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Covert Assessment of Concurrent and Construct Validity of a Chart to Characterize Fecal Output and Diarrhea in Patients Receiving Enteral Nutrition

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Background: An accurate and convenient method for characterizing fecal output and a consistent threshold for classifying diarrhea in patients receiving enteral nutrition are required. The aim of this study is to covertly assess the construct and concurrent validity of a chart for characterizing fecal output and classifying diarrhea in patients receiving enteral nutrition. *Methods:* The chart was used to monitor fecal output in patients receiving enteral nutrition for a total of 280 patient days. Nurses characterized 291 fecal samples, of which 84 underwent measurement of fecal water using lyophilization and 60 underwent *Clostridium difficile* enterotoxin analysis using enzyme-linked immunosorbent assay. Construct and concurrent validity was assessed covertly to measure the true performance of the chart in a real-life clinical and research context. *Results:* Use of the chart demonstrated higher fecal frequency ($P \leq .04$), heavier stools ($P \leq .167$), more unformed stools ($P \leq .001$), higher daily fecal scores ($P \leq .001$), and higher incidence of diarrhea ($P \leq .002$) on days when patients had severe hypoalbuminemia, were receiving antibiotics, or had a recent positive *C difficile* assay, demonstrating construct validity. The water content of samples assigned to hard and formed (62.0%), soft and formed (72.1%), loose and unformed (79.3%), and liquid (87.9%) categories was significantly different ($P < .001$), demonstrating concurrent validity. *Conclusions:* Under covert assessment, the chart demonstrated construct validity for characterizing fecal output, daily fecal score, and diarrhea, together with concurrent validity for characterizing fecal consistency. Use of the chart in clinical practice and research will standardize the characterization of fecal output and classification of diarrhea in patients receiving enteral nutrition. (*JPEN J Parenter Enteral Nutr.* 2008;32:160-168)

Keywords: enteral nutrition; diarrhea; *Clostridium difficile*; stool chart; fecal output

Enteral nutrition results in alterations in fecal output in some patients. The impact on the patient or his or her career may depend on the exact nature of these alterations. For example, in patients who are incontinent, an increase in fecal frequency may be unpleasant and may require intensive nursing, whereas a reduction in fecal consistency may increase the risk of wound infection. In view of this, close monitoring of fecal output is important in this patient group.

Although monitoring fecal frequency is relatively easy, monitoring fecal weight and consistency is more problematic. For example, accurate characterization of fecal weight relies on the collection and weighing of an entire sample that is uncontaminated with urine,[1] whereas accurate characterization of fecal consistency requires experimental methods such as water content analysis or rheological assessment.[2] As these methods are impractical in routine clinical care, visual estimation is frequently used to characterize fecal output. However, studies have shown that visual estimation may be inaccurate or unreliable for characterizing fecal weight[3] and consistency.[4] Therefore, accurate methods of characterizing fecal output are largely impractical, whereas practical methods are largely inaccurate, a dilemma for everyone involved in managing patients receiving enteral nutrition.

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In both short-term enteral nutrition in the hospital[5] and long-term enteral nutrition at home,[6] alterations in fecal output can become so severe to warrant a diagnosis of diarrhea. Even assuming that these alterations in fecal frequency, weight, and consistency have been accurately characterized, the threshold above which they result in the diagnosis of diarrhea is disputed among health professionals in clinical practice and among researchers in the clinical nutrition literature. For example, in one study, gastroenterologists, nurses, and dieticians differed on the relative importance of fecal frequency, weight, and consistency when defining diarrhea in patients receiving enteral nutrition, whereas in 25% of occasions, nurses disagreed whether a patient had diarrhea or not.[7] Meanwhile, 33 unique definitions of diarrhea have been used in clinical trials of patients receiving enteral nutrition, including descriptors of fecal frequency (>3 stools/d, >4 stools/d), weight (>300 g/d for 2 days), consistency (loose stool), and combinations of these (>2 liquid stools/d, >200 g liquid stool/d).[8] Consequently, the incidence of diarrhea reported in the literature is highly variable, with values ranging from 2% to 95% of patients.[9,10] The absence of a single threshold above which alterations in fecal output result in the diagnosis of diarrhea is therefore problematic in both clinical practice and research.

