

Managing glycaemic trends in people with diabetes requiring enteral feeding support: The challenges in primary and secondary care

Erica A Richardson, Nneka Agbasi, written on behalf of TREND-UK

Matching therapeutic treatments to manage glycaemic excursions in people with diabetes receiving enteral nutrition (e.g. nasogastric, gastrostomy or jejunostomy) can be difficult. There is evidence to suggest that there is an increased risk of complications and mortality, longer lengths of stay in hospital, higher risk of intensive care input and higher demands for transitional or nursing home care post discharge. Other intrinsic factors, such as illness, timing of medications, poly-pharmacy, types of feeding regimen chosen and history of diabetes, all need to be considered when choosing appropriate treatments. This article describes the challenges of supporting people with diabetes requiring enteral feeding and the implications for diabetes nurses.

The number of people living with diabetes in the UK is estimated to be 4.5 million (Diabetes UK, 2016). With one in seven inpatient hospital beds occupied by someone with diabetes (this number rises to 30% in some areas) and increasing numbers of people being diagnosed with diabetes, it is little wonder that the number of individuals requiring specialist input to manage associated risk has also risen (NHS Digital, 2016).

As a result, there has been an increased focus on the management of hyperglycaemia and diabetes in many observational and randomised controlled trials over the past two decades (Mabrey et al, 2015). With the advances in medical treatments and technology, and close association between diabetes and microvascular disease, there is a growing population of people surviving these events (Stroke Association, 2016). These events, however, will often leave people with some degree of disability, dependence and requirements for ongoing medical support, including nutritional

deficiencies and requirements for enteral feeding support (Joint British Diabetes Society for Inpatient Care (JBDS-IP, 2012).

Although NICE published guidance on nutritional support for adults receiving enteral tube feeding and parental nutrition (NICE, 2006), this was not specific for use with people with diabetes. In 2012, the JBDS-IP introduced guidance on glycaemic management during the inpatient enteral feeding of stroke patients with diabetes (JBDS-IP, 2012). Despite this, there still remains a number of individuals requiring enteral feeding therapy that sit outside of this guidance.

This article aims to describe some of these issues in further detail and highlight how the management may differ from an inpatient to community setting.

Introduction

The impact of poor glycaemic control on long-term clinical outcomes is well recognised in both type 1 and type 2 diabetes (UKPDS, 1998; Nathan, 2014). With most standard enteral

Citation: Richardson EA, Agbasi N (2017) Managing glycaemic trends in people with diabetes requiring enteral feeding support: The challenges in primary and secondary care. *Journal of Diabetes Nursing* 21: 241–6

Article points

1. With the advances in medical treatments, there is a growing population of people surviving microvascular events, leaving many people requiring enteral feeding support.
2. Guidance regarding managing glycaemic excursions in people with diabetes requiring enteral support is lacking. This article outlines some of the management issues in both the inpatient and community settings.
3. Timings of medications and enteral nutritional feeding support are essential, as is the education of healthcare professionals around medications and risk avoidance. It is also essential that treatment is tailored to the individual.

Key words

- Enteral feeding
- Hyperglycaemia
- Hypoglycaemia

Authors

Erica A Richardson is Adult Diabetes Nurse Specialist, Shrewsbury and Telford NHS Trust; Nneka Agbasi is Diabetes Nurse Specialist, Barnet, Enfield and Haringey Mental Health Trust

Page points

1. There are three key considerations when commencing enteral therapy in order to achieve appropriate individualised glycaemic control: prior history of diabetes, hypoglycaemia or hyperglycaemia; timing of feeds and consumption of oral nutrition in addition to enteral feed.
2. When other considerations are added, such as poly-pharmacy, altered absorption rates and resting times, the management of the glycaemic excursions may become very difficult to manage in this patient group.
3. Research shows a significant relationship between the level of stress and depression found in people whose lifestyle had changed because of enteral feeding.

nutritional formulas containing high amounts of carbohydrate, it is essential that therapeutic guidance is available to ensure that glycaemic control is well managed.

