

# Assessing the home management of hypoglycaemia in paediatric T1DM

Paul Torpiano, Karen Sapiano, John Torpiano

## Abstract

**Objectives:** The home management of hypoglycaemia is an essential part of diabetes care. All carers of children with T1DM in Malta receive education on managing hypoglycaemia at the time of initial diagnosis. While this education is often revisited at subsequent appointments, it is not always retained and put into practice. We conducted a survey to assess Maltese carers' knowledge of how to manage suspected episodes of hypoglycaemia in their children, as well as identify areas where carers feel least confident.

**Methods:** All Maltese patients under the age of 16 years with T1DM were included. A questionnaire was formulated to assess various aspects of hypoglycaemia management that any carer of a child with T1DM might be expected to know. The carer of each patient with T1DM was contacted a minimum of 6 months following the diagnosis of T1DM.

**Results:** 117 carers of children with T1DM were interviewed by telephone or in person. While most correctly described appropriate first-line management of suspected hypoglycaemia, only 21% recognised the need to place an unconscious child in the lateral recumbent position, and only 53% suggested they would avoid giving anything by mouth in such an event. Over 80% felt confident in managing hypoglycaemia, but 78% feared using intramuscular glucagon.

**Conclusions:** This survey highlights areas of knowledge that parents of children with T1DM lack despite regular education. Doctors taking care of children with T1DM should regularly assess carers' knowledge, and discuss specific areas of concern.

## Key words

Patient education, paediatric, T1DM, glucagon, hypoglycaemia

## Introduction

Type 1 Diabetes Mellitus (T1DM) is common in Maltese children, occurring at an incidence rate of 21.8/100,000 children/year. This incidence rate appears to be rising.<sup>1</sup> Recurrent hypoglycaemia limits optimal glycaemic control in T1DM, and may cause high glycosylated haemoglobin (HbA1c) values when repeatedly over-treated or when carers maintain the blood glucose concentration in a higher-than-ideal range in an attempt to avoid hypoglycaemia.<sup>2</sup> Recurrent, severe episodes of hypoglycaemia in children are also associated with altered cognitive function, and may influence learning and attention levels as the child grows.<sup>2</sup> Furthermore, hypoglycaemia can be expensive: in an Italian study, 58 work-days per 100 person-years were lost by patients or their family members because of hypoglycaemia. Hypoglycaemic episodes cost €91 per person-year, while the total annual cost of hypoglycaemia in T1DM in Italy was over €26 million per annum.<sup>3</sup> The burden of hypoglycaemia in T1DM is both direct and indirect. Direct costs include medications used to treat

**Paul Torpiano\*, M.D., M.R.C.P.C.H., M.R.C.P.**

Higher Specialist Trainee in Paediatrics

Mater Dei Hospital

Msida, Malta

paul.torpiano@gov.mt

**Karen Sapiano, M.D.**

Basic Specialist Trainee in Anaesthesia

Mater Dei Hospital

Msida, Malta

**John Torpiano, M.D., M.Sc.(Lond), F.R.C.P., F.R.C.P.C.H.**

Consultant Paediatric Endocrinologist

Mater Dei Hospital

Msida, Malta

*\*Corresponding author*

hypoglycaemia (glucose/glucagon), ambulance services, hospitalization for severe episodes, family doctor contact, and additional blood glucose testing required during periods of hypoglycaemia.<sup>4-5</sup> Indirect costs include working time lost due to hypoglycaemic episodes and additional food needed to treat hypoglycaemia.<sup>4-5</sup>

All patients under the age of 16 years in Malta are followed by a single paediatric diabetes team at Mater Dei Hospital. Patient education about the various aspects of T1DM and its care is provided at diagnosis, and this includes the management of hypoglycaemia. Printed information sheets are given, additional to meetings with the patients and their carers. All information is delivered by paediatric diabetes specialists, with support by the specialist diabetic nursing team. The patients are followed up at least every 3 months, and diabetes education is opportunistically revisited on these occasions.

The aim of this survey was to assess the knowledge retained by carers of paediatric and adolescent T1DM patients taught how to manage episodes of hypoglycaemia appropriately outside hospital, and identify the impact of the current paediatric education offered to carers of children with T1DM at Mater Dei Hospital in Malta.