A number of stool charts and scoring systems have been developed to standardize the characterization of fecal output and to set a threshold for the classification of diarrhea in patients receiving enteral nutrition.[11-13] One example is the King's Stool Chart, which comprises verbal and pictorial descriptors of fecal weight and consistency, to assist in the accurate characterization of fecal output, together with a weighted scoring system and a threshold for diarrhea classification.[13] In a validation study, its use in characterizing fecal frequency and consistency, and the scoring system and threshold for diarrhea classification, have undergone construct validation (ie, measuring the construct between contrasting groups), while its use in characterizing fecal weight has undergone concurrent validation (ie, comparison with actual fecal weight).[13] However, there are some limitations with this validation of the King's Stool Chart. First, its use in characterizing fecal weight did not undergo construct validation, and its use in characterizing fecal consistency did not undergo concurrent validation (eg, comparison with fecal water content or fecal rheology). Moreover, overt assessment of reliability—and therefore validity—in such validation studies may exaggerate the reliability and validity of an instrument when it is used in routine clinical practice.[14]

The aim of this study was therefore to describe the covert assessment of construct and concurrent validity of the King's Stool Chart for characterizing fecal output, and the application of the scoring system for diarrhea classification in patients receiving enteral nutrition.

Table 1. Scores Assigned to Each of the Fecal Weight and Consistency Categories

	Fecal Weight		
Fecal Consistency	<100 g	100-200 g	>200 g
Hard and formed	1	2	3
Soft and formed	2	3	4
Loose and unformed	4	6	8
Liquid	8	10	12

Methods

King's Stool Chart

The chart incorporates descriptors of fecal frequency, weight, and consistency, as previously described (Figure 1).[13] Briefly, the chart comprises 3 categories of fecal weight (<100 g, 100-200 g, >200 g) and 4 categories of fecal consistency (hard and formed, soft and formed, loose and unformed, liquid).[15] This results in 12 fecal weight and consistency category combinations that are provided with a verbal and pictorial descriptor to assist in their accurate characterization. Each category is assigned an alphabetical code so that physicians, nurses, and dieticians are able to record and communicate fecal output using standard verbal and pictorial descriptors (Figure 1). Fecal frequency is incorporated by recording the code of each feces passed. In addition, each category is assigned a score, enabling calculation of a daily fecal score from summation of all scores that day (Table 1). Scores are weighted such that an increase in fecal frequency alone results in a higher score than a change in fecal consistency alone, which in turn results in a higher score than an increase in fecal weight alone.[7] Diarrhea is classified by a daily fecal score of 15 or more.

Study Design

Patients starting enteral nutrition were recruited to a prospective observational study from St George's Hospital (London, UK). The current analysis formed part of a major study investigating the colonic microbiota of patients receiving enteral nutrition[16] and was approved by the Merton, Sutton and Wandsworth Health Authority Research Ethics Committee. This major study involved the lead researcher recording clinical data and regularly visiting patients to collect fecal samples for analysis of colonic microbiota together with *Clostridium difficile* enterotoxins and fecal water. Meanwhile, nurses used the chart to characterize and record fecal output in line with their normal clinical practice. Therefore, this enabled a unique opportunity to covertly assess the validity of the

