

Evaluation of Inpatient Diabetes Complications

*Raisa Minhas¹, Mimi Chen², Chris Manu¹

¹Kings College Hospital London.

²St. George's University Hospital London. University of Warwick

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*Corresponding author: Raisa Minhas, Kings College Hospital London. E-mail: Raisaminhas09@gmail.com

Abstract

Objective: This was a service evaluation project to assess the standards of care being provided in hospital for patients with diabetes, looking into inpatient diabetes complications to propose quality improvement recommendations.

Method:

This was a retrospective and cross-sectional review of patients admitted with diabetes over 4 months. Data was collected from electronic records using a modified data collecting tool based on the Standard of care as depicted by the National Diabetes Inpatient Audit form. No intervention was performed at any stage. A set of recommendations based on results were put forward.

Results:

121 patients were included in the study. Mean age of the patients was 67±16 years. 10 (8.26%) patients had their foot examined at the time of admission amongst those 7 (5.78%) were admitted due to diabetic foot disease. 23 patients who had an episode of hypoglycaemia, 43% (10/23) were managed as per Joint British Diabetes Society guidelines. 39% (9/23) had management not in accordance with the national guideline. Furthermore, no documentation was available for 4 patients (17.39%). Average length of stay in hospital was 16±33 days with a median of 7 days.

Conclusion:

There needs to be an improvement in the performance of diabetic foot examination on admission of all patients either admitted due to diabetes related complication or non-diabetic causes. The management of inpatient hypoglycaemia also needs better standardization processes.

Keywords: Diabetic foot examination; Diabetic Ketoacidosis; Length of stay; Multidisciplinary teams; Transition of care

Introduction

Global burden of diabetes is expected to increase to 590 million by 2035 (1). Currently, in the UK 18% of all acute hospital beds are occupied by patients with diabetes (2). A retrospective audit showed the mean hospitalisation cost for Type 1 diabetes was €4,027 and for Type 2 diabetes was €5,026 per admission (3).

Diabetic complications result in massive financial implications to the health care system. (4). People with diabetes are 2 to 6 times more likely to be admitted to a hospital alongside with an increased duration of hospital stay compared to people without diabetes (5). Lower socioeconomic status, older age, poor glycaemia control and clinical indicators including glycosylated haemoglobin (HbA1c), insulin use, and presence of complications are some of the major factors driving hospital admission amongst patients with diabetes (6). This project included the majority of these factors in questionnaire to evaluate and emphasize on impact of these variables on admission rate.

There were massive gaps found in in-patient diabetes care in a survey conducted on 262 acute hospitals in the UK (7). Regardless of diagnosis of diabetes, a relationship between dysglycemia, duration of stay and 28-day readmissions was found, hence dysglycemia can be used as a prognostic marker for a non-selected population with a range of medical problems

admitted acutely to secondary care (8). Several other studies indicated a link between inpatient hyperglycemia and the increase in hospital complications, length of stay, and mortality (2) (9) (10). Patients being managed with insulin were found to have high rates of medication error and hospital-acquired harm along with low rates of appropriate glycaemic control (11).

Direct and immediate benefits have been observed by careful management of inpatient diabetes complications including hyperglycemia, hypoglycaemia and glucose variability that are associated with prolonged hospital stay, infections, disability after hospital discharge, and death (12).

The effectiveness of multidisciplinary teams has been demonstrated in a study that showed improvement in care provision and decreased risk of diabetes complications (13). Another systematic review showed that after the introduction of diabetes inpatient specialist nurses there was a reduction in length of hospital stay (14) (15).

This was a service evaluation project with the aim to assess various inpatient diabetic complications as explained in Tables 1, 2 & figures 1, and early involvement of multidisciplinary teams in their management. It highlights the importance of managing patients with diabetes even if the cause of admission is non-diabetic.