Mabrey et al (2015) suggest the following key considerations are essential when commencing enteral therapy, to achieve appropriate individualised glycaemic control:

- Prior history of diabetes, hypoglycaemia or hyperglycaemia.
- Timing of feeds: nocturnal, continuous or bolus.
- Consumption of oral nutrition in addition to enteral feed.

When other considerations are added, such as poly-pharmacy, altered absorption rates and resting times, the management of the glycaemic excursions may become very difficult to manage (Draznin et al, 2013).

This article will focus on the management of glycaemic excursions with insulin therapy, as there is little evidence proving efficacy in enteral feeding with most oral antidiabetes agents due to complications associated with administration (JBDS-IP, 2012). Most oral antidiabetes agents are not available in liquid form, apart from metformin. Tablets should not be crushed due to the risk associated with altered composition, efficacy and possible toxicity of these medications (Institute For Safe Medication Practices, 2010).

Considerations

The psychological impact

Research shows a significant relationship between the level of stress and depression found in people whose lifestyle had changed because of enteral feeding (Rickman, 1998). Hunt (2007) also highlights the stress related to social aspects of eating and the impact of enteral feeding requirements on family dynamics. In addition, there may be low mood relating to glycaemic excursions, recurrent infections, requirements for continuous dose adjustment of diabetes medication, and on occasions, decreased functional or mental ability and possible pressure sores. It is little wonder that both studies suggest the need for more multi-agency involvement, and requirements for ongoing practical and

psychological support for both people requiring enteral feeding and their carers. Since both these studies, there has been significant improvements in mental health support and the guidance by NICE (2006) suggests that healthcare professionals should escalate concerns to the individual's GP or the mental health team for support.

Communication problems

Language barriers can affect the communication process to enable better management. It helps if an agreement is made with the person to nominate a representative to communicate concerns and agree treatment options.

Altered absorption rates and delayed gastric emptying

Altered absorption rates and delayed gastric emptying may exist in people with critical illness and those with long-standing or poorly controlled diabetes (Deane et al, 2014; Phillips et al, 2015) Also, it is not truly understood how the continuous intestinal glucose exposure may affect the action of incretin hormones (gastric inhibitory polypeptide and glucagon-like peptide-1). This may contribute to hyperglycaemia in people both with and without a pre-existing diabetes diagnosis (Bharucha et al, 2014.) Often, the first indicator of such issues is identified through glycaemic excursions. The healthcare teams then have the arduous task of adjusting anti-glycaemic medications to manage this.

Steroid therapy

Administration of glucocorticoids usually has a detrimental effect on glycaemic control, as steroid treatment increases the amount of glucose produced by the liver. Steroids can suppress endogenous insulin production (JBDS-IP, 2014a; TREND-UK, 2017) presenting a significant challenge for both inpatient and community management. Often the dose and frequency of steroid administration can vary and the dose may be stopped abruptly. Depending on preparation of steroid used and frequency of administration, there may be glycaemic excursions for 6–48 hours (JBDS-IP, 2012; Draznin et al, 2013).

Infection and antibiotics

The use of antibiotic medication is associated with the development of gastrointestinal disturbances (diarrhoea), through alteration of gut flora levels. This may lead to altered absorption levels of essential vitamins and minerals (Whelan et al, 2011; Perez-Cobas et al, 2013; Blumenstein et al, 2014). There is evidence that avoiding gastric acid suppression and allowing breaks in feeding to allow gastric pH levels to fall aids in the prevention of bacterial overgrowth during feeding (Stroud et al, 2003). Additional studies suggest that using feeds with different fibre mixtures may be the most promising strategy for the prevention of diarrhoea (Elia et al, 2008; Kamarul Zamen et al, 2015). However, studies relating to fibre in feeds and reduction in glycaemic excursions remain controversial due to the lack of conclusive trial data (Elia et al, 2005; Gosmanov and Umpierrez, 2012; Tarleton et al, 2013).

