

Outcomes of Continuous Process Improvement of Nutritional Care Program Among Geriatric Units

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Background. Up to 65% of elderly patients are protein-calorie undernourished at admission or acquire nutritional deficits while hospitalized. The aims of this project were: (a) to assess the quality of care concerning nutrition among Belgian geriatric units, (b) to include more routinely nutritional assessments and interventions in comprehensive geriatric assessment, and (c) to assess the impact of nutritional recommendations on nutritional status and on the length of hospitalization.

Method. We studied 1139 patients consecutively admitted to 12 geriatric units of general hospitals prospectively for 6 months (from January through June 2001). All patients underwent a comprehensive geriatric assessment. For the first 3 months, the nutritional status of the patients on admission and at discharge were assessed without particular recommendations for nutritional intervention. A standardized nutritional intervention was proposed for the last 3 months.

Results. Median value of the Mini Nutritional Assessment test score was 18 points (range 9–29), mean admission's serum prealbumin concentration was 0.185 ± 0.076 g/L, and C-reactive protein was 5.3 ± 7.5 mg/100 ml. Hospitalization stay was significantly lower during the interventional period than during the observational period. A higher mean serum prealbumin concentration variation was observed during the interventional period as compared to the observational period.

Conclusions. Nutritional assessment should be part of routine clinical practice in elderly hospitalized patients. A comprehensive screening tool for assessment of nutritional status is needed that is clinically relevant and cost effective to perform. If malnutrition is suggested by such screening tests, then a supplemental conventional nutritional assessment should be performed before treatment is planned.

NUTRITIONAL status is an important determinant of health, especially for the older hospitalized patient. Up to 65% of elderly patients are protein-calorie undernourished at admission or acquire nutritional deficits while hospitalized. Once established, the nutritional deficits place the patient at increased risk of developing subsequent in-hospital complications, the likelihood of developing a complication increasing in direct relation to the severity of the nutritional deficits. In approximately one third of cases, this risk becomes substantial. These severely undernourished patients often enter a cycle of progressive clinical deterioration. Their hospital stay may be up to twice as long (1), and they experience 2 to 20 times higher complication and death rates compared to patients with the same pathologies, but who are well nourished (2,3). Because of their severe nutritional deficits, patients are often unable to recover from one physiologic insult prior to developing a second. For those who survive the hospitalization and do not receive adequate nutritional support, the nutritional deficits often persist for variable periods subsequent to discharge (4–6). Patients who remain undernourished at discharge have substantially increased rates of early hospital readmission and 1-year mortality. In contrast, the continuous process improvement of nutritional care program is able to improve the outcomes of geriatric patients (7).

The aims of this project were: (a) to assess the quality of care concerning nutrition among Belgian geriatric units, (b) to include more routinely nutritional assessments and interventions in comprehensive geriatric assessment, and (c) to assess the impact of nutritional recommendations on nutritional status and on the length of hospitalization.

METHODS

Patients

Our study included 1139 patients consecutively admitted on the basis of feasible complete assessment. Patients were hospitalized in 12 geriatric units from 12 different hospitals. The admission policies are based on the “geriatric” characteristics of the “geriatric patient”: polypharmacy, polypathology, poor homeostasis (frailty), dependence in activities of daily living, and mental, psychological, and/or social problems. Age is not the predominant factor, although its median was 84 years. All patients underwent the comprehensive geriatric assessments to characterize medical, psychiatric, therapeutic, social, functional, and nutritional problems.

Study Design

This study was a prospective observational and interventional 6-month trial (from January through June 2001). For the first 3 months, the nutritional status of the patients on admission and at discharge was assessed without particular recommendations for nutritional intervention (observational study—Phase 1). A standardized nutritional intervention was proposed for the last 3 months (intervention study—Phase 2).

