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# Factors Affecting Nutritional Adequacy Delivered by Enteral Tube Feeding among ICU Patients

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***Abstract:*** *Introduction: Adequate nutritional support is crucial in the prevention and treatment of malnutrion in critically ill patient. Patient in the intensive care unit who cannot take food orally require either enteral or parenteral nutritional support. Enteral nutrition is generally preferred over parenteral nutrition because the former associated with lower incidence of infectious and non-infectious complication, reduced cost, and decreased length of hospital stay.Aim: Aim of this study is to investigate factors affecting nutritional adequacy delivered by enteral feeding among ICU patient.Material and Method:A prospective, descriptive design was used in this study.The present study was conducted in the Critical Care Unit at KingFahdUniversityHospital. Al-khobar, Eastern Province. The subjects consisted of 60 patients who are on continuous enteral feeding via nasogastric tube are coming during the period of data collection. Two instruments were used for data collection:1) Demographic and medical data sheet, 2) Nutritional data sheet.Results: The result of the present study showed a mean age of 50.05 ± 22.46 years, 56.7 % of the subjects were males. There is highly significant relationship between the daily prescribed energy and actual daily energy intake (P< 0.005). The common causes for enteral feeding interruption were found to be because of change in position and suctioning (40%),during morning care, before extubation and feeding hold for increasing residual volume (33%). Patients were kept nil per oral (NPO) because of surgicalor diagnostic procedure (27%). Beside this there is no replacement for feeding interruption.Conclusion & Recommendation:It can be concluded that there is an inadequacy of enteral nutritional intake for critically ill patient. Also the factors affecting nutritional adequacy delivered by enteral feeding are change position, suctioning, during morning care, extubation, feeding hold for increasing residual volume, NPO, surgical procedure and diagnostic procedure. It can be recommended that specific nutritional protocols, a multidisciplinary approach to nutritional support, regular training of medical and nursing staff involved in nutritional support, routine review prescribed and actual calorie intake might help to achieve optimal nutrition care for critically ill patients.*

***Kay words:*** *Enteral feeding, Calories, Critical care*

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## I. Introduction

Adequate nutritional support is crucial in the prevention and treatment of malnutrition in critically ill patient. Patient in the intensive care unit who cannot take food orally require either enteral or parenteral nutritional support. Enteral nutrition is generally preferred over parenteral nutrition because the former associated with lower incidence of infectious and non-infectious complication, reduced cost, and decreased length of hospital stay [(1)].

Despite the of adequate energy, intake attributable impact of nutritional support on morbidity and mortality in intensive care unit (ICU) patients remains difficult to demonstrate it. It has been observed that patients in intensive care units (ICU) often receive less energy intake, than desired. Factors that impede delivery of enteral feedings include those related to feeding intolerance (e.g. vomiting ) and those associated with standard nursing practice( e.g. interruption of tube feeding during changes in body position. Or routine orders (e.g. nothing per mouth before and after procedure) [(2)].

During the last decade, the concept of quality control in critical care medicine has been promoted (5, 6). In terms of nutritional support, discrepancies between the optimal and the actually delivered caloric intake have been reported (7, 8). Although these have been attributed largely to technical problems in administering enteral nutrition, the relative contribution of under prescribed and under administered appropriate caloric delivery in ICU patients has not been investigated[(3)].

Recent studies[4, 5] indicated that repeated interruptions of enteral tube feeding result in significant underfeeding in critically ill patients. Adam and Batson[4] found that ICU patients received only 76% of the patients' daily energy requirements with enteral tube feeding, primarily because of gastrointestinal intolerance and elective withholding of feedings for procedures. In a similar study, McClave et al [5] found that ICU patients received only 52% of the patients' energy requirements with enteral tube feeding and that 66% of the interruptions in tube feedings were avoidable.

Now a day, it may be difficult for critical care practitioners to revise methods of enteral feeding and develop strategies to improve patients' energy intake. this strategies might be establishing and implementingfeeding protocols, which can improve energyintake, and recalculating infusion times in considerationof projected "down time" (eg, calculate hourlyfeeding infusion rates for 18 hours rather than for 24hours, limit infusion times to hours when patients areunlikely to be out of the unit for tests or procedures[6].

