Nutrition
to Improve Outcomes

Delivery of Enteral Nutrition Improved After Transition to Closed Enteral Feeding System

Nutrition plays a critical role in patient care. Enteral nutrition (EN) support is often indicated in patients with a functional gastrointestinal tract who are unable to meet their nutritional needs through oral intake alone. In patients receiving EN, formula is delivered through a flexible catheter feeding tube into the stomach or small intestine (Padula, Kenny, Planchon, & Lamoureux, 2004). EN support products are classified as being either open system (OS) or closed system (CS).

In an OS, formula from ready-to-use cans, bottles, or tetra paks are poured into the enteral feeding container (usually a bag). Nurses generally have to refill the feeding bag with formula every 4-8 hours due to infection control guidelines; however, this may vary from institution to institution (Phillips, Roman, & Glassman, 2013). In a CS, the manufacturer prefills a ready-to-hang sterile container with formula. The container is spiked using a sterile tubing set before being connected to the patient's feeding tube and is then infused into the patient without further manipulation of the system (Vanek, 2000). CS products are often marketed as having a 48-hour hang time, based on manufacturers' recommendations (Luther, Barco, Chima, & Yowler, 2003). However, many institutions can use them only with a 24-hour hang time due to the need to change EN tubing every 24 hours (Phillips, Roman, & Glassman, 2013).

Provision of adequate nutrition via EN has been shown to decrease a patient's length of hospital stay by reducing complications and improving his or her response to therapies (Silkroski, Allen, & Storm, 1998). In an institution utilizing an OS of EN delivery, a patient may go without feeding due to delay in refilling the bag. Therefore, hypothetically, a patient receiving EN through a CS instead of an OS may receive a greater percentage of ordered volume of formula. The research behind this idea is limited.

In a study done by Rees, Ryan, Attrill, and Silk (1988), patients (n=25) receiving EN through a CS received a significantly greater amount of tube feeding compared to those receiving EN via an OS. Similarly, in a study done by Silva, Assis, Silveira, Beghetto, and Mello (2012) that compared ICU patients receiving EN using the OS (n=85) to the CS (n=70), the authors found that patients receiving nutrition through a CS received more volume of EN and more protein (as reported in g/kg) ($p<0.05$). However, higher calories per kilogram of body weight were prescribed to the OS group and higher volume (as reported in mL/kg) and protein (g/kg) were prescribed to the CS group. Therefore, patients on a CS likely received a greater volume of formula than the patients on an OS because they were prescribed a higher volume, not because of the system utilized. Furthermore, another study (n=417) found that patients on an OS were only receiving 70% of their prescribed tube feeding because of frequent discontinuations and delays in refilling feeding bags (Silkroski et al., 1998).

Purpose of This Study

Previous research done by Phillips and colleagues (2013) at an academic medical center showed that switching from an OS to a CS of EN is beneficial from an economic standpoint. To further investigate the switch from an OS to a CS of feeding at the same facility, this project specifically focused on the amount of formula delivered to patients before and after switching from an open to a closed EN feeding system.

Methods

This quality improvement project did not involve any changes in patient therapy. Both retrospective and prospective data was collected on patients receiving continuous EN before and after switching from an OS to a CS at the author's institution. Retrospective data included patients receiving EN through an OS. Prospective data included patients receiving EN through a CS. The following information was collected on each patient after receiving continuous feedings for 3 consecutive days: the type of formula ordered, ordered volume (mL/24 hour), and actual volume received (mL/24 hour) according to nursing documentation in the electronic medical record. Days that the patient was NPO were excluded from analysis. A total of 325 feeding days were analyzed on 30 adult patients receiving formula via the OS and 237 feeding days on 30 adult patients receiving formula via the CS (see Table 1). Data was organized, tabulated, and statistically analyzed and reported via descriptive results.

Results

Patients receiving formula in an OS received an average of 74% of ordered volume and patients receiving formula in a CS received an average of 84% of ordered volume ($p\leq0.05$) (see Figure 1). The ranges of ordered volume received per patient in both the open system (43-104%) and the closed system (59-104%) are shown in Table 2.

Discussion

Reasons for EN discontinuation are often unavoidable, occurring primarily because of clinical instability and/or performance of diagnostic and therapeutic procedures (Silva et al., 2012). With a CS, it is less likely that a patient will go with-

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Table 1.
Comparison of Number of Patient and Data Points Collected in Each Enteral System Type

Type of Feeding System	Number of Patients	Total Number of Days on EN Evaluated
Open	30	325
Closed	30	237

Table 2.
Average Percent of Formula Received Compared to Ordered Volume Per Patient in Each Enteral Nutrition Delivery System Type

Type of EN Delivery System	Average Volume Received Compared to Volume Ordered	Range of Ordered Volume of Formula Received Per Patient (%)
Open	74%	43-104%
Closed	84%	59-101%

out feeding due to an empty bag because nurses are not required to refill the feeding container every 4-8 hours. Consequently, it is assumed that using a CS results in greater percentage of ordered formula delivery.