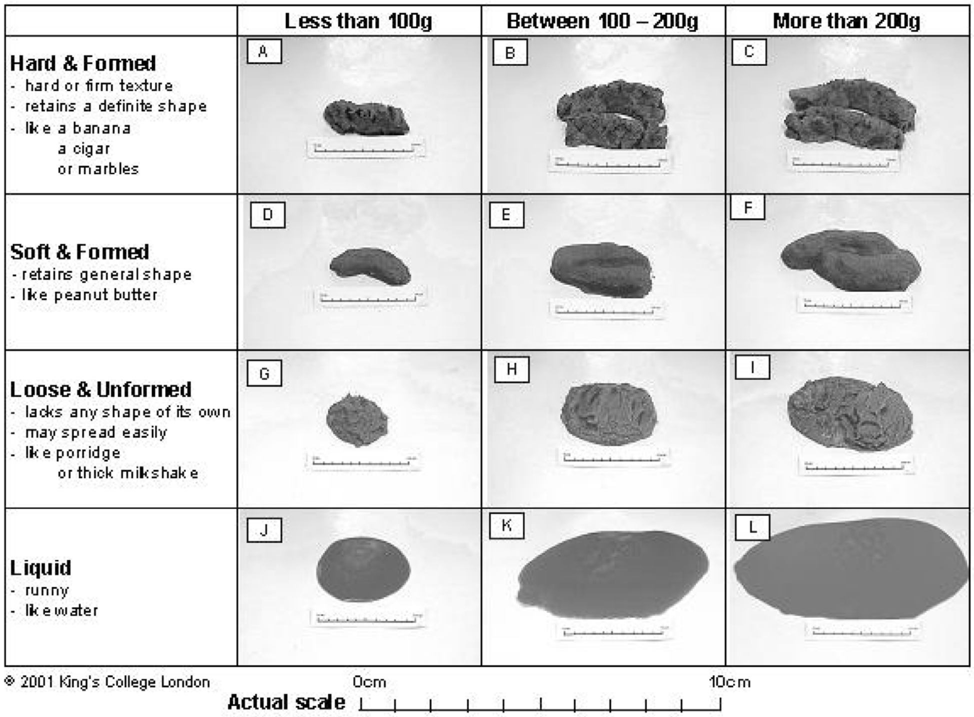

Figure 1. The King's Stool Chart. The full chart can be downloaded at http://www.kcl.ac.uk/stoolchart. © 2001 King's College London. Reprinted with permission.

chart for characterizing fecal output and diarrhea through comparison of the clinical data (eg, serum albumin concentrations, antibiotic prescription, *C difficile* enterotoxin assay, fecal water) with the fecal output data recorded by nurses. This validation was therefore covert because, although the lead researcher frequently attended the ward for collection of fecal samples, nurses were unaware that such comparisons could be made post hoc.

The inclusion criteria were patients starting exclusive intragastric enteral nutrition with standard formula that was likely to continue for a minimum of 14 days. Exclusion criteria were patients in intensive care units and those with any GI disorder that may independently influence fecal output. Consecutive patients were recruited from a variety of general wards to achieve a diverse cohort representative of the general hospital population receiving enteral nutrition. Prior to recruitment to the study, informed consent was obtained from the patient, or when the patient was unconscious, assent was obtained from their next of kin and the medical team.

Patients received standard enteral formula in line with the recommendations of the clinical dietitian. The formulas were 1.0 kcal/mL (Osmolite; Abbott UK, Maidenhead, UK), 1.2 kcal/mL (Osmolite Plus; Abbott UK), or 1.5 kcal/mL (Ensure Plus; Abbott UK) depending on the calculated total energy expenditure, and were delivered via pump infusion for a maximum of 20 h/d at rates ranging from 75 mL/h to 125 mL/h.

For the purpose of the major study, patients were monitored for 14 days from passage of the first fecal sample following initiation of enteral nutrition. A laminated copy of the chart was placed in each patient's nursing records with a form on which to record fecal output. Each time a patient passed feces, nursing staff used the chart to assist in characterization of its weight and consistency and recorded this in line with normal clinical procedures.

Data Collection

Patient demographics (age, gender) and clinical details (diagnosis, indication for enteral nutrition, serum albumin concentrations, antibiotic prescriptions) were taken from paper and electronic medical records. Serum albumin concentrations were measured only at the request of the attending physician.

The lead investigator visited patients daily on weekdays to review their enteral nutrition regimen, including recording the volume of formula delivered from nursing charts, and to collect samples for the major study. During these routine visits, the alphabetical codes recorded by the nursing staff were taken from the patient's nursing records, and a daily fecal score was calculated.

A number of fecal samples passed during working hours of weekdays were collected and analyzed for their water content by lyophilization, which is accurate even in samples with high water content.[17] In duplicate, approximately 3-5 g of fresh feces was accurately weighed into a preweighed tube and frozen at –20°C until analysis. The duplicate samples were lyophilized at –45°C in a lyophilizer (LSL Secfroid, Switzerland) for a minimum of 7 days, weighed, and then returned to the lyophilizer for another 7 days until constant weight was recorded (±0.01 g). The fecal water content was determined by calculation of the mean percentage weight loss of duplicate samples.

A fecal sample was also taken at the start (days 1-4), middle (days 6-9), and end (days 11-14) of the 14-day period of enteral nutrition and sent to the medical microbiology laboratory for analysis of *C difficile* enterotoxins. Enterotoxins A and B were detected using the ToxA/B II enzyme-linked immunosorbent assay kit (TechLab, Blacksburg, VA), which was performed according to the manufacturer's instructions.

