Title: Evaluation of an innovative hypoglycaemia pathway for self-care at home and admission avoidance: a partnership approach with a regional ambulance trust

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Trial Registration: ISRCTN 56314240 **Registration date:** 10/02/2016

Abstract

Introduction: Episodes of severe hypoglycaemia which result in an ambulance call out can frequently affect people with diabetes on certain medications and are a significant cause of morbidity and reduced quality of life. People with diabetes can often experience multiple episodes of severe hypoglycaemia, with no standardised procedure for referral from ambulance staff to primary or secondary care services. Further work is required to provide robust evaluation of referral pathways to ensure optimal care for this population.

Methods: A multicentre Randomised Trial in partnership with the East Midlands Ambulance Service, UK. Eligible participants with diabetes calling out an ambulance for a severe hypoglycaemic episode were referred by ambulance staff to either a novel Diabetes Specialist Nurse (DSN) led pathway or to their GP for routine follow up. Primary outcome was proportion of participants with a documented consultation with a healthcare professional to discuss their call out or a change in their medication within 28 days of the call out. Secondary outcomes included rates or repeat hypoglycaemia, medication changes.

Results : 162 people were referred to one of the pathways (73 DSN arm, 89 GP arm) with 81 (35 DSN, 46 GP) providing full consent to be followed up. Due to lower than anticipated referral and consent rate, the recruitment target was not met. Primary outcome data showed higher rates of consultation following the call-out when referred to a Diabetes Specialist Nurse compared to primary care (90% vs 65% of participants)

Conclusions: Although consultation rates following the call-out were higher in the Diabetes Specialist Nurse led arm, the lower than anticipated referral and consent rates meant we did not have sufficient power to complete the planned analysis. This study highlighted the difficulty in recruitment and delivery of research in pre-hospital emergency care. Further work is needed to provide more feasible study designs and consent procedure balancing demands on ambulance staff time with the need for robust well designed evaluation of referral pathways.

Introduction

In the UK, ambulance trusts are the main provider of first contact emergency medical services for severe hypoglycaemia (SH). It is estimated that there are 70,000 to 100,000 emergency call-outs per year for hypoglycaemia at a cost of £13.6 million per year to the National Health Service, with each admission to hospital costing around £1000 (1). Recurrent call outs for SH occur within two days in 2-7% of cases (2)(3) depending on the study population and length of follow-up.

Ambulance trusts in the UK operate 'treat and refer' protocols for SH (4), which means the ambulance crew manage the patient at the scene of the incident, unless there is a need to transport them to an emergency department. They subsequently refer them to their primary care team or to a local diabetes care service, to enable a review of the patient and their management plan to be carried out, to ensure their understanding of hypoglycaemia and to avoid further hypoglycaemic events and emergency call-outs. Local referral pathways have been implemented in various sites (5), (6) and reviews of the literature (7), (8), (9) suggest that specialist diabetes referrals by ambulance staff after a SH emergency may be beneficial to patients. However, the evidence is limited, with poor quality studies and no randomised controlled trials.

The aim of this study was to evaluate a hypoglycaemia referral pathway which involves the patient receiving a telephone call from a diabetes specialist nurse (DSN) within two days of the call-out (10). The pathway was developed by the Integrated Care Diabetes Service at University Hospitals of Leicester NHS Trust in collaboration with the Emergency Medical Service leads from the East Midlands Ambulance Service (EMAS) NHS Trust.

Methods

The study was a two centre randomised controlled trial (RCT) with two parallel arms and balanced randomisation (1:1). Participants were either offered a telephone consultation with a locally based DSN, or the details of the call-out were sent to their general practitioner (GP) with a recommendation to contact the participant to discuss their diabetes management. Ethics approval was granted by East Midlands –

Nottingham 1 Research Ethics Committee (15/WM/0538), the Health Research Authority and relevant NHS Trusts.

Eligibility for referral

Individuals were eligible for referral if they had diabetes, had called the ambulance service for a SH event (confirmed by the ambulance staff attending on the basis of a blood glucose level of <4.0 mmol/l) and were aged 18 years and over, willing and able to give informed consent, able to speak and read English, living in and registered with a general practice in Northamptonshire or Lincolnshire and responsible for their own care and/or medication. Individuals transported to hospital were eligible unless they were subsequently admitted to hospital for more than 48 hours.