## Methods

All Maltese patients with T1DM under the age of 16 years, under the care of the paediatric endocrinology team at Mater Dei Hospital, were included. This is the main national hospital in Malta and the only one providing specialist paediatric diabetes care. A questionnaire was formulated, written in both English and Maltese. This questionnaire asked about various aspects of hypoglycaemia management that any carer of a child with T1DM might be expected to know, as based on the information sheet given to every family at the time of diagnosis. Questions were of two types: open-ended questions aimed to assess carers' awareness of how to generally handle a hypoglycaemic episode, while close-ended questions were asked at the end to assess carers' knowledge of specific areas of hypoglycaemia management. Each carer was contacted a minimum of 6 months following the diagnosis of T1DM. This was done to avoid interviewing carers of children with recently-diagnosed diabetes, who might not

have had the opportunity to absorb the taught information, and who might not have had much experience yet in the management of hypoglycaemia. Furthermore, if questioned too close to the date of diagnosis, the carers' knowledge might reflect a lecture they had received recently, rather than retained information they would apply to the real-life scenario of hypoglycaemia.

For each patient, the carer was contacted on telephone numbers available on hospital records. The answering carer was asked if he or she would ordinarily take responsibility for the child's diabetes management. It is often one of the two parents who specifically takes charge of a child's medical care: questioning the parent who would ordinarily not be expected to manage the hypoglycaemia might have given an unfairly poor representation of the management the patient would receive in real life. The questionnaire was piloted on 20 carers to ensure that they were easily understood. The remainder of the study population was then questioned over a period of 4 months.

## RESULTS

130 patients fulfilled the inclusion criteria, and 117 (90%) carers were successfully interviewed. 82 (70.1%) correctly identified 4 mmol/L as the recommended cut-off capillary blood glucose to define hypoglycaemia (Table 1). 55 (47%) could give 3 or more causes of hypoglycaemia, while 65 (55.6%) could mention at least 3 possible symptoms of hypoglycaemia to look out for.

107 (91.5%) said they would confirm a suspected episode of hypoglycaemia by testing the capillary blood glucose, while 10 (8.5%) said they did not feel the need to do this once hypoglycaemia was suspected (Table 2). 111 (95%) said that in the event the carer suspected a hypoglycaemia, and their glucose meter was unavailable, they would assume the diagnosis of hypoglycaemia and treat as such. 3 carers said they would seek medical attention in such a situation. 110 (94%) knew that hypoglycaemia should be treated with a sugar-containing product given by mouth, while 97 (83%) identified the recommended amount of sugar to administer. When asked what they would do if their child developed decreased level of consciousness, 96 (82%) specified they would avoid putting anything in their child's mouth.

*Table 1. Results: Recognising a hypoglycaemic episode.*

<b>Recognising a hypoglycaemic episode</b>		
<b>i. Knowledge of the lower limit of CBG (4mmol/L)</b>		
<b>Response</b>	<b>No. of carers</b>	<b>%</b>
<7mmol/L	1	0.9
<5mmol/L	5	4.2
<b>Correctly identified as &lt;4mmol/L</b>	<b>82</b>	<b>70.1</b>
<3mmol/L	17	14.5
<2mmol/L	10	8.5
<1mmol/L	1	0.9
Does not know	1	0.9
<b>ii. Knowledge of causes of hypoglycaemia</b>		
<b>Causes known</b>	<b>No. of carers</b>	<b>%</b>
0	1	0.9
1	8	6.8
2	53	45.3
3	47	40.2
≥4	8	6.8
<b>iii. Knowledge of the symptoms of hypoglycaemia</b>		
<b>Symptoms known</b>	<b>No. of carers</b>	<b>%</b>
0	1	0.9
1	12	10.3
2	39	33.3
3	49	41.9
4	13	11.1
≥5	3	2.6

111 (95%) identified the need to re-check the CBG after giving oral sugar for hypoglycaemia, while 66 (57.4%) said they would wait 11-15 minutes before doing so. If the CBG remained below 4 mmol/L on re-testing, 100 (85.5%) said they would give a second oral dose of sugar, a further 28 (24%) saying they would check the CBG once again 15 minutes afterwards. 101 (86.3%) knew that a snack or meal should be given after successful correction of hypoglycaemia. 114 (97.4%) confirmed they would record an episode of hypoglycaemia on their diabetes diary to discuss with the doctor at the next available clinic visit.