Other potential benefits of the CS of EN delivery include that it is easier to administer than the OS, and because of this, has been associated with reduction of nursing time and labor costs. In addition, the CS has been associated with decreased risk of nosocomial infections in patients (Herlick, Vogt, Pangman, & Fallis, 2000; Silkroski et al., 1998; Wagner, Elmore, & Knoll, 1994; Vanek, 2000). Therefore, CS may be safer for the patient and economically beneficial for the institution, while simultaneously increasing nutrient delivery.

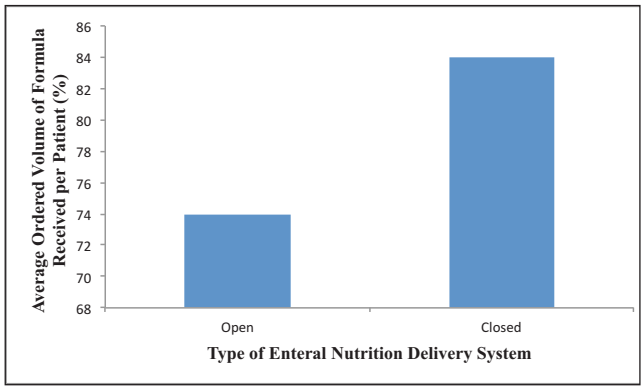
There are limitations to the project. Data collection for the CS began only seven days after the author's facility switched to a CS; therefore, results may have been skewed due to staff unfamiliarity with the new system. Furthermore, the likelihood that discontinuations of feeding were mainly due to diagnostic and therapeutic procedures rather than an empty feeding container cannot be overlooked.

Future research evaluating EN formula delivery should look at clinical outcomes of patients after receiving their total estimated nutritional needs or 100% of the ordered volume of formula/day. Examples of clinical outcomes that could be evaluated include, but are not limited to, improved wound healing, successful weaning from the ventilator, discharge from the ICU, recovery or lack of infectious complications, and survival.

Conclusion

At the author's institution, adult patients receiving EN via a CS received, on average, a greater percentage of ordered volume of formula compared to those patients receiving EN via an OS. Because a CS of EN delivery has also shown to be easier to administer, more cost effective, and safer for the patient, it may be advantageous for medical institutions to utilize this method of EN delivery.

Figure 1.
Comparison of Average Percent Ordered Volume of Formula Received Per Patient in Each Enteral System Type ($p<0.05$)



References

Herlick, S.J., Vogt, C., Pangman, V., & Fallis, W. (2000). Clinical research: Comparison of open versus closed systems of intermittent enteral feeding in two long term care facilities. *Nutrition in Clinical Practice, 15*, 287-298.

Luther, H., Barco, K., Chima, C., & Yowler, C.J. (2003). Comparative study of two systems of delivering supplemental protein with standardized tube feedings. *Journal of Burn Care Rehabilitation, 24*(3), 167-172.

Padula, C.A., Kenny, A., Planchon, C., & Lamoureux, C. (2004). Enteral feedings: What the evidence says. *American Journal of Nursing, 104*(7), 62-69.

Phillips, W., Roman, B., & Glassman, K. (2013). Economic impact of switching from an open to a closed enteral nutrition feeding system in an acute care setting. *Nutrition in Clinical Practice, 28*(4), 510-514.

Rees, R.G., Ryan, J., Attrill, H.A., & Silk, D.B. (1988). Clinical evaluation of two-liter prepacked enteral diet delivery system: A controlled trial. *Journal of Parenteral and Enteral Nutrition, 12*(3), 274-277.

Silkroski, M., Allen, F., & Storm, H. (1998). Tube feeding audit reveals hidden costs and risks of current practice. *Nutrition in Clinical Practice, 13*, 283-290.

Silva, S.M., Assis, M.C., Silveira, C.R., Beghetto, M.G., & Mello, E.D. (2012). Open versus closed enteral nutrition systems for critically ill adults: Is there a difference? *Revista da Associacao Medica Brasileira, 58*(2), 229-233.

Vanek, V. (2000). Closed versus open enteral delivery systems: A quality improvement study. *Nutrition in Clinical Practice, 15*(5), 234-243.

Wagner, D.R., Elmore, M.F., & Knoll, D.M. (1994). Evaluation of "closed" vs "open" systems for the delivery of peptide-based enteral diets. *Journal of Parenteral and Enteral Nutrition, 18*(5), 453-457.

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