Referral and consent procedures

Ambulance staff working for EMAS and based in Northamptonshire or Lincolnshire were trained in the referral procedures. As individuals were recovering from a SH event, there was a risk they lacked the cognitive capacity to provide informed consent. The Research Ethics Committee therefore requested that consent be taken in two stages. After treating the individual's symptoms, the ambulance staff checked their eligibility and obtained 'brief consent' to be referred to one of the two pathways. Ambulance staff trained in the referral procedure were provided with packs of 10 sequentially numbered envelopes with instructions on which arm to randomise each patient provided inside. The randomisation list was completed by an external statistician using a 4 block randomisation procedure. Due to the need to provide a simple procedure for ambulance staff to randomise participants immediately after brief consent, it was not possible to stratify randomisation by any other demographic characteristic.

After consent was taken, ambulance staff opened a randomisation envelope and informed the participant that they would either be called by a DSN within two working days (DSN arm) or that the details of the call-out would be sent to their GP (GP arm). Participants in both arms were given an information booklet about the management of hypoglycaemia. Ambulance staff then transferred the information to the research

team who referred the patient to the appropriate pathway. At this point the research team initiated the second stage of the consent process. Participants were contacted by telephone, their eligibility confirmed, and they were asked if they would consent to follow-up data being collected. They were sent a patient information leaflet and provided 'full consent' by telephone or by returning a signed consent form.

Outcome data

The primary outcome was "documented evidence that the hypoglycaemic episode was discussed (within 4 weeks of the call-out) with a health care professional, and that relevant advice was given and/or changes made to their medication". This information was either provided by the local diabetes care service (DSN arm) or the participant's practice was approached for the information (GP arm). Information on whether the participants made a further call-out to the ambulance service for an SH event during the following 12 months was provided by EMAS from their central records. They also provided information on the total number of call-outs and repeat call-outs as a result of SH, that occurred over the region during the study period.

Sample size

There were no reliable data on which to base a formal sample size calculation. Therefore, we assessed a range of plausible treatment differences based on obtaining primary outcome data for 150 participants (this number was deemed reasonable in the recruitment period). Assuming that full consent would not be obtained for 20% of participants and that primary outcome data would be unobtainable for 10%, around 216 referrals were needed to obtain this sample size.

Results

In total 165 ambulance staff completed training in the referral and study procedures (20 attended group training, 70 attended a one-to-one session, and 75 completed an e-learning module), this amounted to approximately 25% of ambulance staff working in the two recruitment sites.

Referral took place between 29/4/2016 and 30/6/2018 (26 months) during which time a total of 162 people provided 'brief consent' and were referred to one of the two pathways (Figure 1). The number of referrals in the DSN and GP arms was different (73 and 89 respectively). Full consent was obtained from 81 participants (50% of

those who provided brief consent). Of the 81 who did not provide full consent, 22 were not eligible (63.8 ± 21.8 years, 13 (59.1% men)), 15 declined to provide consent (70.3 ± 15.4 years, 12 (80% men)) and 44 were lost to follow-up (53.2 ± 20.3 years, 26 (59.1% men)). At this point, it was agreed the recruitment target would not be reached and referral was stopped.

Table 1 provides demographic data on the 182 referrals, the 81 who did not provide full consent and the 81 who did provide full consent. The GP and DSN arms were matched in terms of age and gender, however there were small differences between those who did and did not provide full consent. Practices needed to be approached for clinical data (type of diabetes, medication etc) and for information on the primary outcome. Obtaining this data proved very difficult and as a result there is a large amount of missing data, either because it was not obtained or was of poor quality (Table 1).

In the DSN arm, 26 out of 29 (90%) participants were successfully contacted by a DSN within 4 weeks of the call out, and a discussion was held about their recent hypoglycaemic event, (Figure 1) while in the GP arm, 17 out of 26 (65%) were contacted by or met with a health care professional at their practice within 4 weeks of the call out. The level of missing data was high in the GP arm with primary outcome data only available on 26/46 (57%).

26 out of 81 (32%) participants called the ambulance service for a SH event on a second occasion during the following 12 months (9% within 14 days, 11% within 30 days and 16% within 60 days). The average age of those who had a second call out was higher than those who did not (65.5 ± 15.0 and 61.0 ± 17.2 years respectively). The second call-out rate was higher in the DSN arm compared to the GP arm (13 out of 35 (37%) and 13 out of 46 (28%) respectively). Data from EMAS records showed that 2988 people called the ambulance service for a SH event during the 26-month study period and the second call-out rate within 12 months was 14.7%.