Table1	
TYPE OF DIABETES	
Type 1	9/121 (7.43%)
Type 2	112/121 (92.56%)
ADMISSIONS	
Elective	3/121 (2.47%)
Emergency	118/121 (97.52%)
WARDS	
Medical	118/121 (97.52%)
Surgical	3/121 (2.47%)
REASON OF ADMISSION	
Active Foot disease	4/121 (3.30%)
Active foot disease alongwith other symptoms	1/121 (0.82%)
AFD with hyperglycemia	1/121 (0.82%)
HHS	6/121 (4.95%)
DKA	2/121 (1.65%)
Hyperglycemia	16/121 (13.22%)
Hyperglycemiaalongwith other causes	1/121 (0.82%)
Hypoglycemia	2/121 (1.65%)
Non-Diabetic	88/121 (72.72%)
RENAL REPLACEMENT TEHRAPY	
Heamodialysis	1/121 (0.82%)
Not applicable	120/121 (99.17%)
PAST FOOT COMPLICATIONS	
Charcoat	1/121 (0.82%)
Ulcer	6/121 (4.95%)
Amputation	2/121 (1.65%)
Charcoat plus Ulcer	1/121 (0.82%)
Not Applicable	111/121 (91.37%)
TYPE OF TREATMENT	
Diet	8/121 (6.61%)
Insulin	28/121 (23.14%)
Tablets	45/121 (37.19%)
Tablets and Insulin	40/121 (37.19%)
TYPES OF INSULIN	
Basal Bolus	27/121 (22.31%)
Basal insulin	34/121 (28.09%)
Mix	9/121 (7.43%)
Not applicable	51/121 (42.14%)
TABLETS	

Metformin-Yes	64/121 (52.89%)
No	57/121 (47.10%)
Sulphonylurea-Yes	22/121 (18.18%)
No	99/121 (81.81%)
SGLT-2 inhibitor-Yes	4/121 (3.30%)
No	117/121 (96.69%)
GLP-1 agonist-Yes	2/121 (1.65%)
No	119/121 (98.34%)
DPP-4 inhibitor-Yes	29/121 (23.96%)
No	92/121 (76.03%)
Glitazones-Yes	0/121
NO	121/121
Acarbose-Yes	1/121 (0.82%)
No	120/121 (99.17%)
FIXED DOSE COMBINATION	
Yes	29/121 (23.96%)
No	92/121 (76.03%)
ENTERAL FEED	
Yes	120/121 (99.17%)
No	1/121 (0.82%)
GLUCOSE CHART	
Yes	118/121 (97.52%)
No	3/121 (2.47%)
INSULIN INFUSION	
Yes	18/121 (14.87%)
No	103/121 (85.12%)

Table-2 inpatient complications

BM 3-3.9	
Yes	16/121 (13.22%)
BM<3	
Yes	7/121 (5.78%)
HYPOGLYCEMIA MANAGEMENT AS PER GUIDELINES	
Yes	10/121 (8.26%)
No	9/121 (7.43%)
Not Documented	4/121 (3.30%)
NO. OF EPISODES REQUIRING DEXTROSE/GLUCAGON	
Yes	1/121 (0.82%)
TARGET BLOOD SUGAR	
4 to 11	83/121 (68.59%)

>14	38/121 (31.40%)
POST ADMISSION DKA/HHS	0/121
INSULIN ERROR:	
No	74/121 (61.15%)
Not applicable	47/121 (38.84%)
DOSAGE ERROR	
No	74/121 (61.15%)
Not applicable	47/121 (38.84%)
DOSAGE ERROR	
No	74/121 (61.15%)
Not applicable	47/121 (38.84%)
ORAL ANTI-DIABETIC DRUGS ERROR	
No	84/121 (69.42%)
Not applicable	37/121 (30.57%)
DOSAGE ERROR	
No	84/121 (69.42%)
Not Applicable	37/121 (30.57%)
TIMING ERROR	
No	84/121 (69.42%)
Not Applicable	37/121 (30.57%)
REFERREL TO DST	
Yes	50/121 (41.32%)
NO	71/121 (58.67%)
SEEN BY DST	
Yes	50/121 (41.32%)
No	71/121 (58.67%)
ADMISSIONS DUE TO AFD	
Yes	7/121 (5.78%)
No	114/121 (94.21%)
RISK FACTORS ON FOOT	
Yes	7/121 (94.21%)
No	114/121 (94.21%)
FOOT LESION MENTIONED ON ADMISSION	
Yes	10/121 (8.26%)
No	111/121 (91.73%)
SEEN BY MULTIDISCIPLINARY FOOT TEAM	
Yes	18/121 (14.87%)
No	103/121 (85.12%)
SURGERY PERFORMED	

Yes	7/121 (5.78%)
No	114/121 (85.12%)
PRE-OP ASSESSMENT PERFORMED	
Yes	6/121 (4.95%)
No	1/121 (0.82%)
DIABETES MANAGED IN PRE-OP ASSESMENT	
Yes	6/121 (4.95%)
No	1/121 (0.82%)
PLAN FOR MANAGEMENT OF DIABETES MENTIONED IN PRE-OP ASSESMENT	
Yes	6/121 (4.95%)
No	1/121 (0.82%)

Design and Methods:

This was a retrospective and cross-sectional review of the standard of care and complications of consecutive patients with diabetes admitted over a 4-week period. Data was collected from electronic patient's record throughout their inpatient stay and tabulated into an Excel spreadsheet. No intervention was performed at any stage. A set of recommendations based on the results were put forward at the end of project to help to improve the quality of service being provided.