Concerning the management of severe hypoglycaemia (Figure 1), 113 (96.6%) recognized the need for glucagon by intramuscular injection in this situation. Fifty-eight (49.6%) said they would call an ambulance immediately, and only 25

(21.4%) emphasised the importance of placing the child in a lateral recumbent position. 102 (87.2%) said they would call emergency services if the child failed to show signs of a response within 10 minutes of glucagon administration, and 95 (81.2%) understood the need to give oral sugar to the child once he or she recovered consciousness following glucagon administration. 85 (72.6%) could correctly recall the free phone number to call emergency services.

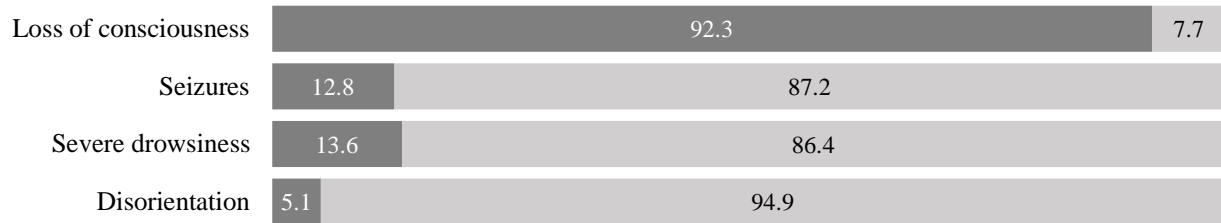
43 (36.8%) and 52 (44.4%) of carers felt 'very good' or 'quite good' respectively when asked about how confident they felt in managing hypoglycaemia (Figure 2). Only 1 (0.9%) felt 'quite bad' at this, while 4 (3.4%) felt 'very bad'. 91 (77.8%) of carers said that using glucagon was the main aspect of hypoglycaemia management that they did not feel confident about.

**Table 2. Results: Managing a hypoglycaemic episode (HC = Health Centre; A&E = Accident and Emergency).**

<b>Managing a hypoglycaemic episode</b>			
<b>i. Knowledge of the need to confirm suspected hypoglycaemia</b>			
<b>Response</b>	<b>No. of carers</b>	<b>%</b>	
Checks CBG	107	91.5	
Does not check CBG first-line	10	8.5	
<b>ii. Knowledge of what to do in case glucose monitor is unavailable/not functioning</b>			
Assumes it is a 'hypo' and treats as such	111	95	
Calls Doctor	1	0.9	
Goes to HC or A&E	3	2.6	
Does not know	1	0.9	
Other	1	0.9	
<b>iii. Knowledge of administration of oral sugar as first-line treatment for hypoglycaemia</b>			
<b>Response</b>	<b>No. of carers</b>	<b>%</b>	
Yes	117	100	
No	0	0	
<b>iv. Knowledge of administration of oral sugar – appropriate choice of sugar (fast-acting)</b>			
<b>Response</b>	<b>No. of carers</b>	<b>%</b>	
Yes	110	94	
No	7	6	
<b>v. Knowledge of administration of oral sugar – appropriate amount of sugar (15g)</b>			
<b>Response</b>	<b>No. of carers</b>	<b>%</b>	
Yes	97	83	
No	18	51.3	
Not specified	2	17	
<b>vi. Knowledge of need to keep patient nil-by-mouth in case of loss of consciousness</b>			
<b>Response</b>	<b>No. of carers</b>	<b>%</b>	
Yes	96	82	
No	21	8	
<b>vii. Knowledge of need to re-check CBG after administering oral sugar</b>			
<b>Response</b>	<b>No. of carers</b>	<b>%</b>	
Yes	111	95	
No	6	5	
<b>viii. Knowledge of how long to wait before re-checking CBG after administering oral sugar</b>			
<b>Response</b>	<b>No. of carers</b>	<b>%</b>	
0-5 minutes	7	6	
6-10 minutes	14	12	
11-15 minutes	66	56.4	
16-20 minutes	8	6.8	
21-30 minutes	9	7.7	
31-45 minutes	2	1.7	
46-60 minutes	4	3.4	
>60 minutes	4	3.4	
Does not know	1	0.9	
Does not check again	2	1.7	
<b>ix. Knowledge of what to do if CBG remains low on re-checking</b>			
<b>Response</b>	<b>No. of carers</b>	<b>%</b>	
Repeats oral dose of sugar	100	85.5%	
Re-checks CBG after further 15 minutes	28	24%	
Repeats 1) and 2) until CBG>4mmol/L	19	16.2%	
Re-checks CBG after 15 minutes without giving oral sugar	1	0.9%	
Gives snack/lunch/carbohydrates	10	8.5%	
Does not know	4	3.4%	
Administers glucagon	1	0.9%	
<b>x. Knowledge of need to give carbohydrates/snack/meal after hypoglycaemic episode</b>			
<b>Response</b>	<b>No. of carers</b>	<b>%</b>	
Yes	101	86.3	
No	16	3.7	
<b>xi. Knowledge of need to record hypoglycaemic episodes</b>			
<b>Response</b>	<b>No. of carers</b>	<b>%</b>	
Yes	114	97.4	
No	3	2.6	