### 1.1. Significance of the study

Because Continuous enteral feeding is one of the nutritional support methods used in critically ill patients at King Fahd Hospital of University, University of Dammam and it has been found that feeding is frequently held for one or the other reasons which might compromise the total energy requirement of critically ill patients. Therefore nurses needed a clear polices and guidelines to achieve the required caloric goal of patients in (ICU) so, it is crucial to detect factors that are interfering with patient enteral feeding during ICU period. Thus, it is essential to assess and monitor adequacy of nutritional intake in critically ill patients. It is important to examine the enteral nutrition delivery practices observed in the ICU and for nurses to be aware of how much nutrition the patient receives each day, each shift. It is within the scope of our nursing practice to monitor nutritional intake, advocate for early feeding, and limit feeding interruptions.

## II. Subjects and Methods

**Aim:**

The aim of this study wasto investigate factors affecting nutritional adequacy delivered by enteral feeding among ICU patient.

**Objectives:**

1. To examine the adequacy of enteral nutritional intake for ICU patient.
2. To determine the factors that affecting nutritional delivery among ICU patient.
3.

**Research Design:**

A prospective, descriptiveresearch design was utilized in this study.

**Setting:**

This study was conducted in Medical Surgical Intensive Care Unitat King Fahad Hospital of University, AL-Khobar, Eastern Province, and Kingdom of Saudi Arabia.

**Subject:**

Randomsample of 40 critical ill patients on enteral feedingwere selected according to the inclusion criteria.The inclusion and exclusion criteria included:

**Inclusion criteria:-**

1. Adult patients 18 years of age and over.
2. Admitted to ICU for more than 48 hours.
3. Continuous Enteral Tube Feeding.

**Exclusion criteria:-**

1. Patients below the age of 18 years
2. Patient admitted to the intensive care unit less than 48hours.
3. Patient was receiving oral or parenteral feeding.
4. Patients discontinue of enteral feeding.

**Data collection tool:-**

The following tool consisted of two sections namely:

**Part (1): Demographic and Medical Data Sheet:-**

The demographic and medical data sheet was developed by the researcher including age, gender, baseline height, weight, body mass index; hospital and ICU admission dates; diagnosis at admission and/or surgical procedure; the New Simplified Acute Physiology Score II[7],the score was computed for each patient at the time of enrollmentto measure the severity of disease.

**Part (2): Nutritional Data Sheet**: -

Nutritional data sheet developed by the researcher including daily weight by bed scale, type of enteral formula used, tube feedings infusion rate, volume of tube feeding infused during 24 hours, reasons for and duration of interruption tube feedings, gastric residual volumes (measured every 4-6hours) the number of episodes of emesis and diarrhea, and number of times the feeding tube was replaced. Daily energy intake was determined based on the volume and type of enteral formula administrated; the mean amount of energy intake was calculated by using Hamwi calculationduring a 3-day period[1&3]. The mean amount of energy received during the 3-day period was then calculated. Validity was established through a panel of experts,who checked the tool for content and ease of questions .In addition, a pilot study carried out on five patients in ordered to assess the clarity and the applicability of the tools.

**Method:**

Data collection commenced once ethical approval was received from the Ethical Committee at the University of Dammamand the necessary permission was obtained from the hospital administration and the chairman of the ICU department. Thepatients were randomly selected by enrolling the patients who admitted to the ICU on odd days of the week (Sunday, Tuesday and Thursday), and met the inclusion criteria. After explanation the purpose of the study to the patients who are conscious. All patients received enteral nutrition via continuous infusion by a feeding pump was observed for three consecutive days during data collection period.

The Demographic and medical data have been obtained and recorded as a baseline e.g.age, gender, baseline height, weight, and body mass index, ICU admission dates, diagnosis at admission, and surgical procedure, the simplified acute physiology score II (SAPS).then daily measuring patients weight by used bed scale.