Nutritional Evaluation

Mini nutritional assessment.—Nutritional assessment used the mini nutritional assessment (MNA) test (8,9). The MNA test is composed of the following simple measurements and rapid questions to be performed in less than 10

Table 1. Characteristics of 1139 Consecutive Admissions Between January and June 2001

Descriptive Statistics	Mean or %	Median	Minimum	Maximum	SD
Phase 1	61%				
Phase 2	39%				
Women	70%				
Stay, d	25.1	20.0	1.0	223.0	19.9
Age, y	82.9	83.0	54.0	104.0	7.3
Mini-MNA, points	8.4	9.0	2.0	14	3.2
MNA, points	18.1	18.5	2.0	29.0	5.5
Admission					
PAB, mg/100 ml	18.5	18	1	90	7.6
CRP, mg/100 ml	5.3	2.3	0.10	51.6	7.5
Lymphocyte count, per mm ³	1401	1353	11	3972	653
Discharge					
PAB, mg/100 ml	17.4	18.6	1	18	10.5
CRP, mg/100 ml	3.6	1.2	.1	79.3	7.2
Lymphocyte count, per mm ³	1527	1443	80	5200	669
Nutritional intervention					
Caloric supplementation	22%				
Enteral	2%				
Parenteral	1%				

Note: SD = standard deviation; MNA = Mini Nutritional Assessment; Mini-MNA = short-form of MNA; PAB = serum prealbumin concentration; CRP = C-reactive protein.

minutes: (a) anthropometric measurements, (b) dietary questionnaire, (c) global assessment, and (d) subjective assessment (self-perception of health and nutrition). The scoring of each part allows researchers to identify elderly patients with adequate nutrition and those who are either at risk of malnutrition or who are malnourished.

Biochemical markers.—Serum prealbumin (PAB) determination was performed by rate nephelometry. A PAB concentration lower than 170 mg/L is usually associated with a risk of malnutrition (7). Measurement of serum C-reactive protein (CRP) was performed systematically to assess the inflammatory process and the possible endogenous component of malnutrition. Both these measurements were taken on the third day after admission and at discharge.

Nutritional Intervention

The staff participating in the project received information about this intervention for the last 3 months. Nutritional intervention was started when risk of malnutrition was established as an MNA score < 23.5 and/or a PAB < 0.2 g/L. When the presence of nutritional risk had been established, the physician in charge identified treatable causes of malnutrition using the "meals on wheels" approach (10) (Appendix 1), and caloric supplementation was initiated. This nutritional intervention was monitored during hospitalization; if PAB did not increase, enteral (tube feeding) or parenteral nutrition was initiated (Appendix 2).

Statistics

Data were collected in a database using Access software (Microsoft, Redmond, WA), and statistical analyses were

Table 2. Characteristics of Patients According to Period

Characteristic	Phase I (Observational Period)		Phase II (Interventional Period)		p Value
	Mean or %	SD	Mean or %	SD	
Women	70%		70%		NS
Stay, d	27.1	21.9	21.7	15.1	<.001
Age, y	82.8	7.3	83.1	7.2	NS
Mini-MNA, points	8.3	3.2	8.7	3.2	NS
MNA, points	17.9	5.5	18.2	5.4	NS
Admission					
PAB, mg/100 ml	18.3	7.3	18.7	7.9	NS
CRP, mg/100 ml	5.5	7.6	5.2	7.2	NS
Lymphocyte count per mm ³	1405	617	1395	701	NS
PAB/CRP ratio	22.2	44.6	23.6	72.3	NS
Discharge					
PAB, mg/100 ml	17.2	8.9	17.6	12.9	NS
CRP, mg/100 ml	3.7	7.8	3.4	6.1	NS
Lymphocyte count per mm ³	1552	665	1493	676	NS
PAB/CRP ratio	23.5	29.9	27.5	41.3	NS
Nutritional intervention					
Caloric supplement	20%		25%		<.01
Enteral	2%		6%		NS
Parenteral	<1%		<1%		NS

Note: SD = standard deviation; MNA = Mini Nutritional Assessment; Mini-MNA = short-form of MNA; PAB = serum prealbumin concentration; CRP = C-reactive protein; NS = not significant.

performed with Statistica 5 (Microsoft). Results from groups of patients are presented as means \pm standard deviation. The paired Student *t* test was used to assess the difference of the values of the parameters between admission and discharge. The nonpaired Student *t* test was used to compare means of the parameters between the periods of the study (observational [Phase 1] vs interventional [Phase 2]). *Z* score with Yates correction was used to assess the differences between proportions of conditions.