Validation

All aspects of the chart (fecal frequency, weight, consistency, daily fecal score, diarrhea classification) underwent assessment of construct validity, which is the property of an instrument to demonstrate appropriate relationships with other variables.[18] Construct validity was measured using the contrasting groups approach, whereby the results from the chart were compared between pairs of patient groups expected to have differences in fecal output and diarrhea. Therefore, results were compared between patients with (≤20 g/L) and without (>20 g/L) severe hypoalbuminemia,[19] between patients receiving and not receiving antibiotics that day,[20] and between patients with positive and negative *C difficile* enterotoxin assay in their most recent test.[21]

Fecal consistency characterization underwent assessment of concurrent validity, which is the property of an instrument to produce results that can compare with an accepted gold-standard measurement.[18] Concurrent validity was measured by comparison of the fecal water content of samples that had been assigned to each consistency category.

Statistical Analysis

Fecal frequency (mean [SD]), was compared between contrasting groups using an unpaired *t* test. The number (%) of samples assigned to different fecal weight categories was compared between groups using the χ^2 test, whereas fecal consistency categories were compared between groups using the Mann-Whitney test due to insufficient samples in each cell. Fecal water content (mean [standard deviation, SD]) was compared between samples assigned to the 4 consistency categories and for the 3 weight categories using an ANOVA, together with a Bonferroni post hoc correction for multiple comparisons. Fecal scores (median [interquartile range]) were compared between groups using the Mann-Whitney test, as the data were ordinal. The correlation between daily fecal score and serum albumin concentration was assessed using the Spearman ρ. The incidence of diarrhea was presented as the proportion of days with diarrhea[22] (n [%]) and was compared between groups using the χ^2 test. All data were analyzed using SPSS for Windows (version 14.0; SPSS Inc, Chicago, IL), and a *P* value of <.05 was considered statistically significant.

Results

Twenty patients (5 men, 15 women; mean age, 77 years 5 months; SD, 10 years 7 months) starting enteral nutrition via a nasogastric tube were recruited. Most patients had been admitted with stroke (n = 15), and the remaining patients had primary diagnoses of muscular dystrophy, multiple sclerosis, fractured pelvis, pneumonia, and aortic aneurysm rupture (all n = 1). The indication for enteral nutrition was dysphagia (n = 18) or disease-related anorexia (n = 2). Patients were monitored for 14 days each, resulting in the collection of 280 patient days of data.

Serum albumin concentrations were measured at the request of the attending physician between 1 and 8 times in each patient. Therefore, values were available on 63 of the 280 days (23%), and on 20 (32% of days measured) of these days, the value was ≤20 g/L.

Upon recruitment to the study, 11 patients were already prescribed antibiotics and another 5 patients were prescribed them during the study. Of these 16 patients, 3 patients received only 1 course of antibiotics, 4 patients received 2 courses, 7 patients received 3 courses, and 2 patients received 4 different antibiotics. In total, patients were receiving antibiotics on 148 of the 280 days (53%).

All patients were tested for *C difficile* enterotoxin at the start, middle, and end of the 14-day period of enteral nutrition. Five patients were positive for *C difficile* enterotoxin at the start, whereas another 4 patients developed a subsequent positive sample. Where symptoms existed, patients were treated with the appropriate antibiotic, such that in 3 patients, a subsequent sample was found to be negative. Therefore, in total, the most recent sample was considered to be *C difficile* enterotoxin positive on 74 of the 280 days (26%).

Fecal Frequency, Weight, and Consistency

Nursing staff used the chart to characterize a total of 291 fecal samples from patients receiving enteral nutrition

(Table 2). Overall, the modal category to which samples were assigned was category G, <100 g, loose and unformed (n = 72, 24.7%; Table 2). Construct validity was assessed by comparison of the fecal frequency, weight, and consistency on days when patients had severe hypoalbuminemia, were receiving antibiotics, or had a recent positive *C difficile* enterotoxin assay, compared with the respective comparison group (Table 3).

Modal and median fecal frequency was once per day, with a mean of 1.0 (1.0) per day. Fecal frequency was higher on days when patients had severe hypoalbuminemia (P = .04), were receiving antibiotics (P = .014), or had a recent positive *C difficile* enterotoxin assay (P < .001) than those in the respective comparison group (Table 3).

The modal fecal weight category was <100 g, and median weight category was between 100 and 200 g. There were fewer samples assigned to lighter fecal weight categories and more assigned to heavier fecal weight categories on days when patients had severe hypoalbuminemia (P = .001) or were receiving antibiotics (P = .011), than those in the respective comparison group (Table 3). However, there was no difference in the distribution of fecal weight categories between patients with a recent positive or a negative *C difficile* enterotoxin assay (P = .167, Table 3).