Hyperglycaemia is associated with infection, especially when coupled with enteral feeding (Gosmanov and Umpierrez, 2012); however, effective management of glycaemic excursions through regular blood glucose (BG) management is proven to reduce the complications associated (Mendes and Palmer, 2016).

Erratic BG levels often occur when both infection and pain are experienced. This may relate to regular repositioning to ease symptoms of pain, poor response to simple analgesia that may be made worse through use of the tube, and the body’s response to adrenalin and cortisol. The presence of erratic BG levels may be the first indication of the presence of infection (National Patient Safety Agency, 2010; Haywood, 2012).

Weight gain/loss

Enteral feeding is often coupled with reduced mobility, which may cause weight gain. This is especially the case if given in conjunction with steroids, certain mental health medication, or insulin. Variation in a person’s weight will alter their insulin sensitivity levels (Diabetes.co.uk, 2017). This will require alteration of both insulin doses and feed requirements. Reduced calorie feeds may be recommended to avoid further weight gain and reduce the possibility of insulin resistance (Pohl et al, 2005).

Monitoring

The guidance around BG targets for people receiving enteral nutritional support suggests a target range of 6–12 mmol/L (JBDS-IP, 2012; 2014a). There are guidelines that stipulate the regularity of BG monitoring (JBDS-IP, 2012). While there is some variance around this, the common theme relates to patient safety in respect of reducing the possibility of hypoglycaemia. Consensus identifies the need for 4–6 hourly BG monitoring in those on established feeding regimens. Variable rate intravenous insulin infusion (VRII) is recommended for the management of glycaemic control in the acutely ill person when commencing and establishing enteral nutritional support (Kelly, 2014). Monitoring of these individuals should follow the national standards (JBDS-IP, 2014b).

The JBDS-IP (2012) guidelines suggest that people with type 1 diabetes who have BG ≥15 mmol/L on two consecutive occasions should undergo blood or urinary ketone assessment. In the presence of significant ketosis (blood ketones >3 mmol/L or ketonuria >2+),

Page points

1. Hyperglycaemia is associated with infection, especially when coupled with enteral feeding; however, effective management of glycaemic excursions through regular blood glucose management is proven to reduce the complications associated.
2. The guidance around blood glucose targets for people receiving enteral nutritional support suggests a target range of 6–12 mmol/L.
3. Consensus identifies the need for 4–6 hourly blood glucose monitoring in those on established feeding regimens.

Table 1. Feeding regimens and suggested insulin regimens.

Type of feeding regimen	Examples of insulin regimen
Continuous feeding or TPN usually used in acute setting.	Variable rate insulin infusion (see below). For those with type 1 diabetes, continue basal insulin.
Supplementary/prolonged feeding (8–20 hour feed).	NPH insulin at beginning of feed. Or: Pre-mixed insulin at start and mid-point of feed. Or: For people receiving supplementary feed and also eating orally: NPH insulin at start of feed and bolus rapid-acting insulin with oral intake/meals. For people with type 1 diabetes, continue basal insulin and add soluble insulin at start and midway through feed.
Bolus feeding.	Soluble insulin given at beginning of each feed. For people with type 1 diabetes, continue basal insulin.

NPH=neutral protamine Hagedorn; TPN=total parenteral nutrition.

Box 1. Factors influencing hypoglycaemia in enteral feeding (JBDS-IP, 2012).

- Feed stopped to give medication
- Blocked feeding tube
- Feed stopped for physiotherapy/procedure
- Vomiting
- Misplacement or removal of nasogastric tube
- Insulin and oral medication (metformin) not given at appropriate time for feed
- Alteration of type of feed, rate or volume, or timing of feed
- Change in time or duration of rest period
- Hypoglycaemia in the previous 24 hours
- Increased physical activity (e.g. during physiotherapy input)
- Use of steroids or cessation

care staff should consider use of an intravenous insulin infusion (inpatient only) or correction doses of rapid-acting insulin to suppress ketone body formation and refer the person urgently to a DSN or emergency care provider.