RESULTS

Table 1 shows the characteristics of 1139 patients consecutively admitted between January and June 2001. Mean age was 82.9 ± 7.3 years, 70% of the patients were women, MNA was measurable in 833 cases (73%) with a median value of 18.5 points (range 9–29), mean admission's PAB concentration was 18.5 ± 7.6 mg/100 ml, and CRP was 5.3 ± 7.5 mg/100 ml. The limited number of registrations for MNA represents the difficulty to obtain valid data from patients presenting cognitive impairments.

The characteristics of the patients according to the study phase (Phase 1 vs Phase 2) are presented in Table 2. Hospitalization stay was significantly shorter during the Phase 2 than during Phase 1 (21.7 ± 15.1 vs 27.1 ± 21.9 days, $p < .001$). The other basal parameters did not differ according to the phase of study.

The proportion of patients receiving caloric supplementation significantly increased during the interventional period (20%–25% of patients; $p < .01$). Admission PAB

Table 3. Determinants of Admission PAB

Admission PAB and:	Spearman's R	p Value
Hospital stay	-.04	NS
Age	-.06	NS
Mini-MNA	.26	<.0001
MNA	.33	<.0001
Admission:		
CRP	-.46	<.0001
Lymphocyte count	.16	<.0005
Discharge:		
PAB	.37	<.0001
CRP	-.20	<.0001
Lymphocyte	.04	NS
PAB changes	-.43	<.0001
CRP changes	.37	<.00001
Lymphocyte changes	-.12	<.0005
Multiple Regression Analysis including MNA, admission CRP, and lymphocyte count (adjusted $R^2 = .27, p < .0000$)		
Variable	β	
MNA	.27	
Admission CRP	-.40	
Admission lymphocyte count	.01	

Note: MNA = Mini Nutritional Assessment; Mini-MNA = short-form of MNA; PAB = serum prealbumin concentration; CRP = C-reactive protein; NS = not significant.

concentration correlated positively with MNA and negatively with admission CRP (Table 3). Multiple regression analysis showed that MNA appeared to be determinant of admission PAB/CRP ratio (Table 4). Multiple regression analysis including MNA, admission CRP, and lymphocyte count did not show a determinant factor for PAB variation (adjusted $R^2 = .020, p < .187$) (Table 5).

Table 4. Determinants of Admission PAB/CRP Ratio

PAB/CRP Ratio and:	Spearman's R	p Value
Stay	-.08	<.05
Age	-.02	NS
Mini-MNA	.21	<.0001
MNA	.20	<.0001
Admission		
PAB	.64	<.0001
CRP	-.96	<.0001
Lymphocyte count	.22	<.0001
Discharge:		
PAB	.14	<.0001
CRP	-.43	<.0001
Lymphocyte count	.03	NS
PAB/CRP	.32	<.0001
Multiple Regression Analysis including stay, MNA, and admission lymphocyte count (adjusted $R^2 = .01, p < .080$)		
Variable	β	
Stay	.043	
MNA	.124	
Admission lymphocyte count	.020	

Note: MNA = Mini Nutritional Assessment; Mini-MNA = short-form of MNA; PAB = serum prealbumin concentration; CRP = C-reactive protein; NS = not significant.

Table 5. Determinants of PAB Variations

PAB Variations and:	Spearman's R	p Value
Stay	-.002	NS
Age	-.02	NS
Mini-MNA	-.11	<.01
MNA	.09	<.05
Admission		
PAB	-.43	<.0001
CRP	.31	<.0001
Lymphocyte count	-.13	<.005
PAB/CRP	-.39	<.0001
Discharge		
PAB	.53	<.0001
CRP	-.09	<.05
Lymphocyte count	.06	NS
PAB/CRP	.37	<.0001
CRP changes	-.34	<.0001
Lymphocyte count changes	.23	<.0001
Multiple Regression Analysis including MNA, admission CRP, and lymphocyte count (adjusted $R^2 = .020, p < .187$)		
Variable	β	
MNA	-.10	
CRP	.098	
Admission lymphocyte count	-.05	

Note: MNA = Mini Nutritional Assessment; Mini-MNA = short-form of MNA; PAB = serum prealbumin concentration; CRP = C-reactive protein; NS = not significant.