**Figure 1: Results: Managing an episode of severe hypoglycaemia (IM = intramuscular).**

**i. % Correct identification of situations where the patient must be kept nil by mouth** ■ Yes ■ No



**ii. % Knowledge of appropriate management of severe hypoglycaemia (actively listed by carer)**



**iii. % Knowledge of need to call ambulance once patient fails to respond to intramuscular glucagon within 10 minutes**



**iv. % Knowledge of contact number for emergency services**

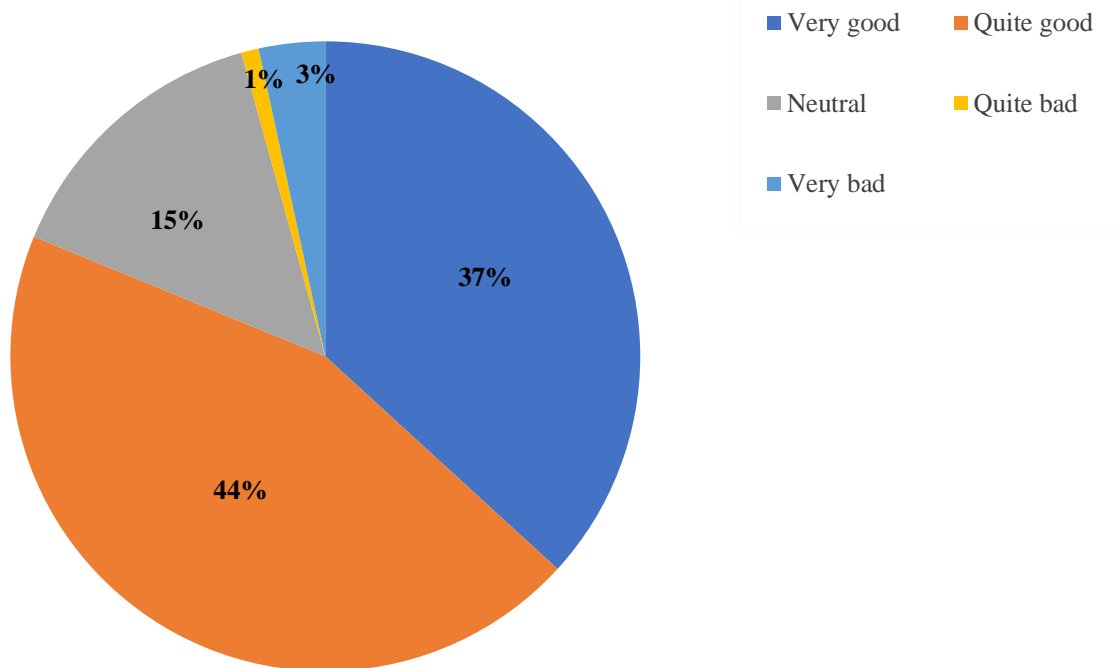


**v. Knowledge of need to give patient oral sugar once he/she wakes up following glucagon dose**

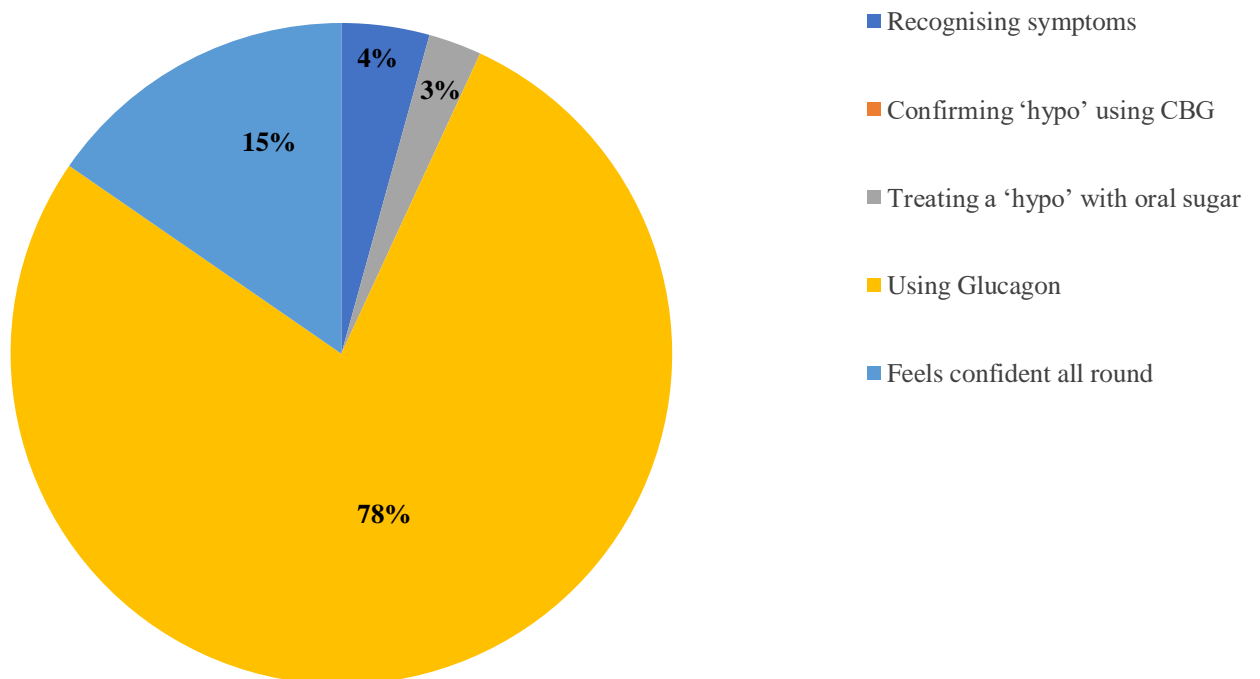


Figure 2. Results: Assessing parental confidence in managing hypoglycaemia.

i. How confident do parents feel in managing hypoglycaemia?



ii. Where do parents feel least confident?



## Discussion

We present an assessment of the knowledge retained by carers of children and adolescents with T1DM, pertaining to the management of hypoglycaemic episodes. The data obtained covers the whole paediatric population with T1DM in Malta, and is the first of its kind in our country. It provides insight into the approach that doctors who see children with T1DM take regarding patient education. In Malta, carers of children with T1DM receive several one-to-one teaching sessions at initial diagnosis, covering most aspects of home care, including management of hypoglycaemia. This teaching is revisited opportunistically at subsequent outpatient visits, though there is no structured follow-up programme to assess carer knowledge retention and reinforce points that may have been forgotten.

Maltese carers fared worst in the section investigating their knowledge of managing an episode of severe hypoglycaemia. It was worrying that only 53% actively suggested they would avoid putting anything in their child's mouth in this situation, and although 96.6% appropriately mentioned intramuscular glucagon as the treatment of choice here, 77.8% said they did not feel confident in administering this drug. Furthermore, only 21.4% suggested they would place their child in the recovery position. These lacunae in their knowledge could put a hypoglycaemic child at increased risk of aspiration and other complications of severe hypoglycaemia. Just under 50% suggested they would immediately resort to emergency services in the event of a severe hypoglycaemic episode. This approach may lead to considerable inconvenience for the family of a child with T1DM, and will contribute to the patient load and thus overall waiting times at the hospital paediatric emergency department.