Feeding and insulin regimen decision

The choice of the insulin therapy used should match the predicted rise and profile of BG levels. This will depend on the frequency, duration and carbohydrate content of the feeding regimen. A mismatch will result in hyperglycaemia (and therefore loss of calories) or hypoglycaemia requiring immediate action. *Table 1* summarises some commonly used feeding regimens and suggested insulin regimens.

Regular BG monitoring is used to determine the effectiveness of the insulin dose, which should be adjusted as required to maintain BG levels within the individual target range. It is important to clarify the type of diabetes the person has, as insulin should never be omitted in type 1 diabetes due to the risk of ketosis and associated complications (JBDS-IP, 2012).

It is important to note that people may try a number of the different feeding regimens while the feed is being established and tailored for each person's individual requirements; however, the majority of people living with diabetes and requiring prolonged enteral feeding in the community are on a percutaneous endoscopic gastrostomy feed regimen (Gomes et al, 2014). A nasogastric tube is not normally recommended for long-term use due to the risk of tube dislodgement (Rowat, 2017).

Hypoglycaemia

Box 1 summarises the factors influencing hypoglycaemia in enteral feeding. For this group of individuals, episodes of hypoglycaemia are not uncommon. With this in mind, we have developed the flow chart for the treatment of hypoglycaemia in people with diabetes requiring enteral feed (*Figure 1*).

The insulin management should then be reviewed with referral to specialist diabetes nurses for advice, especially if hypoglycaemia recurs (JBDS-IP, 2012; 2013).

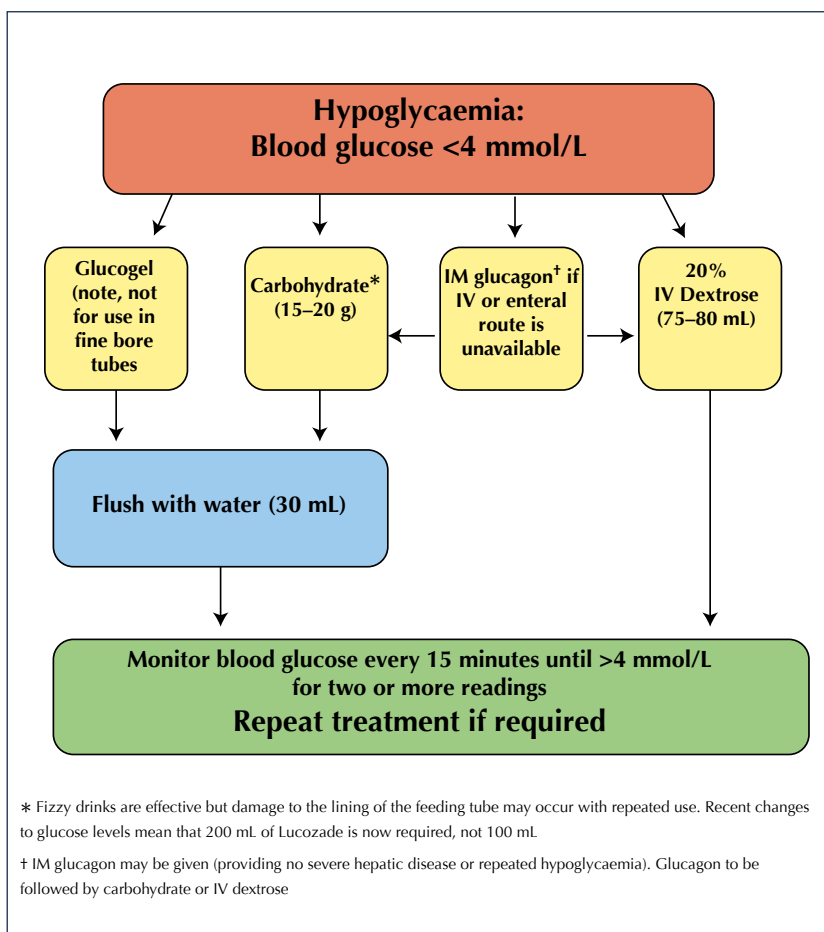


Figure 1. Hypoglycaemia treatment flowchart for people with diabetes requiring enteral feed (Dandelees and Lodolce, 2011; JBDS-IP, 2012; 2013; 2014b; Fisher and Blalock, 2014).