Comparison between admission and discharge values (paired Student *t* test) is shown in Table 6. Considering the whole group, mean PAB values did not change; however, as compared with their values at admission, CRP was significantly lower, and lymphocyte count higher, at discharge. The significantly decreased PAB values at discharge observed during the Phase 1 was no more obvious during Phase 2. MNA scores and admission PAB/CRP levels were

Table 6. Comparison Between Admission and Discharge Values (Paired Student's *t*)

Values	Admission		Discharge		p
	Mean	SD	Mean	SD	
Whole group					
PAB, mg/100ml	18.3	7.6	17.6	10.6	NS
CRP, mg/100ml	5.5	7.4	3.6	7.2	<.0001
Lymphocyte count	1404	656	1539	657	<.0001
PAB/CRP ratio	22	61	25	33	NS
Phase 1					
PAB, mg/100 ml	18.3	7.3	17.4	8.8	<.05
CRP, mg/100 ml	5.5	7.4	3.7	7.8	<.0001
Lymphocyte count	1413	609	1556	664	<.0001
PAB/CRP ratio	20	45	24	30	NS
Phase 2					
PAB, mg/100 ml	18.1	8.0	17.9	13.2	NS
CRP, mg/100 ml	5.4	7.4	3.4	6.1	<.0001
Lymphocyte count	1390	722	1314	671	<.005
PAB/CRP ratio	25	84	28	38	NS

Note: SD = standard deviation; PAB = serum prealbumin concentration; CRP = C-reactive protein; NS = not significant.

Table 7. Determinants of Hospitalization Stay

Stay and:	Spearman's <i>R</i>	<i>p</i> Value
Age	-.02	NS
Mini-MNA	-.09	<.05
MNA	-.060	NS
Admission		
PAB	-.04	NS
CRP	.07	<.05
Lymphocyte count	-.008	NS
PAB/CRP	-.08	<.05
Discharge		
PAB	-.02	NS
CRP	.04	NS
Lymphocyte count	.02	NS
PAB/CRP	-.09	<.05
PAB changes	-.002	NS
CRP changes	-.02	NS
Lymphocyte count changes	.03	NS
Multiple Regression Analysis including Mini-MNA, admission CRP, and PAB/CRP ratio (adjusted $R^2 = .0180$, $p < .004$)		
Variable	β	
Mini-MNA	-.12	
Admission CRP	-.02	
Admission PAB/CRP ratio	-.09	
Proportion of Patients Presenting With a Prealbumin Concentration Lower than 0.20 g/L According to the Phase of the Survey		
	Admission	Discharge
Phase I	56%	43%
Phase II	54%	36%
<i>p</i>	NS	<.05

Note: MNA = Mini Nutritional Assessment; Mini-MNA = short-form of MNA; PAB = serum prealbumin concentration; CRP = C-reactive protein; NS = not significant.

determinant of hospitalization stay by multiple regression analysis (adjusted $R^2 = .0180$; $p < .004$) (Table 7).

The characteristics of the patients according to the presence or absence of caloric supplement intervention are shown in Table 8. During Phase 1, the decision to propose caloric supplement was made for a group of patients presenting at admission a lower PAB concentration and a higher CRP concentration than patients who did not receive caloric supplementation. At discharge, the group receiving nutritional intervention presented a higher PAB concentration and a lower CRP concentration than the group without caloric supplementation. During Phase 2, the decision to propose caloric supplement was made for a group of patients presenting at admission a lower PAB concentration than the group without caloric supplementation. Discharge PAB did not differ between the groups, but the change in PAB was negative in the control group and positive in the interventional group.