Non-probability sampling method was used, in which purposive sampling technique was applied. Data collection method was quantitative, with categorical variables used with level of measurement as nominal.

Participants:

A total of 121 patients with Type 1 & 2 diabetes including pregnant patients were included who were admitted via emergency department, elective via clinic to medical or surgical ward with exception to the following.

1-Not known to have diabetes (16)

2-Patient's length of stay less than 48hrs

3-Patients discharged from emergency department.

4-Diagnosis of pre-diabetes.

5-Patients directly admitted to Intensive Care unit from emergency department

Data Collection

The questionnaire was mirrored or was an adaptation of the NADIA (National Diabetes Inpatient Audit) parameters to measure the effectiveness of inpatient diabetes care being provided throughout length of stay. Data collection was performed via questionnaire consisting of 41 questions covering various aspects as shown in table 2 & figure 2,3,4. Data was then transferred to a password protected and encrypted excel

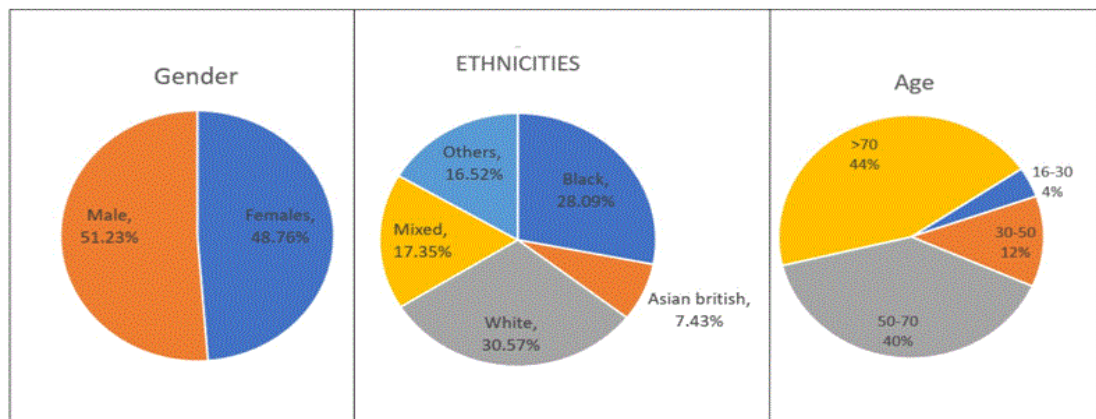
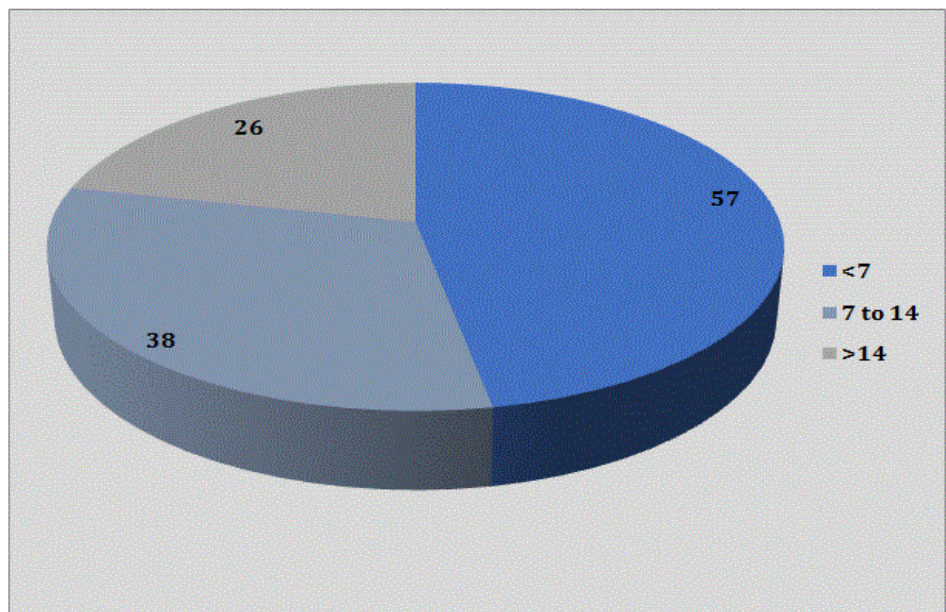


Figure 1: Shows Gender, Ethnicity, Age.