Inpatient management perspective

Often these individuals are acutely unwell and the aims of treatment are stabilisation of acute illness, healing and maintenance of homeostasis (Blumenstein et al, 2014; Mabrey et al, 2015). Managing glycaemic excursions in hospitalised people that require nutritional support can be difficult due to the range of presenting conditions. These individuals may be sedated, non-mobile and confused, making it difficult to maintain safe enteral feeding access, or mobile and requiring nocturnal feed regimens to allow other therapeutic interventions to aid their recovery.

Although it is expected that those receiving care within the hospital setting are usually concordant to therapy, this is not always the case. Individuals may leave ward areas, consume additional foods or delay feeding. In addition, scheduled subcutaneous insulin may be difficult

to implement safely. These may relate to feeding delivery interruptions, investigations, rehabilitation and lack of access, including blocked tubes (Draznin et al, 2013; Fisher and Blalock, 2014) or equipment failures (White and King, 2014). Therefore, a multidisciplinary approach to care is essential as often treatment changes have an interaction/reaction and require a multi-faceted approach to enable effective management (JBDS-IP, 2012).

Community perspective

It may be assumed that people living with diabetes discharged into the community with enteral feeding have the right tools to manage this, but this may not always be the case. These people have been discharged from a controlled environment where the hospital multidisciplinary teams are rapidly available. Often they may be discharged to areas where there is little knowledge around the care and management of these clinical issues, a high turnover of staff and little emphasis on the importance of training in this area (National League for Nursing, 2017). Support from the multidisciplinary team should include both secondary and primary care, pharmacists, district nurses, specialist nutrition professionals, and residential and home care staff. There should be ongoing liaison between the individual and all necessary health professionals from diagnosis, and contact numbers should be provided in case of a potential problem (NICE, 2006; Hughes, 2012).

Conclusion

A case study showing the management of a woman with type 2 diabetes who required enteral feeding after a stroke is shown in *Box 2*. The case study describes the management of the enteral feeding and the move to insulin infusion.

Although the care settings may differ, the management of glycaemic excursions and different contributing factors are not dissimilar. Timings of medications and enteral nutritional feeding support are essential, as is the education of healthcare professionals around medications and risk avoidance (JBDS-IP, 2012). Choosing therapies that fit the needs of the individual and

Page points

1. Although it is expected that those receiving care within the hospital setting are usually concordant to therapy, this is not always the case. Therefore, a multidisciplinary approach to care is essential.
2. Continued support for people with diabetes on enteral feeding regimens in the community is essential and should involve a multidisciplinary team.
3. Timings of medications and enteral nutritional feeding support are essential, as is the education of healthcare professionals around medications and risk avoidance.

Box 2. Case study.

Betty was admitted to the hospital following a stroke. She has had type 2 diabetes for 15 years, previously was managed with metformin and gliclazide. The stroke left her with dysphagia; she was no longer able to take her oral medications and she required enteral feeding.

During her acute phase of illness, the feed was given continuously, and an insulin infusion was commenced and adjusted to match her glycaemic excursions. As Betty's condition improved she commenced the rehabilitation process. This made continuous feed impractical due to the multiple interruptions during the working day when these visits occurred. The multidisciplinary team (MDT) decided to switch Betty to nocturnal feed. The insulin infusion stopped and NPH (neutral protamine Hagedorn) insulin introduced at the start of the feed. Her glycaemic control remained poor and she was switched to pre-mixed insulin at the start of the feed and half way through.

Betty was discharged to a care home for ongoing convalescence and rehabilitation. The nocturnal feed continued and Betty started to take small amounts of cold soft diet. At this point, the MDT advised small doses of rapid-acting insulin with these meals. The nutritional requirements were reassessed and the nocturnal feed and the related insulin doses were also reduced.