DISCUSSION

These data confirm the high prevalence of poor nutritional status among geriatric hospitalized patients. Another recent Belgian study (11) clearly demonstrated the high prevalence

Table 8. Characteristics of the Patients According to the Presence or Absence of Caloric Supplements

Characteristic	Without Caloric Supplement		With Caloric Supplement		<i>p</i> Value
	Mean	<i>SD</i>	Mean	<i>SD</i>	
Phase 1					
Stay, d	27.0	22.1	26.9	20.7	NS
Age, y	82.9	7.3	82.1	7.6	NS
Mini-MNA, points	8.0	3.2	9.2	3.1	<.005
MNA, points	17.6	5.5	19.6	5.4	<.001
Admission					
PAB, mg/100 ml	18.6	7.5	17.1	6.4	<.05
CRP, mg/100 ml	5.1	6.9	6.8	9.9	<.05
Lymphocyte count per mm ³	1422	608	1354	645	NS
PAB/CRP	.233	.466	.177	.357	NS
Discharge					
PAB, mg/100 ml	16	9.1	21.2	6.9	<.0001
CRP, mg/100 ml	3.8	7.6	3.2	8.2	NS
Lymphocyte count per mm ³	1551	699	1555	559	NS
PAB/CRP	.217	.293	.291	.313	<.05
Changes					
PAB, mg/100 ml	-2.4	9.5	4.5	6.8	<.0001
CRP, mg/100 ml	-1.719	10.0	-3.9	12.0	<.05
Lymphocyte count per mm ³	43.5	480.	98.5	438.3	NS
Phase 2					
Stay, d	21.8	15.9	21.5	12.8	NS
Age, y	83.1	6.8	83.3	8.4	NS
Mini-MNA, points	9.2	2.9	7.7	3.5	<.005
MNA, points	18.1	5.6	18.5	4.8	NS
Admission					
PAB, mg/100 ml	19.5	7.2	16.6	9.6	<.005
CRP, mg/100 ml	4.7	6.9	6.2	7.8	NS
Lymphocyte count per mm ³	1400	687	1388	724	NS
PAB/CRP	.265	.820	.161	.349	NS
Discharge					
PAB, mg/100 ml	16.7	15.3	19.3	6.1	NS
CRP, mg/100 ml	3.3	5.4	3.6	7.2	NS
Lymphocyte count per mm ³	1452	682	1554	665	NS
PAB/CRP	.247	.364	.321	.482	NS
Changes					
PAB, mg/100 ml	-1.6	1.6	5.5	10.4	<.0001
CRP, mg/100 ml	-1.69	6.71	.47	38.94	NS
Lymphocyte count per mm ³	22	554	103	615	NS

Note: *SD* = standard deviation; MNA = Mini Nutritional Assessment; Mini-MNA = short-form of MNA; PAB = serum prealbumin concentration; CRP = C-reactive protein; NS = not significant.

of malnutrition and the clinical usefulness of the MNA scale in geriatric medicine. Therefore, we developed this project to sensitize Belgian geriatric teams to this topic.

Nutritional assessment should be part of routine clinical practice in elderly patients who are frail, sick, or hospitalized. A comprehensive screening tool for assessment of nutritional status is needed that is clinically relevant and

cost-effective to perform. A number of simple and rapid tests for detecting or diagnosing malnutrition in elderly persons have recently been developed. If malnutrition is suggested by such screening tests, then the individuals should be supplemented by conventional nutritional assessment before treatment is planned (12).

In this study, we chose PAB measurement and MNA to detect protein-calorie malnutrition (PCM). It has been reported that the risk of PCM for hospitalized patient populations can be as high as 50%. Left undiagnosed, PCM can have serious consequences, including increased morbidity and mortality. Serum albumin is the traditional biochemical marker of PCM. In the past few years, however, several other serum proteins have been presented as being superior markers. Mears (7) undertook several studies to test the effectiveness of using one of these, PAB, as an aid in nutritional assessment. PAB was found to be a sensitive measure of nutritional status, allowing for earlier assessment and intervention, thus reducing length of stay. On the basis of these findings, Mears generated and implemented a multidisciplinary nutrition care program that meets the 1995 Joint Commission on Accreditation of Healthcare Organizations Nutrition Care Standards. PAB measurement is part of this program; levels are determined on admission and repeated until discharge. Use of this program has led to improved patient care and financial benefit to the hospital.