The nutritional data was collected and recorded daily for each patients including type, size and position; the date and time of insertionof the tube. Dailyenergy intake was calculated and recorded. Type of formula and rate of infusion during the 24 hourswererecordedfor consecutive three days. In addition the reasons for feeding interruption were also observed and recorded. Gastric residual volume was measured every 4-6 hours. The emesis and diarrhea was also noted for the three days.

**Data Analysis:-**

Data was analyzed using SPSS, version 16.0.Descriptive statistics were used to characterize the sample of 40 respondents included in the study. Frequency tables were drawn with percentages means, median, minimum and standard deviation to describe the outcome of the study. Twotailed, paired t test were used to determine the differences between mean energy required and mean energy received for theICU patients over the three days.Multiplelinear regression analysis was used to examine theeffects of clinical predictor variables on the percentageof required enteral feeding actually received. A P valueof less than .05 was selected as the level of significance.

## III. Results

The study showedthat almost one third of the study sample was aged between 26-50 years. The majority of the patients were male (60%).Half of the patients had surgical procedure. Majority of the patients (37.5%) were between the weightsgroups of 53-69 kg, with a height of 157-171 cm.

The nutritional toolshowedthat more than half of the study sample (67.55%), received their feeding through a flexiflo tube, and (67.7%) of the study sample used atube size of 14 FR.The entire study sample had stomach access for the feeding tube. Thirty seven and half percent of patients were taking Ensure plus formula. More than half of the study sample (57.5%)showed that intubation was the reason for the enteral feeding.

Further to this, Adequacy of enteral nutritional intake was determined by comparing the amount of energy used with the amount requiredin the three consecutive days by using t test. It can be seen that there was a highly significant difference between them at *($P < 0.05$) which means that all the patients under the study their adequacy of feeding are underfed.

The study highlighted that changing positions and suctioning was the common reasons (35%) for enteral feeding tube interruption, followed by 28 % for all reasons mentioned in the Fig.(2).

Univariate analysis of the predictor variables wasused to determine factors that significantly correlatedwith the percentage of required energy received,the study showed that there is a significant effect of all constant predictor together (Gastric residual volume, simplifies acute physiology score II, diarrhea, emesis) on dependent variable (on enteral tube feeding) at ($P< 0.05$).

The study revealed that all predictors (together) are significantly effective on each other (P=.002) but there is a highly significant relationship only between the Simplified Acute Physiology Score II and duration of feeding interruption ($P < 0.05$).This means that the amount of time feedings were withheld had the greatest effect on reducing patients' energy intake and increased the severity of disease leading to increase the mortality

rate.On the other hand those patients with a higher SAPS II score(high severity of illness) were less likely toreceive enteral nutrition due to increase the duration of tube feeding interruption because of instability of their condition.

## IV. Discussion

Nutritional adequacy is the important goal of the nutritional supportfor critically ill patients as it maintains patient's lean body mass andmakes critically ill patients to exceed the state of catabolic stress safely. Sothe main finding of our study involved the comparison between the patients required energy and daily energy intake, and the most common cause of interruptions in tube feeding.

The present study revealed that there is a highly significant difference between the patients required energy and daily energy intake which means that the delivered calories are less than the required calories among ICU patients. This result is in line with the study was doneby Kelley [(1)] on ICU patients who were mechanically ventilated whereby more than two third of ICU patients on mechanical ventilation received less than 90% of their nutritional requirements, as determined by using HBE, via enteral tube feeding; half of those patients received less than 50% of their required energy during the three day study period. Further to this, Elpern[(3)] reported that ICU patientsreceived a mean of 2799 fewer kilojoules (669 fewer calories) than their daily requirements.

According to Hwasoon [(8)]who included neurosurgical ICU patients,reported thatthe enteral feeding calories actually provided to the patient were less than the estimated average daily caloric requirements 1,551.38kcal. The calories actually provided 1,186.69kcal for enteral feeding alone and 1,211.33 kcal for that including additional parenteral nutrition; the former representing only 76.49% of the estimated energy requirements, which is less than their adequate daily energy intake.

