

# Glucagon availability and training in Yorkshire and the Humber: A survey and a new consensus guideline

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**Hypoglycaemia is a common and feared complication of type 1 diabetes and is often seen as a barrier to optimal glycaemic control. Intramuscular glucagon is an effective treatment for severe hypoglycaemia outside of the hospital setting. However, families of children with type 1 diabetes have raised concerns about the availability of glucagon and training in its delivery. This study aimed to assess parents' and healthcare professionals' views and practice with regards to glucagon availability and training within the Children and Young People's Yorkshire & Humber Diabetes Network, via completion of structured surveys. Surveys were returned by all 18 diabetes teams within the network and 403 families. The results have been used to develop a gold standard regarding provision of glucagon and training.**

**H**ypoglycaemia is the most common acute complication of type 1 diabetes (Ly et al, 2014). Severe hypoglycaemia involving seizures or coma occurs with an incidence of between 4.1 and 9.6 episodes per 100 person-years (Wagner et al, 2005; Katz et al, 2012). There is no universally agreed numerical value to define hypoglycaemia in people with diabetes; however, blood glucose levels under 3.3–3.9 mmol/L are generally considered to place people at risk of severe hypoglycaemia (Ly et al, 2014). Severe hypoglycaemia itself is defined in childhood as:

*“An event associated with severe neuroglycopenia usually resulting in coma or seizure and requiring parenteral therapy.” (Ly et al, 2014)*

The effects of hypoglycaemia on the developing brain are not clearly understood. Some studies have suggested that repeated severe hypoglycaemia may impact on cognitive function; however, results are inconsistent and in other studies no differences in neurocognitive outcomes were found (Wysocki et al, 2003; Strudwick et al, 2005; Ly et al, 2011).

In adults, the DCCT (Diabetes Control and Complications Trial Research Group, 1993) demonstrated a reduction in the risk of complications with intensive insulin therapy and improvements in HbA<sub>1c</sub>; however, such therapy resulted in a three-fold increase in the risk of severe hypoglycaemia. Similar results have been seen in children and young people (CYP), with the youngest children at greatest risk (Davis et al, 1998). As a result, hypoglycaemia has often been seen as a barrier to improving glycaemic control. Although recent evidence suggests the risk of severe hypoglycaemia associated with tighter diabetes control is falling (Karges et al, 2014), hypoglycaemia remains one of the most feared complications of type 1 diabetes, and fear of hypoglycaemia has been shown to be associated with worse diabetes control (Hawkes et al, 2014).

In the majority of episodes, hypoglycaemia is mild and can be managed with oral dextrose. However, in episodes of severe hypoglycaemia, in which there is loss of consciousness, parenteral therapy with either intravenous dextrose-containing fluids or intramuscular glucagon (particularly outwith the

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## Article points

1. Hypoglycaemia is a common and feared complication of type 1 diabetes.
2. Nationally, families have raised concerns regarding access to glucagon and training in its use.
3. These surveys identified little standardisation of practice regarding glucagon prescribing and training in the paediatric setting.
4. A gold standard has been devised, which aims to enhance practice and knowledge.

## Key words

- Children and young people
- Glucagon
- Hypoglycaemia
- Type 1 diabetes

## Authors

Author details can be found on page 39.

### Box 1. Content of survey 1 (diabetes teams' practice regarding glucagon).

#### Post-diagnosis:

#### 1. When do you teach glucagon training?

☐ Before Discharge ☐ First home visit ☐ First clinic ☐ Future clinic ☐ Never

#### 2. How do you teach the use of glucagon?

☐ Talk through it ☐ Role-play with glucagon training kit ☐ DVD  
☐ Other methods (please define)

#### 3. Who do you teach glucagon administration to (tick all which are relevant)?

☐ Parents ☐ Child ☐ Other family members ☐ School ☐ Other (please define)

#### 4. Once initial glucagon training has happened, how often do you do refresh education?

Frequency (please state)

Location: ☐ Clinic ☐ Home ☐ School ☐ Other (please define)

#### 5. Do your school care plans include information regarding the availability and use of glucagon?

☐ Yes ☐ No

#### 6. Do you have any other comments you would like to make?

(Please state)

2. To survey parents' views regarding (a) the availability of glucagon and training in its use they have received; and (b) current practice and opinions on provision of glucagon and training for others involved in the care of their children.
3. To develop a gold standard for the Yorkshire & Humber Network on the provision of glucagon and training to the families and carers of CYP with type 1 diabetes.

