Sign up to Safety – end of 3 year report

Making Surgery Safer for Patients with Diabetes

Context:

Diabetes affects more than 15% of the UK surgical population and this percentage is continuing to rise[1]. Despite nationwide recognition that high quality peri-operative diabetes care improves surgical outcomes, people undergoing surgery often receive inadequate diabetes care[2].

The Newcastle NHS Foundation Hospital Trust is the busiest trust in the UK, with more than 76000 surgical episodes per year, 15% with diabetes. On any day in the trust there will be around 100 patients with diabetes on surgical wards and this number is rising each year (NADIA 2017).
Despite the publication of guidelines for the management of diabetes and surgery from JBDS (2011) and Association of Anaesthetists (2015) patients with diabetes continue to have higher mortality, morbidity and length of stay. For this reason, when in 2014 Newcastle Hospitals Trust enrolled in the national patient safety initiative, Sign up to safety (SU2S), peri-operative diabetes care was identified as one of 5 priorities.

The Problem:

The care of people with diabetes is complex, particularly for those undergoing surgical procedures. Inadequate peri-operative diabetes control is associated with poor outcomes, including increased wound complications, higher mortality rates and increased length of hospital stay[4-6].
The reasons for these adverse outcomes are multifactorial but include poor glycaemic control, medication errors, lack of institutional guidelines and inadequate knowledge of diabetes amongst staff delivering care[7,8]. High quality diabetes care throughout the surgical pathway from preadmission planning of surgery though to discharge is essential. This however involves many steps, a diverse group of health care professionals and the need for seamless transfer of the plan from one team to another.

Despite national guidelines aiming to improve peri-operative diabetes care, concerns have been raised as to how well guidelines are adhered to. National audits consistently report surgical patients are at higher risk from medication errors and hypoglycaemia[1]. The National Diabetes inpatient audit has shown little improvement nationally on reduction of avoidable harm to inpatients with diabetes including diabetes related prescription errors, insulin management errors and inpatient hypoglycaemia (NADIA report 2015)
The National Confidential Enquiry into Patient Outcome and Death (NCEPOD, 2014) also identified vascular patients with diabetes undergoing lower limb amputation (LLA) as a particularly high risk group for hypoglycaemia, medication errors and inadequate specialist diabetes input[3]. Principal NCEPOD recommendations included increasing specialist nurse input, reducing medication errors and clear guidelines for the management of blood glucose levels. Peri-operative management of surgical patients with diabetes is the subject of a national ongoing NCEPOD enquiry due for completion in 2018. Perhaps all this is best summed up by a comment made from a member of staff to a diabetes specialist nurse (DSN) ……. “insulin is not my thing” . Our overarching aim is to turn that in to an attitude for all staff of “Insulin is everyone’s thing”.

Interventions:

Prior to the sign up to safety campaign it was recognised that there was a need to develop a clearer set of trust guidelines to support the management of diabetes in the peri-operative period. This collaboration between anaesthetists and diabetes specialists had already started but lacked a framework to drive implementation. The “Sign up to Safety” (SU2S) project provided the ideal platform to take over the project to identify perioperative diabetes care as a trust priority with the aim to reduce avoidable harm by 50%.
The starting point was to bring together representation from all parts of the perioperative patient pathway (pre-op assessment nurses, anaesthetists, ward matrons , surgeons, diabetes team, junior doctors, pharmacists) on a regular basis to design, implement , evaluate, educate and quality improve a perioperative pathway for diabetes care from initial referral to discharge.
The SU2S perioperative diabetes care working group was formed in May 2015, underpinned by the 5 principals of SU2S;

- Putting safety first,
- Continual learning,
- Being honest,
- Collaboration and
- Being supportive.

We identified the scope of the project initially for elective surgery from pre-assessment to discharge, but it soon became clear that emergency surgery needed to be included.

The initial components of the project plan was identified

1. To understanding the journey for a patient with diabetes through the perioperative pathway.
2. To Measure the baseline quality of care in all parts of the pathway.
3. Using multidisciplinary multispecialty dialogue and the expertise of people working in each area, to redesign the perioperative pathway to be appropriate for each clinical area
4. To develop appropriate handover tools as the patient moves from one clinical area to another.
5. To Design and utilise Quality improvement tools including the feedback and analysis of DATIX and measurement of change in practice and continue to feed this into the ongoing design and implementation of pathways.
6. To provide specific multidisciplinary education to all levels of clinical practitioner through departmental meetings, drop in sessions, doctors teaching sessions, patient safety briefings and departmental clinical governance meetings. Particular focus has been on engaging consultant anaesthetists and surgeons.

