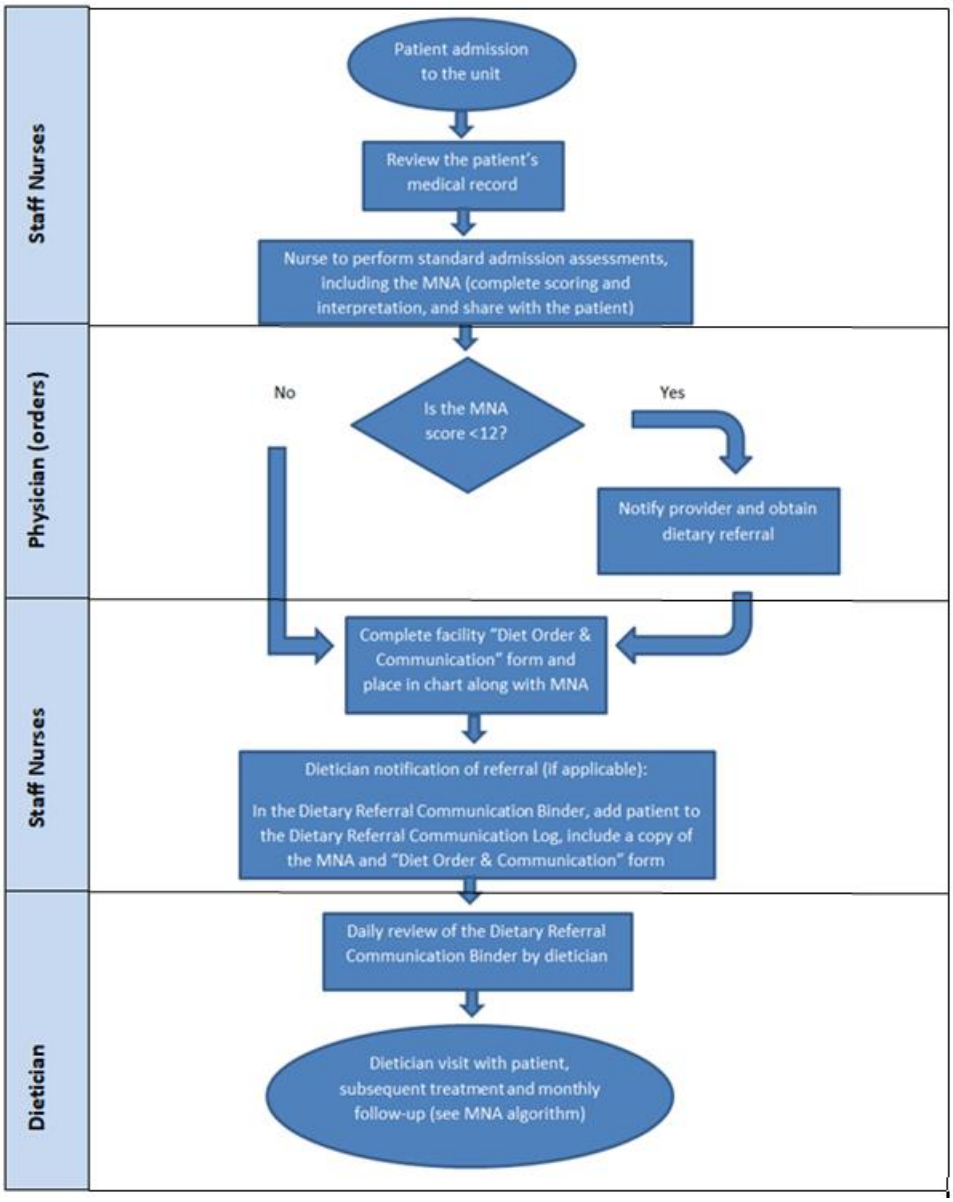
Mini Nutritional Assessment (MNA) Lesson Plan