## Methods

Two separate surveys were designed by a working group consisting of both parental and professional representatives from the Yorkshire & Humber Network. Survey 1 was emailed by the network co-ordinator to each diabetes team in the network ( $n=18$ ). Each team was asked to complete and return the survey over a 4-week period in the autumn of 2015. The questions asked are outlined in Box 1.

Survey 2 was to be completed by the families of CYP with type 1 diabetes within the Yorkshire & Humber Network. There were 2770 CYP (up to 19 years of age) within the network at the time of the survey. Copies of the survey were distributed to families, who were asked to complete and return a copy of the questionnaire over a 6-week period in 2015. The questions asked are outlined in Box 2.

Results were compiled and analysed by the working group, after which a gold standard was drawn-up and approved by the network after several discussions at network meetings.

## Results

### Survey 1 – diabetes teams

All diabetes teams within the network ( $n=18$ ) completed and returned survey 1. All teams reported teaching administration of glucagon, with 50% doing so at diagnosis. The most common methods of teaching were talking through administration (66.6% of teams) and role-play (83.3%).

All teams taught glucagon delivery to parents; additionally, 83% taught other family members, 42% taught school staff and 29% taught the child/young person.

Training was refreshed annually in 42% of teams and on request in 45.8%. Two thirds of teams said their school care plans included glucagon.

hospital setting) may be required (Ly et al, 2014). Recent guidance from NICE (2015) is that:

*"Family members or carers and, where appropriate, school nurses and other carers should be trained and equipped to give intramuscular glucagon for severe hypoglycaemia in an emergency."*

The International Society of Paediatric and Adolescent Diabetes (Ly et al, 2014) suggests that:

*"Glucagon should be readily accessible to all parents and caregivers, especially when there is a high risk of severe hypoglycemia. Education on administration of glucagon is essential."*

Within the UK, concerns have been raised by the Families with Diabetes National Network (FWDNN) about inconsistencies in the prescribing and training in the delivery of glucagon, access to glucagon at school and the practices of families in carrying glucagon outside of the home (Maiden, 2015). With this in mind, the following study was developed. Its aims were:

1. To survey views of diabetes teams within the Children and Young People's Yorkshire & Humber Diabetes Network regarding (a) current practices in the prescription of glucagon for families; and (b) training provided to families and schools.



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## Article

Parents' perspectives  
on the provision of  
glucagon injection kits  
for the treatment of  
hypoglycaemic events

Paula Maiden presents the findings of a survey by the Families with Diabetes National Network and argues that glucagon injection kits should be available to all parents and carers of children with type 1 diabetes.

*Diabetes Care for Children & Young People* 4: 59–62

Available at:

<https://is.gd/DCCYPMaiden>

## Survey 2 – families

In total, 403 surveys were returned from 2770 families across the network (response rate, 15%). The responses are illustrated in *Figure 1*.

The majority of families had glucagon prescribed at diagnosis and were aware that it needed replacing. Two thirds reported receiving training in administration; however, only 17% had been offered retraining.

Overall, 79% of families were aware that glucagon should be carried when away from home, and 61% did so. Of those who carried glucagon away from home, 57% reported they only carried it when away overnight.

Overall, 20% of schools had access to glucagon, with 19% (69% of those with access to glucagon) having received training in its use. The majority of families (73%) felt that glucagon should be available in schools, compared to 10% who did not.

## Discussion

The results of this survey highlight that there is little standardisation of practice in relation to glucagon prescribing and training across the Children and Young People's Yorkshire & Humber Diabetes Network, with discrepancies reported among both diabetes teams and families.

## Glucagon training

Although all teams reported teaching administration of glucagon to families, only two thirds of families reported having received such training. Among these families, even fewer could recollect having had the opportunity to retrain after the first training session at the time of diagnosis, despite 42% of teams reporting that teaching was refreshed annually. Such discrepancies raise concerns about the efficacy of the current teaching methodology.