The SU2S working group met regularly. At each working group progress reports and feedback was received from each department involved in the pathway. Reported incidents, Datix reports and staff feedback were reviewed and the pathway was revised if appropriate on a quality improvement model.

An audit tool was developed based upon the JBDS and British Association of Anaesthetists audit tools. The first draft of the perioperative pathway was designed by a consultant anaesthetist with input from a diabetes consultant and preoperative assessment clinic (PACS) senior nurse and the tool was refined by the multidisciplinary group. It includes the domains

- **Pre-operative assessment and admission**
  - individualised written careplans provided for all patients for their diabetes management prior to and during admission discussed at pre-op assessment clinic.
  - Assessment for Day of Surgery patient admission.
  - A decision about insulin /glucose infusion by an anaesthetist using the guidelines.
- **Theatre and recovery**
  - New anaesthetic/recovery guidelines used by theatre nursing staff and orderlies
  - New ward handover document to confirm whether subcutaneous insulin has been given in theatre and guidance for the ward staff regarding planned eating and the post-op diabetes plan.
- **Post-operative ward care**
  - New diabetes handover care plan to guide ward staff on the ongoing plan for food and medication.
  - New guidelines surgical ward diabetes care
    - Tool for junior doctors on diabetes medication titration
    - persistent hyperglycaemia > 12mmol/l or persistent hypoglycaemia < 4 mmol/l on 2 x BM for 2 days **MUST BE ACTED UPON**
    - diabetic specialist nurse referral advice.

- Sugar cube alert system to use on ward board rounds.

- **Discharge**
  - New advice on discharge planning

In this report we reflect upon and describe the process of change management in each part of the perioperative pathway and report the change in quality improvement outcomes as the project progressed.

Baseline audit of perioperative care was carried out between June and September 2015. Using this data there were specific obvious problems that needed to be addressed, including revision of the cut off HbA1c for Day of surgery admission due to the proportion of patients over the cut off of 69mmol/mol, more training of theatre orderlies for blood glucose monitoring and changes to prevent Glucose /insulin infusions being stopped inappropriately in theatre or recovery. Following targeted education of staff groups involved in perioperative care, the pathway was launched in May 2016. Early revisions were made using the information from datix reports and staff feedback. Follow up detailed audit of the pathway was carried on patients undergoing surgery between September and December 2016. This was repeated from September to December 2017. National Diabetes inpatient audit (NADIA) outcomes for patients in surgical wards was assessed in 2015, 2016 and 2017.

Development and dissemination of the perioperative guidelines.

The initial draft of the Newcastle peri-operative guidelines was drawn through collaboration between a consultant anaesthetist and diabetologist based upon the JBDS guidelines for the management of diabetes and surgery (2011). The MDT from each clinical area was asked to take their part of the pathway back to their department and adapt it to be a functional tool. It returned to the group with specific feedback. Once the pathway was finalized, an electronic copy was published in the Trust inpatient diabetes handbook and easily identifiable paper charts with surgical yellow borders where printed. A standardized short teaching presentation was put together to be shared with each clinical area involved.

A frequently asked questions (FAQs) section was included which is updated as new questions or scenarios arise.

Nineteenth May 2016 was set as launch day. The inpatient DSN team were tasked with the education of nursing staff around the roll out. They arranged 8 drop in sessions and ward and departmental based training. This has continued to be embedded into formal diabetes study days. Clinical educators and clinical leads were engaged to carry our cascade training.

Quality improvement and further innovation resulted from staff feedback, review of audit outcomes and review of reported incidence.

Pre-Operative Assessment clinic (POAC) Interventions and Outcomes

Draft guidelines were circulated amongst all the POAC staff (nurses and consultant anaesthetists) to gain feedback about their content and usability. A series of educational seminars were held for the POAC staff to discuss how the guidelines could be implemented within the timeframe of the patients' clinic appointment and to see if it could be nurse led.

All patients with an HbA1c <69mmol/mol are pre-assessed by a nurse. Those with an HbA1c > 69mmol/mol or poorly controlled diabetes have the notes reviewed by a consultant anaesthetist. A flowchart *(Appendix)* and a diabetes medicines management guide *(Appendix)* were produced to help direct the clinicians on the appropriate management of the patients' diabetes in relation to the timing and nature of their surgery. This

includes referral back to the GP for pre-optimisation (for non-urgent surgery), receiving advice or input from the diabetes specialist nurses, prescribing the GKI protocol *(Appendix X)* for an inpatient admission (valid for 18 weeks) or providing individualised medical management instructions for the day of surgery (e.g. altering dose of insulin and fasting instructions).