However, McClave et al, [(9)], found that among ICU patients, 56% of the patients were underfed, 30% were overfed, and 14% received feeding within 10% of required energy intake. In addition, O'Meara ([10)] found that the mean amount of calories administered to the patientwas lower than the amount of calories estimated by the dietitian. In addition other studies have shown that the real practice in ICUsareto deliver considerably less than that prescribed amount ranging between 50% and 60% of the target of 37–39 Nutrition support for patients in the ICU

In contrast the study doneby Quenot et al (2010)[(11)] among critically ill patient who were mechanically ventilated reported a satisfactory ratio of delivered and prescribed calories exceeding 80%, indicating that in general, medical prescriptions are accurately applied by the ICU team over first seven days.

Multiple factors contribute to inadequate deliveryof enteral feedings in critically ill patients, includinggastrointestinal problems (e.g., large gastric residualvolumes, emesis, abdominal pain and distention, anddiarrhea), frequent interruptions due to surgery andICU-related procedures, problems related to thefeeding tube (e.g.tube dislodgement or occlusion) and inaccurate assessment of nutritional requirements[(1)].In our study the most common factors for feeding interruption are morning care, changing position, frequent suctioning, nothing by mouth, surgical procedure, and diagnostic procedures.

This result was supported by Refaatet al [(12)]they reported thatGI related factors followed by nurses' related factors were the mostfrequent reasons for enteral feeding interruptions while diagnosticand therapeutic related factors were the lowest frequent reason intheir assessment of factors contributing to nosocomial anemia insixty five critically ill patients in Alexandria-Egypt.Thisresult is similar tothe findings of McClave et al[(8)]whoreported feeding interruptions of up to 1 hour for the performance of routine nursing procedures, presumably because nurses forgot to restart the feedings when the procedure was completed. If the flow of formula is interrupted frequently throughout the day to reposition patients, caloric intake could be seriously compromised. On the contraryQuenot et al,[(11)]reported that calories prescribed and actually delivered are often below the patients theoretical needs, because of late initiation, unjustified or excessively long interruptions, diagnostic procedures, airway management, mechanical problems, and failure to reinstall GRV samples.

Hence within this study there were significant correlations between the simplified acute physiology score II (SAPS) and duration of tube feeding interruption among critically ill patients.Patients with a higher SAPS II score (high severity of illness) were less likely to receive enteral nutrition due to increase the duration of tube feeding interruption. Juliana [(13)]evaluatedcritically ill patients before and after the introduction of evidence based guidelines for providing nutritional support in the ICU, the researcher found ICU patients with higher SAPSII score were less likely to receive enteral nutrition. The likelihood of patients receiving enteral nutrition decreased by 4% for every additional 1-point increase in their SAPS II score.

Nurses' role is crucial in nutrition related care as they are conducting nutritional screening, assessment, monitoring and delivery of safe nutritional care according to standardize of nutritional support practices which leading to improved patients' clinical outcomes .

## V. Conclusion

It can be concluded that there is an inadequacy of enteral nutritional intake for critically ill patients. In addition, the factors affecting nutritional adequacy delivered by enteral feeding are changingposition, suctioning, morning care, extubation, feeding on hold for increasing residual volume, NPO, surgical procedures, diagnostic procedures and patient's illness .In the present study the gastric intolerance (diarrhea, emesis, and gastric residual volume), the simplified acute physiology score II, and the duration of tube feeding interruption are also associated with patient's receiving less calories less than the required. Therefore, underfeeding among medical and surgical intensive care patientsare common and may lead to complications that results in long ICU admissions.

## VI. Recommendation

**Based on the result of the present study, it can be recommended to:**

1. Develop specific nutritional protocols for patients have enteral feeding.
2. Using a multidisciplinary approach to nutritional support, regular training of medical and nursing staff involved in nutritional support, increase compliance with enteral nutritional guidelines.
3. Routine review of prescribed and actual caloricintake might help to achieve optimal nutrition care for critically ill patients.
4. Measuring the simplified acute physiology score II daily to limit gastric Intolerance.