## Carrying glucagon when away from home

Although the majority of families are aware that glucagon should be carried away from home, remarkably few carry glucagon with them when away, particularly for short trips. However, the percentage of families who reported carrying glucagon regularly when away from home (43%) is higher than the 21% reported in a previous survey by the FWDNN (Maiden, 2015). The need for glucagon administration is rare; however, episodes

### Box 2. Content of survey 2 (families' views, knowledge and practice regarding glucagon).

#### At home:

##### 1. Was a glucagon hypokit prescribed at diagnosis?

☐ Yes ☐ No ☐ Don't know

##### 2. Are you aware that the glucagon hypokit has an expiry date and requires regular replacement?

☐ Yes ☐ No ☐ Don't know

##### 3. Did you receive training on how to administer the glucagon?

☐ Yes ☐ No ☐ Don't know

##### 4. If yes, have you been offered re-training on the how to administer the glucagon?

☐ Yes ☐ No ☐ Don't know

#### Away from home (please use the text boxes to explain your reasons):

##### 5. Are you aware that you need to carry the glucagon hypokit when away from home?

☐ Yes ☐ No ☐ Don't know

##### 6. Do you carry the glucagon hypokit when away from home?

☐ Yes ☐ No ☐ Don't know

##### 7. Do you think schools should be given a glucagon hypokit?

☐ Yes ☐ No ☐ Don't know

##### 8. Does your child's school have a glucagon hypokit?

☐ Yes ☐ No ☐ Don't know

##### 9. If yes, have the school staff been offered training on how to administer the glucagon hypokit?

☐ Yes ☐ No ☐ Don't know

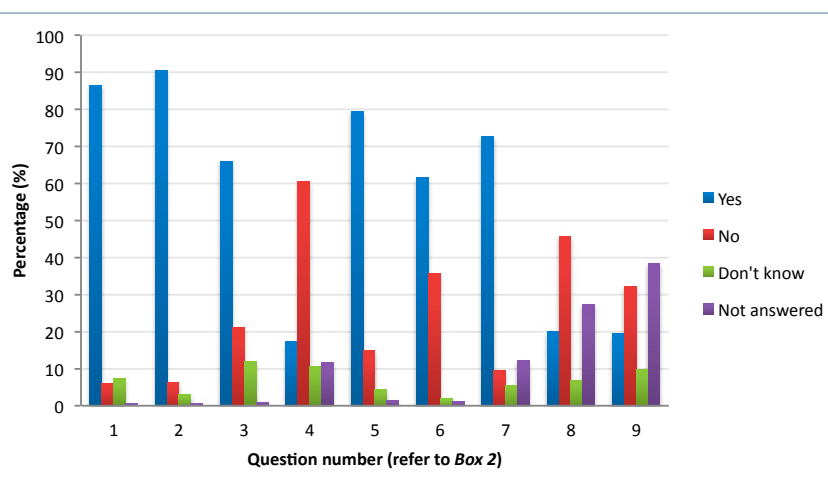


Figure 1. Responses to survey 2 (families' views, knowledge and practice regarding glucagon).

of hypoglycaemia can occur anywhere, and many families would be without an effective treatment for severe hypoglycaemia were episodes to occur away from home.

### NICE (2015) advice on treating severe hypoglycaemia

Treat severe hypoglycaemia in children and young people (CYP) with type 1 diabetes who are not in hospital or who do not have rapid intravenous access available as follows:

- Use intramuscular glucagon or a concentrated oral glucose solution (e.g. Glucogel).
  - Do not use oral glucose if the level of consciousness is reduced.
- If using intramuscular glucagon:
  - Give CYP aged  $\geq 8$  years or who weigh  $\geq 25$  kg **1 mg** of glucagon.
  - Give CYP aged  $< 8$  years or who weigh  $< 25$  kg **500  $\mu$ g** of glucagon.
- Seek medical assistance if blood glucose levels do not respond or symptoms persist for more than 10 minutes.
- As symptoms improve or normoglycaemia is restored, and once the young person is sufficiently awake, give oral, complex, long-acting carbohydrate to maintain normoglycaemia.
- Recheck the blood glucose repeatedly in CYP who have persistently reduced consciousness after a severe hypoglycaemic episode, to determine whether further glucose is needed.