Adapting to feedback.

The diabetes reviews was perceived as a large increase in workload for the consultant anaesthetists, therefore the Band 6 nursing role was expanded to review "suboptimal controlled" patients notes and provide appropriate preoperative advice with signed support from the consultant.

Customised advice, using an information sheet *(Appendix X)* is provided to the patient and a copy filed in the notes. The 'diabetes status' is highlighted to the waiting list officer to be listed early on the list operating. If a patient with poorly controlled diabetes is identified, who requires non urgent surgery, a standardised letter is sent to their GP to request their support in optimising blood glucose control prior to surgery.

In 2016, an HbA1c point-of-care testing machine was introduced to POAC to improve the efficiency in detecting patients' diabetes control, and therefore create a perioperative plan, however it had significant cost implications and so the testing returned to the hospital laboratory

All the changes were taken to the POAC user group to ensure all users had access to the information across both hospital sites within the Trust.

Improvement in pre-operative Diabetes care planning with the patient.

Prior to implementation of the guidelines, the baseline audit (2015) showed that only 39% of patients had a documented plan of their perioperative diabetes management. This doubled to 82% in 2016 and the improvement was sustained at 78% in 2017. The documented POAC plan was deemed to be correct in 82% of the cases in 2016 and 73% in 2017.

National guidance suggested that diabetic patients should be managed in the first third of the scheduled list. We aimed to improve the surgical listing of patient with diabetes, and to also encourage anaesthetising the patient earlier in the day. It was recognised that diabetes is not the only condition and situation influencing the list order. Despite this 55% were listed appropriately in 2015, and this increased to 64% in 2016 and stayed at 63% in 2017.

<u>Hospital Admission Intervention and Outcomes</u>

An aim of the new pathway was to simplify and streamline admission of surgical patients with diabetes. Prior to 2015, there was significant variation in patient care and conflicting advice provided by clinicians. As an active member of the SU2S working party, the Sister from the daycase (and day of surgery admissions, DOSA) unit was involved with the final production of the guidelines. These were then piloted for feasibility on the day unit.

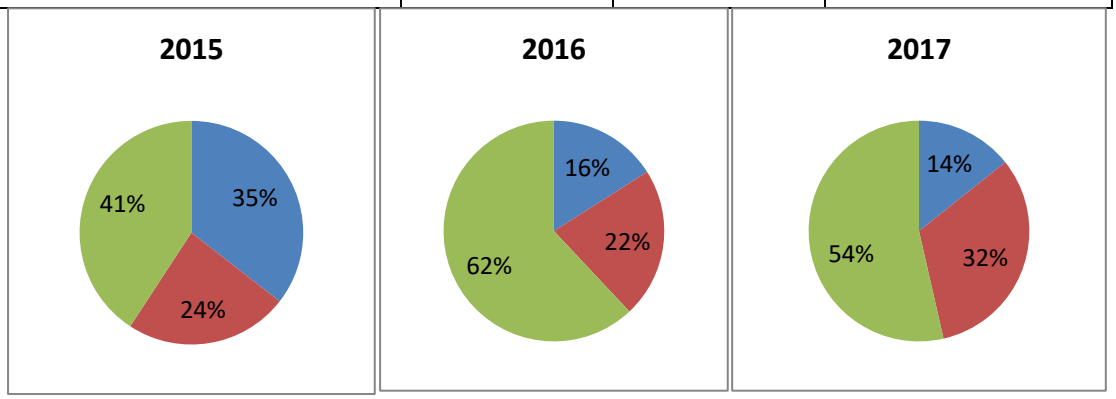
Patients who required GKIs needed the infusion to be started early on admission and pre-prescribed but there is no junior doctor on the ward. The guidelines were amended so that GKIs were prescribed in POAC by an anaesthetic consultant in preparation for admission.

Engaging the daycase unit staff

Training was provided by the inpatient DSN team to increase knowledge and confidence with the new guidelines and pathway. Each patient would attend, either on the day of surgery or on the night before with a clear written plan on their diabetes medication management.