“Timings of medications and enteral nutritional feeding support are essential, as is the education of healthcare professionals around medications and risk avoidance.”

avoiding acute complications should remain the main focus of treatment. ■

Acknowledgements

The development of this article was supported by the co-chairs of TREND-UK. Sincere appreciation to community specialist dieticians at Barnet, Enfield and Haringey Mental Health Trust and Shrewsbury and Telford NHS Trust for their valued contributions.

Bharucha AE, Camilleri M, Burton DD et al (2014) Increased nutrient sensitivity and plasma concentrations of enteral hormones during duodenal nutrient infusion in functional dyspepsia. *Am J Gastroenterol* **109**: 1910–20

Blumenstein I, Shastri YM, Stein J (2014) Gastroenteric tube feeding: Techniques, problems and solutions. *World J Gastroenterol* **20**: 8505–4

Dandeleo LM, Lodolce AE (2011) Efficacy of agents to prevent and treat enteral feeding tube clogs. *Ann Pharmacother* **45**: 676–80

Deane AM, Rayner CK, Keeshan A et al (2014) The effects of critical illness on intestinal glucose sensing, transporters and absorption. *Crit Care Med* **42**: 57–65

Diabetes UK (2016) *Facts and stats*. Diabetes UK, London. Available at: <https://is.gd/VLKeU2> (accessed 01.11.17)

Diabetes.co.uk (2017) *Insulin resistance*. Diabetes Digital Media Ltd, Coventry. Available at: <https://is.gd/houAaG> (accessed 01.11.17)

Draznin B, Gilden J, Golden SH, Inzucchi SE (2013) Pathways to quality inpatient management of hyperglycaemia and diabetes: A call to action. *Diabetes Care* **36**: 1807–14

Elia M, Coriello A, Laube H et al (2005) Enteral nutritional support and use of diabetes-specific formulas for patients with diabetes. *Diabetes Care* **28**: 2267–79

Elia M, Engfer MB, Green CJ, Silk DB (2008) The clinical and physiological effects of fibre-containing enteral formulae. *Aliment Pharmacol Ther* **27**: 120–45

Fisher C, Blalock B (2014) Clogged feeding tubes: A clinician's thorn. *Practical Gastroenterology* **127**: 16–22

Gomes F, Hookway C, Weekes CE (2014) Royal College of Physicians Intercollegiate Stroke Working Party evidence-based guidelines for the nutritional support of patients who have had a stroke. *J Hum Nutr Diet* **27**: 107–21

Gosmanov AR, Umpierrez GE (2012) Medical nutrition therapy in hospitalized patients with diabetes. *Curr Diab Rep* **12**: 93–100

Haywood S (2012) PEG feeding tube placement and aftercare. *Nursing Times* **108**: 20–2

Hughes S (2012) Diabetes: Support for those at risk of malnutrition in the community. *Br J Community Nurs* **17**: 529–30

Hunt F (2007) Changing from oral to enteral feeding: Impact on families of children with disabilities. *Paediatr Nurs* **19**: 30–2

Institute for Safe Medication Practices (2010) Preventing errors when administering drugs via enteral feeding tube. ISMP, Pennsylvania, US. Available at: <https://is.gd/wExdQY> (accessed 01.11.17)

Joint British Diabetes Societies for Inpatient Care (2012) *Glycaemic management during the in-patient enteral feeding of stroke patients with diabetes*. JBDS-IP, Solihull. Available at: <https://is.gd/IOIDRW> (accessed 01.11.17)

Joint British Diabetes Societies for Inpatient Care (2013) *The hospital management of hypoglycaemia in adults with diabetes mellitus*. JBDS-IP, Solihull. Available at: <https://is.gd/Qt413n> (accessed 01.11.17)

Joint British Diabetes Societies for Inpatient Care (2014a) Management of hyperglycaemia and steroid (glucocorticoid) therapy. JBDS-IP, Solihull. Available at: <https://is.gd/LsgWdj> (accessed 01.11.17)