Learning Objectives	Content Outline	Method of Instruction	Time Spent	Method of Evaluation
Discuss the purpose of the MNA and associated benefits	• Identification of malnutrition or the risk for malnutrition • Timely intervention • Reduction of complications such as wounds and deterioration, reduced risks of morbidity and mortality • The MNA is validated/ reliable and efficacious	Instructional video and direct instruction/ didactic with supplemental printed user guide	Approximately 11 minutes for the instructional video, 8 minute review of the user guide, and 6 minutes for any questions (incorporates subsequent objectives)	Teach-back method
Describe each section of the MNA and steps for completion	• Complete patient information and anthropometric section before beginning the MNA • Begin screening and record the appropriate value for each section • Address food intake (for decline) • Address weight loss (involuntary) • Address mobility • Presence of recent acute illness or psychological stress • Presence of neuropsychological problems • Determine body mass index (BMI) or calf circumference • Add all recorded values to obtain a final score	Instructional video and direct instruction/ didactic with supplemental printed user guide	Approximately 11 minutes for the instructional video, 8 minute review of the user guide, and 6 minutes for any questions (incorporates previous and subsequent objectives)	Staff demonstration ; observe and provide feedback
Explain MNA score interpretation and identify recommendation for intervention	• Maximum of 14 points • Score of 12-14 indicates normal nutritional status • Score of 8-11 indicates a risk for malnutrition • Score of 0-7 indicates malnutrition • For a normal nutritional status re-screen at quarterly intervals • For risk of malnutrition perform close monitoring of weight • For malnutrition perform nutritional intervention, diet augmentation and	Instructional video and group discussion with supplemental printed user guide	Approximately 11 minutes for the instructional video, 8 minute review of the user guide, and 16 minutes for discussion and questions (incorporates previous objectives)	Teach-back method

	supplementation and close monitoring of weight			
Outline the entire procedure for facility implementation of the MNA	• Review the patient's medical record on admission • Explain the purpose of the MNA and obtain verbal consent • Perform the MNA on admission by asking the patient questions from each section (or use information from their medical record if needed) • Complete MNA scoring and interpretation and share with the patient • Provider notification for scores <12 and obtain dietary referral • Place the MNA form in the patient's chart • Complete the facility "Diet Order & Communication" form and place in the patient's chart • Notify dietician (if applicable) by entering the patient into the Dietary Referral Communication Binder, completing the log, and placing copies of the MNA and "Diet Order & Communication" form	Didactic review of the MNA implementation procedure with accompanying handout for visual	Approximately 15 minutes for complete review of the entire procedure and necessary materials/resources	Staff demonstration; observe and provide feedback

Appendix E

Mini Nutritional Assessment (MNA) Implementation Procedure



Appendix F

Mini Nutritional Assessment (MNA) Implementation Audit Tool

Date	Shift	Age	Gender	MNA Performed (Yes= 1, No= 0)	MNA Score	Malnourished or At Risk for Malnutrition (0-11 points) (Yes= 1, No= 0)	Dietary Referral Ordered (Yes= 1, No= 0)	Code for Admitting Nurse

Appendix G

Mini Nutritional Assessment (MNA) Permission

Gmail Dmitry Bederak <dbederak26@gmail.com>

Question

Janet Skates <janetskates@charter.net> Tue, Jan 28, 2020 at 6:50 PM
To: Dmitry Bederak <dbederak26@gmail.com>

Dear Dmitry,

Thank you for your interest in Nestlé's Mini Nutritional Assessment (MNA®). There is no charge for using the MNA®. Users may download the MNA® form from the MNA® website (www.mna-elderly.com) and are free to use it as long as absolutely no changes are made to the MNA® form as downloaded from the website). If you want to include the MNA® in any publication or web-based product or service or electronic health record or any other use other than simple using the form in clinical practice, you must request permission by sending your request to this same e-mail with a detailed explanation of the intended use.

I hope you found this information useful. Please let me know if you have further questions.

Kind regards,

Janet Skates

Nestlé Health Science Consultant

MNA® Mini Nutritional Assessment Application

janetskates@yahoo.com