What may be the reasons for these specific failings in the knowledge of carers of patients with T1DM? Little emphasis may have been placed on the management of emergencies within T1DM, particularly at follow-up outpatient encounters, when the child in attendance is often alert and well. Education is often focused on theoretical aspects of T1DM and its care, rather than practical scenario-based sessions placing the carer in a situation where he or she must act out the management of hypoglycaemia. The same is true for the use of glucagon, and practical teaching sessions on the use

of intramuscular glucagon, particularly for those carers with little experience in managing severe hypoglycaemia, would probably be useful. Another potential problem is that carers might receive conflicting information and advice from different health care professionals they meet in various settings, including the emergency department, hospital wards, school, outpatients' department, health centres, family doctor and private paediatrician. A consistent understanding of the recommendations made to carers on how to manage hypoglycaemia would be beneficial.

The study has several limitations. As carers were asked about what they remembered of what was taught to them, as well as questions relating to their own experience in managing hypoglycaemia, a degree of recall bias was inevitable. Secondly, a robust knowledge of the guidelines provided to parents might not necessarily reflect appropriate application of this knowledge in a real-life scenario of a child with hypoglycaemia. In these settings, panic might understandably take over, causing carers to forget the necessary steps to take. On the other hand, carers who struggled to respond correctly might find that they perform reasonably well in a real-life situation. The study considered the national picture, and has not investigated the influence of differing levels of education on the degree of retained knowledge. Furthermore, the telephone questionnaire was made opportunistically over a four-month period, meaning that the length of time that had elapsed since the last meeting with the paediatric diabetes team varied from one carer to another. This variation in time may have had a bearing on which carers responded correctly to the questionnaire. Lastly, although carers might be expected to have a robust knowledge of what to do in the circumstances of a hypoglycaemic episode, their knowledge might be influenced by their individual experiences. Some carers may never have had to deal with hypoglycaemia, while others might have had repeated experience with this. This experience may either make carers more proficient in the appropriate management of hypoglycaemia, or might have the opposite effect: leaving them more accepting of deviations from the target range of CBG.

In conclusion, appropriate training and education of carers of children and adolescents with T1DM is an essential part of their long-term care, not least in the management of hypoglycaemia.

Medical professionals responsible for the care of children with T1DM should include regular assessments of carer knowledge and concerns in the routine follow-up of these patients, as well as structured re-education. Failure to do this may potentially put the child at risk during an episode of severe hypoglycaemia.

### References

1. Formosa N, Calleja N, Torpiano J. Incidence and modes of presentation of childhood type 1 diabetes mellitus in Malta between 2006 and 2010. *Pediatr Diabetes*. Denmark; 2012 Sep;13(6):484–8.
2. Cryer PE. Hypoglycemia risk reduction in type 1 diabetes. *Exp Clin Endocrinol Diabetes*. Germany; 2001;109 Suppl:S412-23.
3. Giorda CB, Rossi MC, Ozzello O, Gentile S, Agliandolo A, Chiambretti A, et al. Healthcare resource use, direct and indirect costs of hypoglycemia in type 1 and type 2 diabetes, and nationwide projections: Results of the HYPOS-1 study. *Nutr Metab Cardiovasc Dis*. Netherlands; 2016 Nov;
4. Brod M, Hojbjerg L, Bushnell DM, Hansen CT. Assessing the impact of non-severe hypoglycemic events and treatment in adults: development of the Treatment-Related Impact Measure-Non-severe Hypoglycemic Events (TRIM-HYPO). *Qual Life Res*. Netherlands; 2015 Dec;24(12):2971–84.
5. Heller SR, Frier BM, Herslov ML, Gundgaard J, Gough SCL. Severe hypoglycaemia in adults with insulin-treated diabetes: impact on healthcare resources. *Diabet Med*. England; 2016 Apr;33(4):471–7.