The modal and median fecal consistency was loose and unformed. Fewer samples were assigned to the formed consistency categories (hard and formed, soft and formed), and more were assigned to unformed consistency categories (loose and unformed, liquid) on days when patients had severe hypoalbuminemia (P < .001), were receiving antibiotics (P < .001), or had a recent positive *C difficile* enterotoxin assay (P < .001) than those in their respective comparison group (Table 3).

The concurrent validity of using the chart to characterize fecal consistency was assessed by comparing the consistency category to which a sample had been assigned with its water content. A subgroup of 84 (29%) fecal samples, between 3 and 7 from each patient, were collected and analyzed for water content, as described. The water content of samples assigned to hard and formed (n = 6, 62.0% ± 5.5%), soft and formed (n = 27, 72.1% ± 4.6%), loose and unformed (n = 39, 79.3% ± 4.6%), and liquid (n = 12, 87.9% ± 6.4%) was significantly different (P < .001, ANOVA; Figure 2). The water content of each consistency category significantly differed from all others (all P < .001, ANOVA plus Bonferroni post hoc correction). Interestingly, of the 84 samples analyzed, the water content for those assigned to <100 g (n = 38, 78.4% ± 7.1%), 100-200 g (n = 32, 74.2% ± 7.9%), and >200 g (n = 14, 79.5% ± 10.3%) were significantly different (P = .044). However, when investigating between-group comparisons, these differences became insignificant following Bonferroni post hoc correction.

Table 2. Distribution of Fecal Samples by Weight From Patients Receiving Enteral Feeds

Samples Assigned to Each Category, n (%)	<100 g	Between 100 and 200 g	>200 g	Total
Hard and formed	4 (1.4)	5 (1.7)	1 (0.3)	10 (3.4)
Soft and formed	26 (8.9)	14 (4.8)	5 (1.8)	45 (15.5)
Loose/unformed	72 (24.7)	34 (11.7)	18 (6.2)	124 (42.6)
Liquid	29 (10.0)	34 (11.7)	49 (16.8)	112 (38.5)
Total	131 (45.0)	87 (29.9)	73 (25.1)	291 (100)

Fecal Score and Diarrhea Classification

A daily fecal score was available for each of the 280 patient days. The median daily fecal score was 4 (interquartile range, 10; 0-46), and the mean was 6.8 (SD, 8.6). The daily fecal score was statistically significantly higher on days when patients had severe hypoalbuminemia (P < .001), were receiving antibiotics (P < .001), or had a recent positive *C difficile* enterotoxin assay (P < .001) than those in their respective comparison group (Figure 3). Meanwhile, there was a negative correlation between patients' serum albumin concentration and the fecal score for the day on which it was requested (correlation coefficient = –0.363, P = .003).

A daily fecal score of 15 or more was used to classify diarrhea. Ten (50%) patients experienced diarrhea; however, in only 6 (30%) of these patients did diarrhea occur on 2 or more consecutive days. When using the recommended method of reporting its incidence,[22] the proportion of days on which patients had diarrhea was 13.6%. The incidence of diarrhea was statistically significantly higher on days when patients had severe hypoalbuminemia (P < .001), were receiving antibiotics (P < .001), or had a recent positive *C difficile* enterotoxin assay (P < .001; Table 3).

The mean formula delivery was only 86.8% (±26.3%) of the volume actually prescribed. Interestingly, formula delivery was significantly lower on days when patients were classified as having diarrhea (n = 38 days, 78.3% ± 28.8%) than on days when they were not (n = 242 days, 88.1% ± 25.7%, P = .032).

Discussion

Visual characterization of fecal output is inaccurate in patients receiving enteral nutrition, whilst the threshold for the classification of diarrhea is poorly standardized. The aim of this study was to describe the covert assessment of construct and concurrent validity of the chart for

Table 3. Construct Validity for Fecal Output Characterization Using the Chart and the Use of a Threshold to Classify Diarrhea