Length Of Stay.

Figure 2 shows total length of stay in hospital in days for 121 patients.

spreadsheet using hospital's computer. Following steps were taken to anonymise the information: Patient's initials were used rather than full names, hospital number was mentioned rather than NHS number.

This project falls in low-risk category where all patient's related information was password protected and was not accessible to anyone except the researcher and there was no risk to participants, or any intervention performed.

Quantitative analysis was performed on the collected data. Descriptive statistics were used to summarize the data. Student t test could not be calculated as there was no comparator group.

Results:

A total of 121 patients were included with mean age of 67 ± 16 years. Average length of stay in hospital was 16 ± 33 days with a median of 7 days as shown in figure 2. Amongst 68 patient who stayed for >7 days, only 10 out of 121 (8.26%) patients had their foot examined at time of admission amongst which 7 out of 121 (5.78%) were admitted due to active foot disease. In our study 10 out of 23 (43.4%) patients had hypoglycemic episodes managed as per the national guidelines but 9 patients (39.13%) had management that was not in accordance to Joint British Diabetes Society guidelines(32). No documentation was available for 4 patients (17.39%). Ethnicities have been shown in figure 1.4

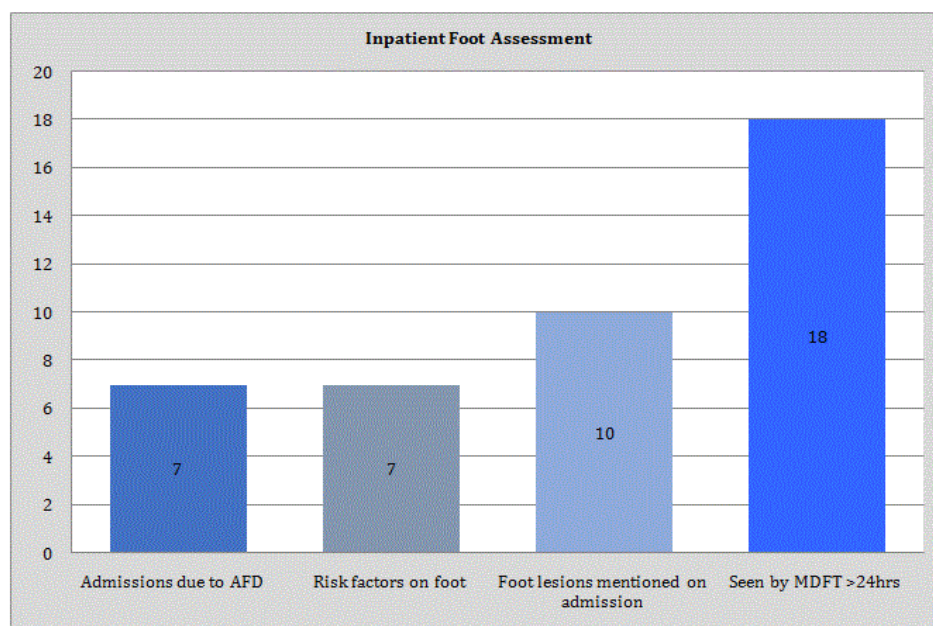


Figure 3: Inpatient Foot Assessment.