**Section (1):-Demographic and enteral feeding tube characteristics**

**Table 1: Distribution of the study subject according to demographic data:**

| Item | Frequency | Percent |
|---|---|---|
| **Age** | | |
| 16-25 | 8 | 20.0 |
| 26-50 | 13 | 32.5 |
| 51-75 | 11 | 27.5 |
| 76-92 | 8 | 20.0 |
| **Mean ± Std** | 50.75±23.118 | |
| **Gender** | | |
| Male | 24 | 60% |
| Female | 16 | 40% |
| **Surgical procedure** | | |
| Yes | 20 | 50% |
| No | 20 | 50% |
| **Weight On admission** | | |
| 36 – 52 | 9 | 22.5 |
| 53 – 69 | 15 | 37.5 |
| 70 – 86 | 12 | 30 |
| 87 – 103 | 4 | 10 |
| **Mean ± Std** | 64.53±15.62 | |
| **Height** | | |
| 141-156 | 4 | 10% |
| 157-171 | 25 | 62.5% |
| 172+ | 11 | 27.5% |
| **Mean ± Std** | 167.27±10.525 | |

Table (1) shows that the almost one third of the study sample was in age (26-50) years. (60%) were men. the half of the subject had surgical Procedure. There were (37.5%) with basic weight (53-69) kg., more than the half of study sample had height (157-171) cm.

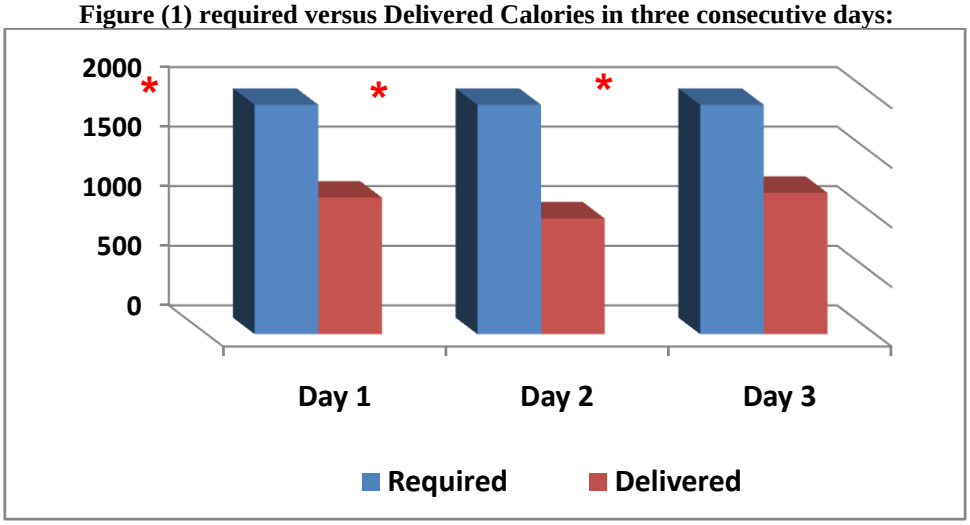
**Table 2: Distribution of the study subjects according enteral feeding tube characteristics**:-

| Items | Frequency | Percent |
|---|---|---|
| **Type of tube** | | |
| Corpak med system | 9 | 22.5% |
| Flexiflo | 27 | 67.55% |
| Kendal | 3 | 7.5% |
| Kendal and flexiflo | 1 | 2.5% |
| **Size of tube** | | |
| 12 | 8 | 20% |
| 14 | 27 | 67.7% |
| 16 | 4 | 10% |
| 18 | 1 | 2.5% |
| **Location of tube feeding** | | |
| Stomach | 40 | 100% |
| **Type of formula** | | |
| Ensure plus | 15 | 37.5% |
| Nephro | 12 | 30% |
| Glucerena | 10 | 25% |
| Nephro and Ensure plus | 1 | 2.5% |
| Ensure plus and Nephro | 2 | 5% |
| **Reason for enteral feeding tube** | | |
| Intubation | 23 | 57.5% |
| Intubation and sedation | 16 | 40% |
| Cannot consume oral feeding | 1 | 2.5% |

The findings in table (2) shows that more than half of study sample (67.55%), they got their nutritional feeding through flexiflo tube, and (67.7%) of the study sample using tube size (14). The entire study sample had stomach access for feeding tube. There were (37.5%) of them were taking Ensure plus formula. The nearly half of study sample had intubation as a reason for enteral feeding tube (57.5%).