	Albumin Concentration			Antibiotic Prescription			*C difficile* Enterotoxin		
	>20 g/L	≤20 g/L	*P* Value	None	1 or More	*P* Value	Negative	Positive	*P* Value
Fecal frequency, n total patient days	43	20		132	148		206	74	
Frequency per day, mean (SD)	1.1 (0.8)	1.6 (1.0)	.04	0.9 (0.9)	1.2 (1.0)	.014	0.9 (0.8)	1.6 (1.2)	<.001
Fecal weight, n total samples	48	31		117	174		176	115	
<100 g, n (% of total)	27 (56.3)	7 (22.6)		65 (55.6)	66 (37.9)		80 (45.5)	51 (44.3)	
100-200 g	14 (29.2)	8 (25.8)	.001	27 (23.1)	60 (34.5)	.011	58 (33.0)	29 (25.2)	.167
>200 g	7 (14.6)	16 (51.6)		25 (21.4)	48 (27.6)		38 (21.6)	35 (30.4)	
Fecal consistency, n total samples	48	31		117	174		176	115	
Hard and formed, n (% of total)	4 (8.3)	0 (0)		10 (8.5)	0 (0)		9 (5.1)	1 (0.9)	
Soft and formed	13 (27.1)	1 (3.2)	<.001	24 (20.5)	21 (12.1)	<.001	36 (20.5)	9 (7.8)	<.001
Loose and unformed	23 (47.9)	5 (16.1)		51 (43.6)	73 (42.0)		96 (54.5)	28 (24.3)	
Liquid	8 (16.7)	25 (80.6)		32 (27.4)	80 (46.0)		35 (19.9)	77 (67.0)	
Diarrhea, n total patient days	43	20		132	148		206	74	
Days with diarrhea, n (% of total)	3 (7.0)	9 (45.0)	<.001	9 (6.8)	29 (19.6)	.002	13 (6.3)	25 (33.8)	<.001

P values for fecal frequency refer to independent *t* tests; for fecal weight and the incidence of diarrhea, they refer to χ^2 tests; and for fecal consistency, they refer to Mann-Whitney tests.

characterizing fecal output and the application of the scoring system for diarrhea classification in patients receiving enteral nutrition.

This is the first time that the construct validity of using the chart to characterize fecal weight has been assessed. Accurate characterization of fecal weight requires collection and weighing of uncontaminated samples, which is excessively burdensome in routine clinical practice or research, particularly in patients who may be bed bound or incontinent. It was possible to accurately collect such samples in the current study only because the protocol for the main study required the meticulous collection of recent samples to measure fecal microbiota in patients receiving enteral nutrition.

The chart has previously been shown to demonstrate construct validity when used to characterize fecal consistency,[13] and this finding has been confirmed here under covert assessment. However, concurrent validity was also demonstrated for fecal consistency characterization through comparison of fecal water content with the consistency category assigned to it.

A number of studies have investigated the concurrent validity of using verbal descriptors to characterize fecal consistency through comparison with fecal water content. In one such study, patients with fecal incontinence were able to use 4 verbal descriptors (hard and formed, soft and formed, loose and unformed, liquid) to assign their feces to categories that were subsequently shown to have different fecal water contents,[15] and for this reason, these descriptors were used in the current chart. The mean fecal water content of samples assigned to each consistency category by patients from that study[15] is similar to those reported here, although even lower standard deviations were found in the current study. The smaller distribution of fecal water in each consistency category in the current study may be due to improved familiarity with using such charts among nurses compared with patients, or it may be due to the additional use of pictorial as well as verbal descriptors of fecal consistency.

Whether there is additional benefit to using pictorial descriptors in conjunction with verbal descriptors for the characterization of fecal consistency is disputed. For example, there was only marginal improvement in reliability among nurses[23] and no differences in concurrent validity among subjects with English as a second language[24] when verbal descriptors of fecal consistency were used in conjunction with pictorial descriptors. However, another study demonstrated that the use of pictorial descriptors of fecal consistency correlate better with symptoms of both patient and physician definition of diarrhea.[25]

The use of scoring systems to grade severity of symptoms is common in clinical practice, where scoring systems are used to guide patient management and to quantify the impact of an intervention, as well as in research, where they are used to compare the effectiveness of interventions in controlled trials. The scoring system has previously been shown to demonstrate construct validity,[13] and again, this finding has been confirmed here under covert assessment.