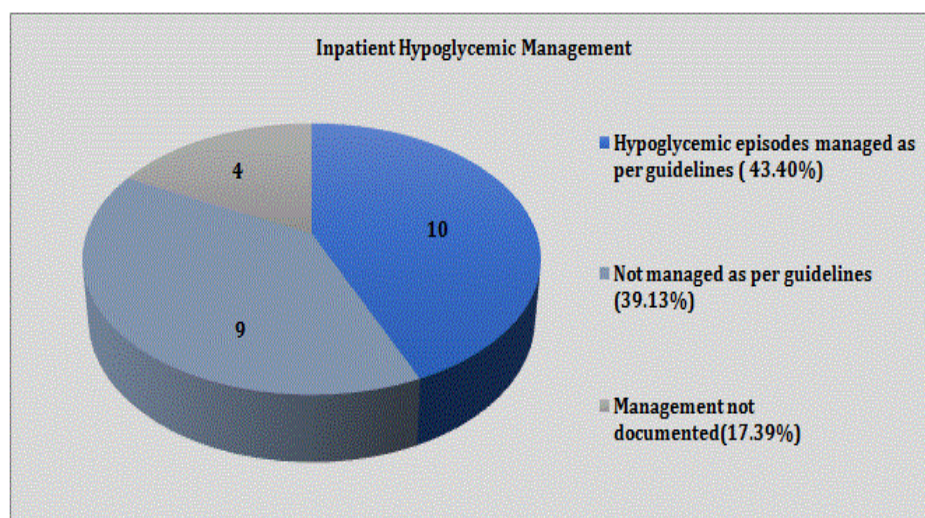


Figure 4 : Inpatient Hypoglycemic Management

out of 121 patients were admitted due to active foot disease – Table 1.16 patients had level 1 hypoglycemia (4 patients were only on basal insulin and 1 was on basal insulin and sulphonylurea), 5 were on basal bolus regimen, 3 were on mix insulin, and 1 patient didn't have any regimen mentioned. 7 patients had level 2 hypoglycemia amongst which 2 were on basal insulin and 1 on basal insulin and sulphonylurea, 2 patients were on mix insulin and 2 were on basal bolus regimen.

Discussion:

Diabetes is the leading cause of cardiovascular disease, renal failure, retinopathy, and lower-extremity amputations and a huge contributor towards economic burden to healthcare system (17).

This is a service evaluation project where the quality of inpatient diabetes care being provided was assessed in accordance with the national standards as per the NADIA (National Diabetes Inpatient Audit). This project reviewed the care provided over the entire admission period of the patients. In 2020 NADIA audit

data showed that 69.5% of the harm were hypoglycaemic rescue where as in our study it was 19%.16.2% of harm was from diabetic ketoacidosis,2.93% from hyperglycemic hyperosmolar syndrome (HHS), however in our study there were no cases of post admission diabetic ketoacidosis & HHS(17).Our study showed an average length of stay 16 ± 3 days compared to an audit that showed average length of stay of 22.39 (22.26) days, vs. 11.68 days in patients without diabetes (18).This is in contrast to a retrospective analysis case series concluding an average length of stay as 6.1 days (19).

Our project showed 27.27% of admissions due to diabetes related complications in contrast to another retrospective analysis conducted at King Abdulaziz University Hospital concluding 17% of admission due to diabetes related complications (20).Diabetes related complications are mentioned in Table 1.

In our study 30.57% of those with diagnosis of diabetes admitted to the hospital were white followed by 28.09% black population in contrast to a cross-sectional analysis that revealed a higher admission risk and lower readmission risk of South Asian British people than white British (21).

18 out of 121 (14.87%) of patients were on insulin infusion, 8/18 (44.44%) did receive a fixed rate due to diabetic ketoacidosis or hyperglycemic hyperosmolar syndrome and remaining 10/18 (55.55%) were on Variable rate infusion, however there was no electronic documentation available due to use of paper chart.

Medication Errors::

Anti-diabetic medications prescription errors remains a very common which can be commonly due to writing U instead of complete "unit" there can be errors in writing the dosage/units of insulin, administration or timing error.

As shown in Table 2- there were no reported errors in either oral anti-diabetic agents or insulin administration in contrast to a snapshot audit conducted over 7 day period showing 22.7% of insulin timing errors, 15.5% of documentation errors, 0.68% has administration errors (22).This is not applicable to those patients who were on insulin infusion as the modification rate of insulin infusion was being documented on paper and not electronically.

Foot assessment:

Foot problems result in almost 20% of hospital admissions among patients with diabetes. Majority of patients with diabetes do not receive adequate foot care or they lack awareness about regular foot checks. (16) Studies showed 50% reduction in ulcer occurrence by creating awareness amongst physicians about foot problems in patients with diabetes(23).

Patients receiving care from a multidisciplinary team have reduced severity of amputation, length of stay and mortality rates, improvement in ulcer healing and quality of life (24).

In our study only 10 out of 121 (8.26%) patients had their foot examined at time of admission. (Table-2) and 7 out of 121 (5.78%) were admitted due to active foot. Another study concluded only 9

(4.5%)patients out of 200 had foot examination in the last 5 years, among the participants,71 (35.5%) had at least one risk factor for the development of diabetic foot ulcer (25).Individuals who had their feet examined or received foot education are more likely to check their feet regularly (26).Time restraints, lack of awareness & training, lack of suitable tools and absence of any foot symptoms are some of the obstacles towards a comprehensive foot exam (27). In our study, at the time of admission foot examination was only performed for patients who had an active foot disease/risk factor present.