Discussion

Despite the difficulties in recruitment, a successful telephone consultation was held with 90% of participants in the DSN arm, but care must be taken when comparing this with the lower follow-up rate in the GP arm (65%) because of the high level of

missing and poor quality data and insufficient power. Overall, 32% of participants called the emergency services for a SH event on a second occasion during the following 12 months and this rate was higher in the DSN arm than the GP arm (37% and 28% respectively). The second call-out rate in study participants was over twice the rate that occurred in the region as a whole during the study period (unpublished data provided by EMAS)

The study covered two counties in the East Midlands, involved four local diabetes care services and 165 ambulance staff employed in the region were trained in the referral procedure (approximately 25% of the total work force). However, due to low referral and consent rates, referral was stopped when 54% of the recruitment target was reached. Previous research has reported on barriers to research in this setting, citing the workload imposed by the required research activities (e.g. checking eligibility, obtaining brief consent) on an already busy workforce as a major barrier to recruitment? (11) (12). Also, due to the pragmatic nature of the study and the number of trained ambulance staff needed, a maximum of only two hours training in the referral procedures was completed. We intend to publish data from telephone interviews with a number of the ambulance staff involved to highlight barriers and facilitators to the successful implementation of study procedures.

The requirement of the research ethics committee to obtain consent in two stages resulted in the loss of half the referrals who provided brief consent. A number of participants refused to give full consent but in the majority of cases full consent was not obtained because eligibility was not confirmed or the participant was unable to be contacted using the contact information supplied. Obtaining primary outcome data for participants in the GP arm proved difficult. Overall, 73 practices needed to be approached and the high level of missing or poor quality data (particularly in the GP arm) meant that the two arms could not be compared with confidence.

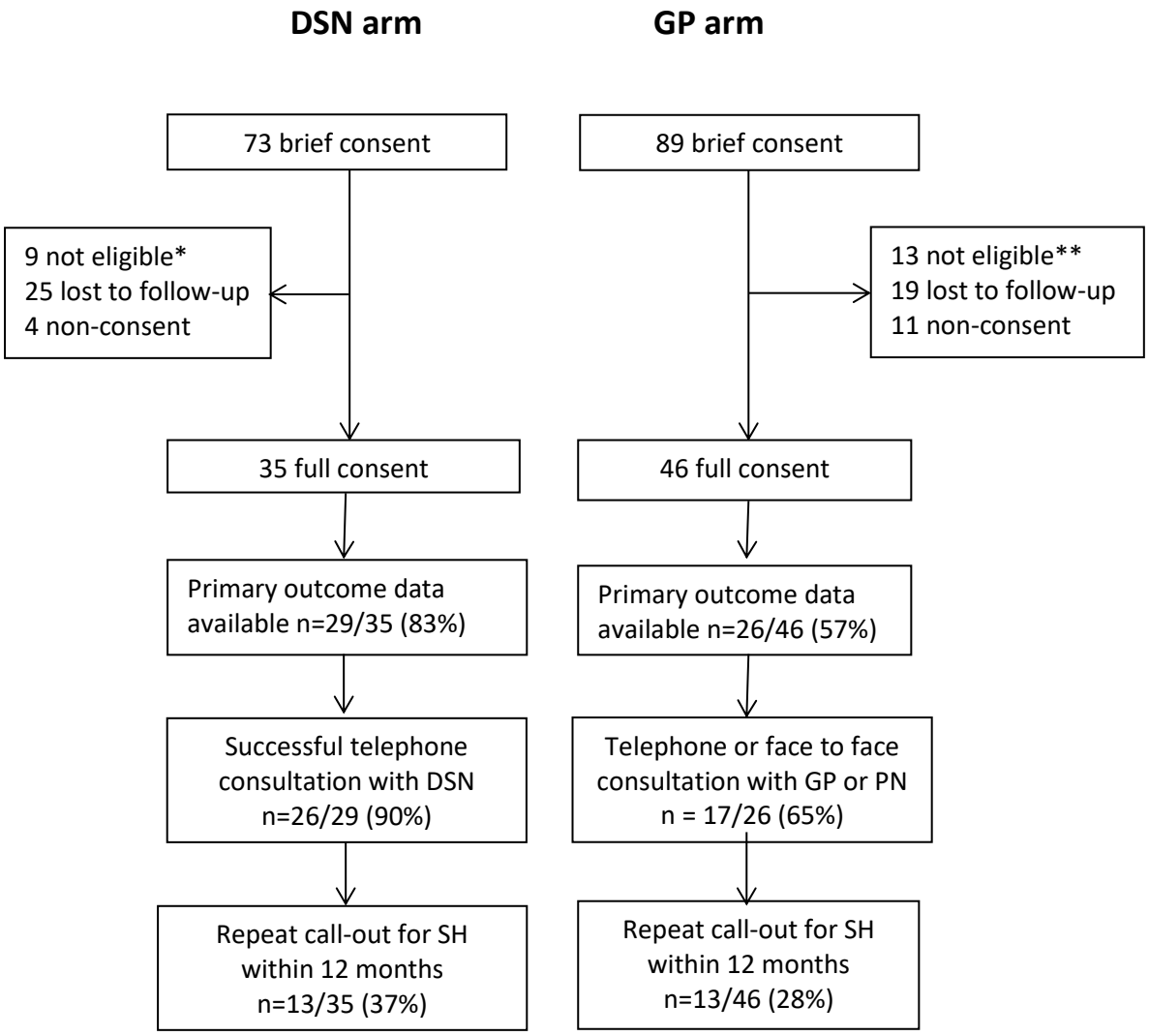
The rate of telephone consultations in the DSN arm was high with 90% receiving a telephone call within 4 weeks, a rate which would be considered successful if implemented in clinical care. This is higher than occurred in the GP arm (65%), although the amount of missing data here is high. Comparison with the literature is difficult due to the heterogeneous nature and poor reporting of the pathways evaluated (Colinette 2018). An evaluation of the first 2000 referrals to a pathway