Scoring systems have previously been used to characterize alterations in fecal output in patients receiving enteral nutrition, with the most notable being the Hart and Dobb score[11] and the Guenter and Sweed score.[12] The Hart and Dobb score[11] comprises verbal descriptors of 3 categories of fecal volume (+ <200 mL, ++ 200-250

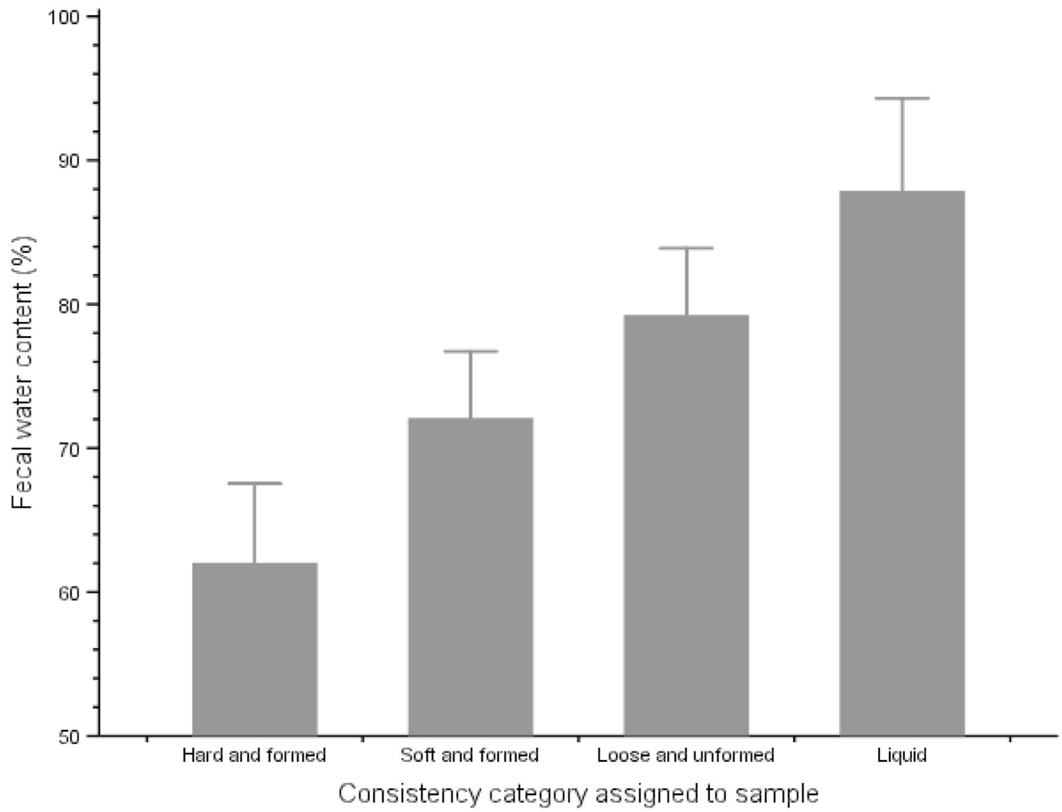

Figure 2. Concurrent validity for fecal consistency characterized using the chart. Mean (SD) water content of 84 fecal samples that had been assigned to the following consistency categories: hard and formed (n = 6, 62.0% ± 5.5%), soft and formed (n = 27, 72.1% ± 4.6%), loose and unformed (n = 39, 79.3% ± 4.6%), and liquid (n = 12, 87.9% ± 6.4%). The water content of samples assigned to different categories is significantly different ($P < .001$, ANOVA), whereas the water content of each consistency category is significantly different from all others (all $P < .001$, ANOVA plus Bonferroni post hoc correction).

mL, +++ >250 mL) and 3 categories of fecal consistency (formed, semisolid, liquid), each assigned a score, with a score of 12 or more being classified as diarrhea. Although this scoring system has been used to classify diarrhea in a number of studies in enteral nutrition, its validity and reliability have never been measured.

The Guenter and Sweed score[12] comprises verbal descriptors of 2 categories of fecal volume (small, large) and 3 categories of fecal consistency (solid and formed, soft and pasty, liquid and watery), each assigned a score. In a validation study in patients receiving enteral nutrition, interrater reliability of the score was good, although concurrent and construct validity of nurse characterization of fecal consistency and weight were not assessed.[12] The scoring system was able to demonstrate construct validity by producing different scores for patients positive and negative for *C difficile* enterotoxin, although not for patients receiving and not receiving antibiotics. However, although extensively validated, the reliability and therefore validity of such instruments are known to be artificially elevated during overt assessment.[14]

The current study is therefore the largest and most extensive covert validation of a chart to characterize fecal output and a scoring system for classification of diarrhea in patients receiving enteral nutrition. Importantly, as nurses were unaware that an analysis for construct and concurrent validity was to be made, the results presented here reflect the true performance of the chart in a real-life clinical and research context. However, as with any instrument, its validity in clinical practice and research is dependent on the skills and experiences of the user. Therefore, prior to its implementation elsewhere, training of nursing staff in using the chart to record fecal output is required, together with training of all relevant health professionals in interpreting the data that are produced. Furthermore, the limitations of the current study, including recruitment of a very specific population of only 20 general hospitalized patients, mean that the validity of the chart in wider populations cannot be assumed.