**Section (2):- Comparison between required Calories and Delivered Calories:-**

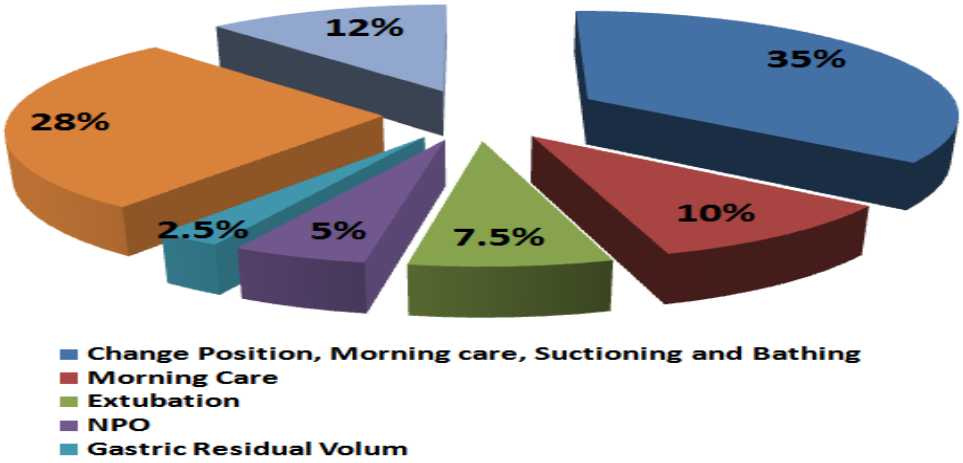
**Figure (1) required versus Delivered Calories in three consecutive days:**




The Previous figure (1) shows the required energy compared with energy intake in three consecutive days by using t test. It can be seen that there was a highly significant difference between them at *($P < 0.05$).

**3-Section (3) Factors affecting enteral feeding:**

**Figure (2) Frequency distribution of interruption reasons of enteral feeding.**




This Figure (2) represents that changing position, suctioning was the common reasons (35%) for enteral feeding tube interruption, followed by 28 % for all reasons mentioned in the table.

**Table (3) Regression of predictor variables on adequacy of enteral nutritional intake.**

| Model | Sum of square | df | Mean square | F | Sig |
|---|---|---|---|---|---|
| **Regression** | 3773387.249 | 5 | 754677.450 | 4.941 | .002 |
| **Residual** | 5192687.859 | 34 | 152726.113 | | |
| **Total** | 8966075.108 | 39 | | | |

This table (3) reveals the significant effect of all constant predictor together (Predictor constant, Gastric residual volume, simplifies acute physiology score II, diarrhea, emesis. Dependent variable: - enteral intake) on enteral tube feeding ( $P < 0.05$) .

**Table (4) the relation of simplified acute physiology score II (SAPS) on enteral feeding tube during three days.**

| Model | Under-Standardized coefficient | | Standardized coefficient | | |
|---|---|---|---|---|---|
| | B | Std.Error | Beta | T | sig |
| **Constant** | 1884.628 | 239.397 | | 7.872 | .000 |
| **Diarrhea** | 300.160 | 296.094 | .138 | 1.014 | .318 |
| **SAPS** | -12.627 | 5.113 | -.337 | -2.469 | .019 |
| **Emesis** | 223.905 | 1281.768 | .025 | .175 | .862 |
| **Duration of feeding interruption** | -66.569 | 16.403 | -.556 | -4.058 | .000 |
| **GRV** | 1.055 | 1.531 | .094 | .689 | .495 |

Table (4), revealed that the all predictors (together) are significantly effective on each other (P=.002) but there is a highly significant relationship only between the Simplified Acute Physiology Score II and duration of feeding interruption ($P < 0.05$).

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