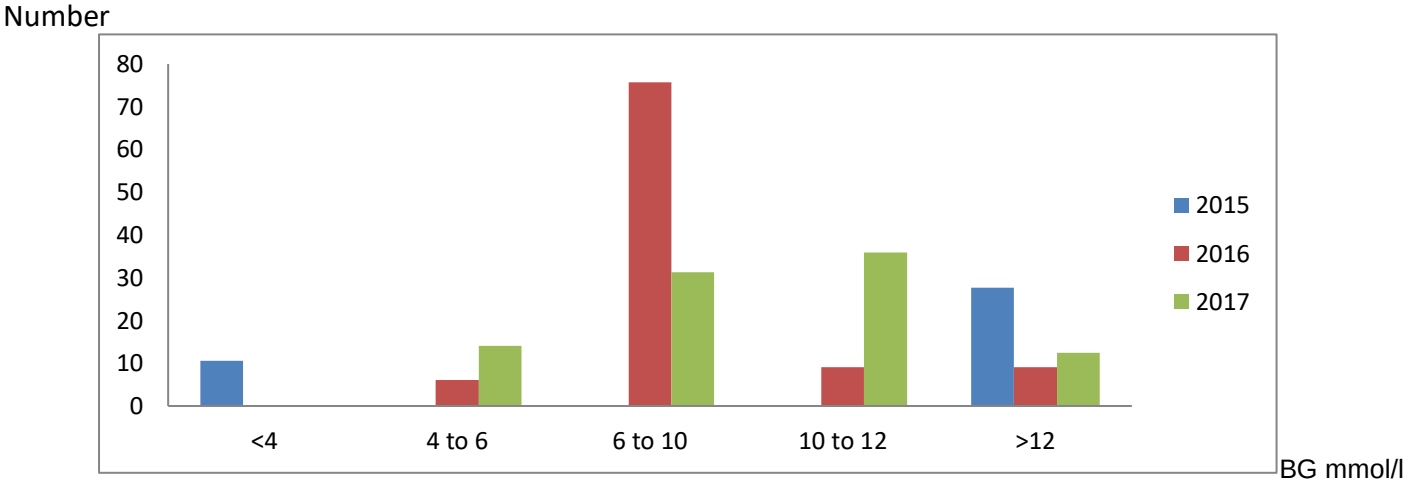
Prior to the new pathway, many patients were brought in the night before to manage blood glucose levels, although many patients received little to no diabetes related intervention and sometimes inappropriate clinical decisions around diabetes management were made. Day before surgery admission was associated with cost implications with little benefit. Since the new pathway was introduced, the mode of admission (day before surgery, daycase, day of surgery (DOSA) is determined after the individualised POAC review. This has significantly reduced unnecessary admissions on the night prior to surgery.

Fig1 : Increase in day of surgery admission for patients with diabetes after introduction of the perioperative diabetes pathway	**2015 (n)**	**2016 (n)**	**2017 (n)**
Day before Surgery admission	36	12	13
Daycase	24	17	28
DOSA	41	47	47



Prior to pathway implementation, most patients were informed to omit all oral hypoglycaemics and insulin whilst fasting prior to surgery. This was the easiest standardised option, but not ideal. The new medication guidance requested patients on long acting insulin take between 50% and 80% of their dose depending on the specific insulin. Clinicians were concerned over the potential for preoperative hypoglycaemia in patients nil by mouth receiving insulin. Repeat audits carried out over the following 2 years demonstrated a significant reduction in the number of patients with hypoglycaemia and hyperglycaemia (Blood glucose >12 mmol/l) and more patients achieving target blood glucose of 4-12 mmol/l prior to surgery (Figure 2). After the introduction of the pathway not patients in the repeat audit had experienced blood glucose levels < 4 mmol/l (Fig 2).

Figure 2: Pre-operative Blood glucose levels before (2015) and after introduction of the perioperative diabetes pathway.



Theatre and Recovery Intervention and Outcomes

Data from the 1st audit prior to launch of the surgical pathway was shocking. Sixty two percent of patients with diabetes did not have a blood glucose checked within 2 hours of surgery and 37/50 (74%) did not have their blood glucose checked hourly whilst under anaesthesia. There was a high number of inappropriate GKI infusions. As the pathway was launched, there was an intense education and awareness programme across the perioperative directorate. Presentations (including the results of each yearly audit) were given in the clinical governance and audit meetings, to the recovery team and the anaesthetic assistants. The diabetic specialist nurses also facilitated drop-in sessions with the theatre staff. The pathways were also presented to different surgical directorates, to increase awareness amongst junior and senior medical staff.