Inpatient hypoglycemia:

Prevention of hypoglycaemia, requires implementation of patient safety, multidisciplinary communication, transitions of care and patient centered care (28) (29).Hyperglycaemic treatment, previous history of hypoglycaemia, type of diabetes, comorbidities and advanced age are some of the risk factors leading to secondary hypoglycemia resulting in increased length of stay and mortality (30) (31).In this study (23 out of 121) 19% of patients had hypoglycaemic episodes including severe hypoglycaemia (level-3) in contrast to a study that showed hypoglycaemic episodes in 7.7% of study population(30).Amongst these 19% study population,13% patients were on sulphonylurea. As discussed above 3 patients who had level-1 hypoglycaemia were on insulin infusion (variable rate). As per national diabetes inpatient audit 2020, 69.5% of harms were due to hypoglycaemic rescue (17). The treatment of hypoglycemia requires an effective coordination between hospital staff including physicians, nurses and support staff(31). In our study 10 out of 23 (43.4%) had hypoglycemia managed as per guidelines.9 (39.13%) had management that was not in accordance with Joint British Diabetes Society (JBDS) guidelines (32).No documentation was available for 4 patients (17.39%).This emphasizes the need for hospital care providers to be proficient at basic diabetes management shown in various other studies (33).

Dialysis:

There was 1 patient in our study who was on haemodialysis and mixed insulin for glycaemic control with no evidence of any hypoglycaemic episodes during his inpatient stay. Risk of hypoglycemia is increased by renal impairment. Hence glucose targets and treatment strategy need to be optimized (34).

Pre-operative assessment:

Pre-operative hyperglycaemia is associated with post-operative adverse outcomes& educating staff is the key to avoid it (35) (36).In our study,7 out of 121 (5.78%) patients had surgical procedures, whereas 6 patients(85%) had pre-operative assessment performed and a plan for diabetes management put in place.

Recommendations:

1. Patients on insulin infusion either fixed or variable rate, need to have an electronic record of their blood glucose chart for easy access to diabetes team remotely, as well as for future referencing

e.g utilization of data in a research/QIP.

2. Educating the staff in form of face to face/online teaching sessions depending on availability of staff, disseminate information by putting up posters in different hospital premises specially diabetes/diabetic foot clinics, all medical and surgical wards. Teaching must be directed towards nurses, doctors of all grades and departments, diabetes specialist nurses (DSNs) aiming to empower patients with adequate knowledge for self-examination of foot after discharge.

3. Staff education on proper documentation must be emphasized to avoid missing any hypoglycaemic /hyperglycemic episodes. It is quite a challenge to chase the on-duty staff to retrieve the information due to work shift patterns, in order to decide whether action is needed in form of modification/optimization of insulin regimen which can have impact on future HbA1c and post discharge planning.

4. There needs to be an individual trust policy with regards to involvement of DSNs in provision of care for patients admitted due to non-diabetic reasons. This can include baseline HbA1c, presence of diabetic complications (micro/macrovacular). Amongst 121 patients admitted, only 33 were due to diabetic reason as mentioned in Table 1 however Diabetes team was involved in provision of care to 50 patients emphasizing the importance of a proper capillary blood glucose check and timely involvement of speciality teams even if primary reason of admission was non-diabetic in first place.

5. Transition of care needs to be pre-determined meaning identifying re-admission risk factors at time of admission, appropriate involvement of patient's family, carers including GP or community diabetes services once patient is ready for discharge.

Limitations:

1. Lack of documentation especially for hypoglycaemic management hence complete results for hypoglycaemic management as per guidelines couldn't be attained.

2. First author has been working full time, meaning conducting the study alongside clinical work.

3. Future studies can be conducted where re-admission rate can be looked into which couldn't be done due to time constraints and other training commitments as well as duration available to complete the project.

4. It would be certainly of interest for future research to find out why the foot exam was not performed for example in several cultures/religions, patient might not be comfortable to have their feet checked. Or considering a patient was admitted due to a reason other than foot problem, admitting physician might not have considered examining the feet as part of their physical examination or if examination was normal, they may not have mentioned it considering only to document abnormal findings in examination.

5. Future studies can be undertaken to introduce an intervention and documenting the comparison of data collected prior to intervention and afterwards, which will certainly provide stronger basis to introduce these recommendations at a trust level.

Conflict of interest statement:

No potential conflicts of interest relevant to this article were reported.

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