Joint British Diabetes Societies for Inpatient Care (2014b) The use of variable rate intravenous insulin infusion (VRII) in medical inpatients. JBDS-IP, Solihull. Available at: <https://is.gd/aqMFKm> (accessed 01.11.17)

Kamarul Zaman MK, Chin KF, Rai V, Majid HA (2015) Fibre and prebiotic supplementation in enteral nutrition: A systematic review and meta-analysis. *World J Gastroenterol* **21**: 5372–81

Kelly JL (2014) Continuous insulin infusion: When, where and how? *Diabetes Spectr* **27**: 218–23

Mabrey M, Barton A, Corsino L (2015) Managing hyperglycaemia and diabetes in patients receiving enteral feedings: A health system approach. *Hosp Pract* **43**: 74–8

Mendes A, Palmer S (2016) Enteral feeding in community nursing. *Br J Community Nurs* **21**: 419

Nathan DM (2014) The Diabetes Control and Complications Trial. Epidemiology of diabetes Interventions and complications study at 30 years: Overview. *Diabetes Care* **37**: 9–16

National League for Nursing (2017) *Nursing shortage*. NLN, Washington DC, USA. Available at: <https://is.gd/LzrL86> (accessed 01.11.17)

National Patient Safety Agency (2010) *Early detection of complications after gastrostomy*. NPSA, Redditch. Available at: <https://is.gd/nwlr8S> (accessed 08.11.17)

NHS Digital (2016) *National Diabetes Inpatient Audit (NaDIA)*. NHS Digital, Leeds. Available at: <https://is.gd/KPVsMQ> (accessed 01.11.17)

NICE (2006) *Nutritional support for adults: Oral nutritional support, enteral tube feeding and parental nutrition*. NICE, London. Available at: www.nice.org.uk/guidance/cg32 (accessed 01.11.17)

Perez-Cobas AE, Gosalbes J, Friedrichs A et al (2013) Gut microbiota disturbance during antibiotic therapy: A multi-omic approach. *Gut* **62**: 1591–601

Phillips LK, Deane AM, Jones KL et al (2015) Gastric emptying and glycaemia in health and diabetes mellitus. *Nat Rev Endocrinol* **11**: 112–28

Pohl M, Mayr P, Mertl-Roetzer M et al (2005) Glycaemic control in type II diabetic tube-fed patients with a new enteral formula low in carbohydrates and high in monounsaturated fatty acids. *Eur J Clin Nutr* **59**: 1221–32

Rickman J (1998) Percutaneous endoscopic gastrostomy: psychological effects. *Br J Nurs* **7**: 723–9

Rowat A (2017) Enteral tube feeding for dysphasic stroke patients. *Br J Nurs* **24**: 138, 140, 142–5

Stroke Association (2016) *State of the Nation: Stroke statistics*. Stroke Association, London. Available at: <https://is.gd/Fspm2k> (accessed 01.11.17)

Stroud M, Duncan H, Nightingale J (2003) Guidelines for enteral feeding in adult hospital patients. *Gut* **52**(Suppl 7): viii–viii12

Tarleton SM, Kraft CA, DiBaise JK (2013) Fibre-enriched enteral formulae: Advantageous or adding fuel to the fire? *Practical Gastroenterology* **37**: 11–22

TREND-UK (2017) Type 2 diabetes and steroid tablets. TREND-UK, Northampton. Available at: <http://trend-uk.org> (accessed 01.11.17)

UK Prospective Diabetes Study Group (1998) Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes. *Lancet* **352**: 837–53

Whelan K, Schneider SM (2011) Mechanisms, prevention and management of diarrhoea in enteral nutrition. *Curr Opin Gastroenterol* **27**: 152–9

White H, King I (2014) Enteral feeding pumps: efficacy, safety, and patient acceptability. *Med Devices (Auckl)* **7**: 291–8



Read more online

Management of people with diabetes receiving artificial nutrition: A review

Sarah Jones and colleagues discuss the implications of artificial nutrition in people with diabetes .

Journal of Diabetes Nursing **21**: 179–83

Available at: <https://is.gd/jdnJones>