We report that a mean PAB concentration less than 170 mg/L is associated with a risk of malnutrition. However, we used a concentration of less than 200 mg/L as an inclusion criterion for nutritional intervention. PAB concentration decreases in the presence of a biochemical inflammatory syndrome; this decrease is common among patients admitted for acute medical problems. PAB with or without CRP has been used as a marker of protein-calorie nutritional status in individuals (13). It has been suggested that PAB may be more sensitive than albumin as an indicator of nutritional status because it has a shorter half-life than albumin. However, PAB is limited by many of the same factors described for albumin. PAB level may not correlate with changes in other nutritional parameters (14,15), and it is a negative acute-phase reactant (i.e., serum levels decline in response to inflammation or infection). In addition, recommendations for the routine use of PAB level as a marker are tempered by the fact that PAB levels are increased in renal failure, presumably due to impaired degradation by the kidney. Several studies (2,3,5,16) have demonstrated that PAB levels less than 30 mg/dL are associated with increased mortality risk and correlate with other indices of PCM. There is insufficient evidence to conclude that PAB is a more sensitive or accurate index of malnutrition than is serum albumin. If PAB level is used to monitor nutritional status, it is recommended that the outcome goal for PAB is a value greater than 170 mg/dL.

Some patients hospitalized in a geriatric unit present malnutrition, but the presence of medical and/or ethical conditions leads the physician to not propose any active nutritional intervention. The design of our survey did not allow us to determine the proportion of patients in such situations. We have no reason to speculate that this proportion of patients could be different according the phase of the

survey. During the second phase, the “meals on wheels” approach could better sensitize the teams to the correction of some malnutrition causes (treatment of oral candidiasis, for example). Unfortunately, we had to limit the variables to assure participation in our project, so we are not able to confirm this hypothesis.

One of the most dramatic changes observed during the Phase 2 of our study was the decreased hospitalization stay. It is tempting to speculate that this observation represents the effect of the proposed standardized nutritional intervention, as we observed higher PAB variations during Phase 2 than during Phase 1. Seasonal variations in the length of stay may be secondary to medical factors (such as the severity of the disease during the winter) or to social factors (such as the low availability of places in the institution which can receive patients after hospital discharge). The fact that we did not observe significant changes in the duration of hospitalization between the two same periods (27.7 ± 14.0 days for the first 3 months and 26.3 ± 10.2 days for the last 3 months) in one of our units that did not participate in the study, further adds to this interpretation. Nevertheless, we are not able to exclude confounding factors such as seasonal differences in the severity of morbidity or accessibility for long-term care at discharge. Moreover, when we compared the group that got caloric supplements to the group that did not, we did not observe a significant difference in the length of stay.

Our experience should be extended to other wards of our hospital, because malnutrition is a common finding in the acute-care hospital not only among geriatric units. In-hospital starvation affects mainly patients with baseline nutritional, functional, or cognitive deficits and is strongly related to inadequate energy intake. (17).

A combination of interventions conducted in community-dwelling elderly persons by medical professionals and by trained neighborhood residents seems to be an effective strategy to approach nutritional problems of seniors living in urban areas (18) and for patients in long-term care, where poor nutritional status is one of the major factors associated with functional decline and mortality in older persons (17,19). To close the quality cycle, these data will be presented in both participating and nonparticipating geriatric units to promote the quality of nutritional care.

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APPENDIX 1

*The "Meals-On-Wheels" Approach to Diagnosing Treatable Causes of Malnutrition**

Medications

Emotional problems (depression)

Anorexia nervosa (tardive) and abnormal attitudes to food

Late life paranoia

Swallowing problems

Oral problems

No money

Wandering and other dementia-behaviors

Hyperthyroidism, hyperparathyroidism

Entry problems (malabsorption)

Eating problems (physical and cognitive)

Low salt, low cholesterol diets

Shopping (food availability)

[Morley JE. See references 10 and 15.]

APPENDIX 2

Flow Chart Suggesting a Rational Approach to the Management of Malnutrition

MNA < 23.5 points and/or PAB < 0.2 g/L

↓

Start caloric supplementation/Rule out treatable causes/

Utilize Meals-On-Wheels approach

↓

If PAB fails to rise, consider enteral

(or parenteral) nutrition

↓

Check PAB at discharge

[Note: MNA = Mini Nutritional Assessment; PAB = serum prealbumin.]