delivered in the East of England (6) reported comparable data showing that 72% had a face-to-face or telephone consultation with a health care professional.

One of the primary objectives of a pathway of this type would be to reduce the number of repeat call-outs made by people with diabetes. One possible explanation for the repeat call-out rate being higher than occurred in the region as a whole is that taking part in the various research procedures, being given a booklet about the prevention of SH and, in the majority of DSN participants having a telephone consultation, may have raised participants' awareness and/or anxiety levels, encouraging them to call the emergency services a second time. An alternative explanation could be that the 81 study participants were not representative of the 2988 people in the region who called out the ambulance service for a SH event during the study period. Although study participants who made a second call-out were older than those who did not (65.5 ± 15.0 and 61.0 ± 17.2 years respectively), their age profile was similar to that of the 2988 people who made a call-out in the region during the study period (information provided by EMAS). It is unlikely that ambulance staff were biased in referring the more serious or high risk patients, or that this group were more likely to agree to take part. However, care needs to be taken when interpreting the different rates as the number of study participants was small.

In conclusion our experiences highlight the difficulties of research in the pre-hospital sector, including ethical problems of gaining consent (13) and staff training (14) (15). There was some evidence of higher rates of consultation in the DSN study arm, however the lack of power limited further analysis of the significance of this. There is a need for future work to design effective community referral pathways which improve diabetes management and minimise recurrence of SH, and to evaluate these, but a randomised controlled trial with individual referral, 1:1 randomisation and a two-stage consent process has proved to be a infeasible study design.

Figure 1: Flow of participants though the study



* 5 admitted to hospital > 48 hours, 2 previously referred, 1 live out of area, 1 no information
**5 admitted to hospital > 48 hours, 3 live out of area, 1 not registered with GP, 1 in nursing home, 1 not diabetic, 2 no information

Table 1: Demographics of a) 162 participants providing brief consent; b) 81 participants not providing full consent and c) 81 participants providing full consent

Participants providing brief consent (n=162)			
	DSN arm (n=73)	GP arm (n=89)	Total (n=162)
Age (y), med (IQR)	65 (45-75)	68(53-68)	67 (48-75)
Male N (%)	38 (52.1%)	54 (60.7%)	92 (56.8%)
Full consent N (%)	35 (48%)	46 (52%)	81 (50%)

Participants not providing full consent (n=81)			
	DSN arm (38)	GP arm (43)	Total (n=81)
Age (y), med (IQR)	64 (38-75)	66 (50-74)	66(38-75)
Male, N (%)	21 (55.3%)	30 (69.8%)	51 (63.0%)

Participants providing full consent (n=81)			
	DSN arm (n=35)	GP arm (n=46)	Total (n=81)
Age (y), med (IQR)	65(53-72)	69(56-75)	67 (54-730
Male N (%)	17 (48.6%)	24 (52.2%)	41 (50.6%)
T1D, N (%)	16/32 (50%)	16/32 (50%)	32/64 (50%)
Insulin only, N (%)	21/25 (84%)	10/13 (76.9%)	31/38 (81.6%)

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