Although frequently used in clinical practice and research, the value of scoring systems is disputed. First, scores may obscure the actual changes in fecal output

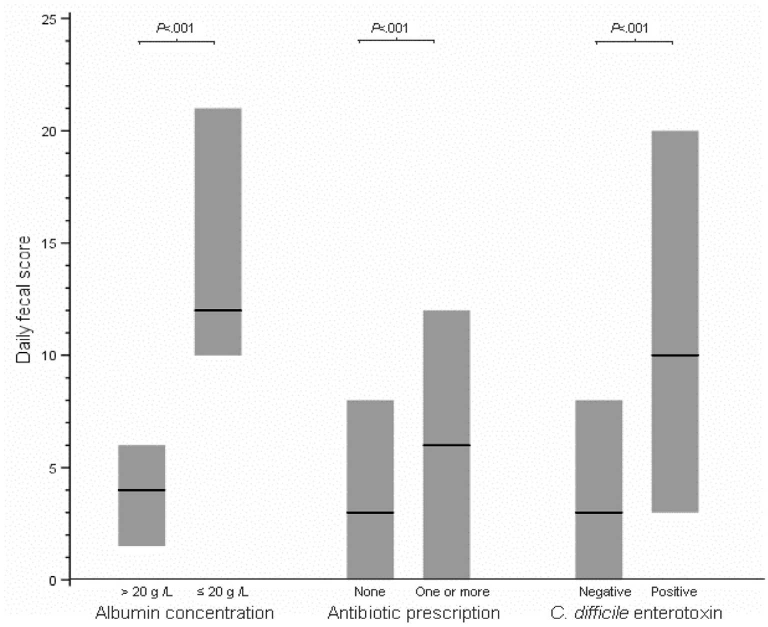

Figure 3. Boxplots for construct validity of the daily fecal score. The bold line denotes the median daily fecal score, and the box denotes the interquartile range.

that occur. Therefore, an advantage of the current chart is that it enables accurate collection and recording of the alphabetical codes relating to actual fecal output that are subsequently converted into a score. Second, in some studies, the scoring system and the threshold for the classification of diarrhea are arbitrary. However, with the current chart, the scoring system is weighted toward changes in fecal frequency, followed by consistency and weight, in line with the views of health professionals.[7] Meanwhile, the threshold for classification of diarrhea (15 or more) was chosen to ensure that passage of only 1 stool would not result in the classification of diarrhea, as is the case with the Hart and Dobb score,[11] whereas passage of 2 or more liquid stools would. Such a threshold was chosen to reflect the preferences of health professionals[7] and healthy people[26] in defining diarrhea.

Ideally, a threshold for the classification of diarrhea should reflect a point at which patients become at greater risk for negative clinical events. In the current study, use of the threshold revealed lower formula delivery on days when patients were classified as having diarrhea. This may be merely an artifact of the higher incidence of diarrhea in the most severely ill patients, who may therefore experience more frequent disruptions to feeding due to investigations and procedures,[27] or it may be due to an active reduction of formula delivery in response to alterations in fecal output. Data relating to a threshold at which alterations in fecal output result in a greater risk of serious negative clinical events (eg, wound infection, dehydration) are unavailable. Further research investigating such a threshold is required, and the chart provides a mechanism through which this could be investigated.

In conclusion, the chart has demonstrated construct validity for characterization of fecal frequency, weight, and consistency. Concurrent validity for characterization of fecal consistency was also demonstrated by comparison with fecal water content. Once accurately characterized, fecal output can then be calculated into a daily fecal score and a threshold for classification for diarrhea, both of which have demonstrated construct validity. Use of the chart in both clinical practice and research will standardize characterization of fecal output and classification of diarrhea in this patient group. This will better enable evaluation of the effectiveness of interventions and allow comparison between studies. Its use in other patient groups is currently under investigation.

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