### Glucagon in schools

Since 2014, there has been a statutory requirement for schools to support children with medical conditions at school. While teaching staff are not required to administer medication, they are required to know how to support children with a medical condition when they need help (Department for Education, 2014). Two thirds of teams reported that glucagon was included in school care plans but only 20% of families reported that their school had access to glucagon. A number of those schools with access to glucagon (30%) had not received training in glucagon delivery. This most probably represents schools receiving glucagon supplies to give to a paramedic or carer to administer in the case of severe hypoglycaemia, instead of schools themselves being asked to administer the drug.

It is unclear what the schools' views of keeping and administering glucagon were; however, the FWDNN survey suggests that 10% of schools have refused to have a kit on site and 8% have refused to administer glucagon if needed (Maiden, 2015). Within Yorkshire, all Yorkshire Ambulance Service paramedic cars and ambulance crews carry a glucagon kit, and all paramedics and Emergency Medical Technicians have training in its administration. The first-line choice of treatment for the ambulance staff, however, is intravenous dextrose, with glucagon available as a back-up (personal communication). There appears to be overwhelming support from families for glucagon to be made available in schools, with 73% of families supporting availability compared to 10% who did not.

During network discussions, the diabetes team members raised concerns regarding the logistics of providing training to all schools, given the very infrequent need for glucagon administration and, hence, the difficulty in maintaining standards within school staff. A study in the US found that 75% of 185 children with diabetes required treatment for hypoglycaemia whilst at school, with a median of five episodes per student per year. However, only one of these episodes was severe, requiring administration of glucagon (Hellems and Clarke, 2007). The authors concluded that glucagon administration may be required at school for up to 3% of children with diabetes during a school year.

### Study limitations

This study has some limitations. While there was a 100% response rate from the diabetes teams, only 15% of families returned their questionnaires. It is possible that these respondents were the families who felt most concerned about hypoglycaemia or glucagon availability/use, and that the results are thus biased to this population. In addition, whilst we have endeavoured to take into account opinions of both families and healthcare professionals, school staff were not consulted in this study.

### Guideline development

Following this study, guidance was drafted and revised with input from the Yorkshire & Humber Network. The finished guideline, taking into account both parental and professional viewpoints, is shown in *Figure 2*. It concentrates on three key areas: availability of glucagon, training in its administration, and its availability and use in schools. It can be accessed at: <https://is.gd/j48vnH>.

It is hoped that this guidance will both improve professional practice across the network and improve the knowledge of families regarding glucagon use. The guideline also aims to provide standardised advice regarding the use and availability of glucagon in schools, which has been identified as an area of concern for families.

### Conclusions

This survey has revealed inconsistencies in practice regarding glucagon availability and training across the Children and Young People's Yorkshire & Humber Diabetes Network. In a number of cases, there appears to be both suboptimal practice and significant gaps in parents' knowledge around glucagon. This work has resulted in the development of a gold standard regarding glucagon prescription and training within the network, with the aim of improving practice and knowledge. ■

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## Author contributions

All four authors formed the working group, which devised the surveys, collated and analysed results, and designed the initial guideline. AN and JF presented the results and initial guideline to the network and led discussions to finalise the guideline. EF wrote the manuscript. All four authors edited and approved the manuscript prior to submission.

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## Children and Young People's Yorkshire & Humber Diabetes Network Consensus Guideline for the Prescription and Training of Glucagon



Authors	CYP YH DN Glucagon Steering Group Members: Anuja Natarajan, Elspeth Ferguson, Layla Twigger and Jenny Foster
Adopted and Approved by	CYP YH DN Members
Date	April 2016
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### Introduction

Following the publication of the NICE guidance in 2015 and the results of parent/carer and multi-disciplinary diabetes team surveys, the following guideline was developed and approved by the Children and Young People's Yorkshire & Humber Diabetes Network for use by network members.

This guideline covers the availability and training of the GlucaGen® HypoKit to parents and carers of children and young people diagnosed with Type 1 Diabetes.

### NICE Guidance 2015

1.2.79 Family Members or carers and where appropriate, school nurses and other carers should be trained and equipped to give intramuscular glucagon for severe hypoglycaemia in an emergency.

### GlucaGen® HypoKit

The GlucaGen® HypoKit is the recognised prescription of glucagon in England and Wales and is for the immediate, emergency use on children and adults with diabetes who use insulin and have become unconscious due to severe hypoglycaemia and are unable to take sugar by mouth.

### Yorkshire Ambulance Service

- All ambulances and paramedic cars have glucagon on board.
- All paramedics and A&E's are trained in how to administer glucagon.
- Asking for a 'paramedic ambulance' may delay response. 999 call handlers may struggle to get a paramedic ambulance to the patient as quickly as a standard ambulance.
- In the vast majority of cases all types of emergency response vehicles will have someone on board who is trained in the use of glucagon.

### 1. Availability

- A prescription for GlucaGen® HypoKit should be given to the parents/carer's of children and young people diagnosed with type 1 diabetes at diagnosis.
- Full training should be provided to each parent/carer within the first 4 weeks of diagnosis with annual training to refresh skills (see section 2. Training).
- Teams should ensure that a GlucaGen® HypoKit is provided to nursery/school/college or other educational establishment that the child or young person attends, within the first 4 weeks of academic calendar, following diagnosis (see section 3. Schools).

### 2. Training

- Training should be given to parents/carers within the first 4 weeks following diagnosis.

#### 2.2. Training should include -

- Details of when the GlucaGen® HypoKit should be used.
- A demonstration using a GlucaGen® HypoKit training kit on a skin substitute.
- Links to online videos and guides - provided below.
- Information on prescriptions, expiry dates, storage and disposal. ★
- Details of carrying the GlucaGen® HypoKit away from the home. ★★
- Explanation and confirmation of the availability and use of GlucaGen® HypoKit within the child or young person's school. (see section 3. Schools).

- Training should be refreshed at least on an annual basis and at others times when requested by family or the MDT identify a clinical need.

### 3. Schools

#### Where necessary Paediatric Diabetes Units should offer the following:-

- The use of glucagon in the rare case of a severe hypoglycaemic episode should be included in all School Care Plans.
- Discussion over the availability of a member of staff to be trained in the use of GlucaGen® HypoKit as identified by parents or school.
- It is the responsibility of the parent/carer's to provide their child's school with a GlucaGen® HypoKit, acquired via prescription from their GP.
- Training of school staff when needed should be carried out by a member of the hospital MDT who has been trained in the use of GlucaGen® HypoKit and should include a practical demonstration using a GlucaGen® HypoKit training kit. The below video link can be used to replace the face to face annual training.

★ GlucaGen® HypoKit should be included in the prescription list sent to GP following discharge. Repeat prescriptions and management of expiry dates is then the responsibility of the parent/carer. The GlucaGen® HypoKit can be either stored in a refrigerator (2°C to 8°C), or out of a refrigerator below 25°C for up to 18 months within the shelf life period.

★★ We recommend that parents/carers carry a GlucaGen® HypoKit whenever they are away from the home with their child or young person with type 1 diabetes.

### References

#### Manufacturer of GlucaGen® HypoKit

<http://www.novonordisk.co.uk/patients/diabetes/our-products.html>

#### NICE

<https://www.nice.org.uk/guidance/conditions-and-diseases/diabetes-and-other-endocrinal-nutritional-and-metabolic-conditions/diabetes>

#### Department of Education

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/306952/Statutory\\_guidance\\_on\\_supporting\\_pupils\\_at\\_school\\_with\\_medical\\_conditions.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/306952/Statutory_guidance_on_supporting_pupils_at_school_with_medical_conditions.pdf)

#### LINK TO VIDEO DEMONSTRATION OF GLUCAGON ADMINISTRATION

UCLH YouTube Link - GlucaGen® HypoKit Injection Demonstration  
<https://www.youtube.com/watch?v=CfRBJqzjzQ>

Figure 2. The finished consensus guideline on glucagon. Available to download at: <https://is.gd/j48vnH>.