Implementation of the pathway resulted in a reduction in the number of inappropriate GKI infusions administered and an improvement in the number of patients who should have been given a GKI who did not receive one. (Table 2).

Table 2.	**2015 (%)**	**2016 (%)**	**2017 (%)**
Needed a GKI & did not receive one	39	28	17
Did not need a GKI & received one	20	2	0

Identifying the barriers: Not enough blood glucose monitors and people trained to use them!

The new pathway recommends regular (hourly) glucose monitoring in the intraoperative and recovery period. It was highlighted that for a large theatre complex, there were insufficient numbers of blood glucose monitoring machines and people trained to use them to achieve this.

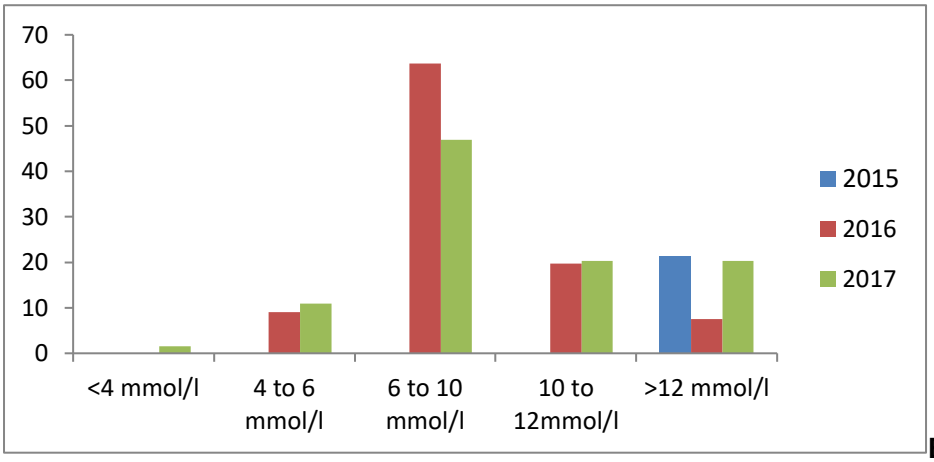
Discussions regarding why GKI infusions were frequently disconnected prior to the end of a procedure revealed one common reason was that the connecting tubing was too short! And there was a poor understanding that IV insulins therapeutic half life was only 3 minutes.

A 'Perioperative Diabetes' folder was introduced into each anaesthetic room containing the new GKI/GI protocols, prescriptions and intraoperative blood sugar control flowchart *(Appendix)*. Solutions were found for longer tubing. A point-of-care testing equipment update session was run to enable all staff (anaesthetists, anaesthetic assistants and recovery staff) to be competent and registered to use the Blood glucose machines.

Regular blood sugar monitoring has improved. This is still an area however needing review and improvement (Table 3).

Table 3. percentage patients getting hourly peri-operative blood glucose monitoring pre and post introduction of the diabetes perioperative pathway	2015 (%)	2016 (%)	2017 (%)
Intraoperative hourly monitoring	32	45	44
Recovery hourly monitoring	n/a	41	61

Figure 3. Blood glucose levels measured in theatre recovery.



Blood glucose

Prior to the pathway launch (2015) only 21% of patients had their blood glucose checked in recovery and they were all above target. This transformed to all patients getting at least one blood glucose checked in recovery. Following pathway launch, 92% of recovery blood glucose tests were within the 4-12 mmol/l target, suggesting that the perioperative diabetes management guidelines was effective in maintain blood glucose control, with a reduction of target blood glucose to 72% in the 2017 audit. (Figure3).

Clinical leadership

In each hospital site, there are lead anaesthetists that are a direct point of contact to answer questions regarding the pathway and to troubleshoot. These anaesthetists, who were on the SU2S working party, investigated each datix related to perioperative diabetes management that was entered within the directorate during the time of the pathway launch, and were able to speak with individuals directly to ensure ongoing learning from errors and improvement.

Don't drop the ball... Care of patients on transfer to the ward.

The problem

In 2014, 2 serious case reviews around harm to patients with diabetes in surgical wards had highlighted a problem with the inappropriate stopping of Glucose/Insulin infusions (GKI) on transfer to the ward from theatre recovery and from critical care without the administration of subcutaneous insulin in patients who were insulin independent. In these cases this resulted in inpatient DKA. Root cause analysis revealed a lack of understanding from staff around the short half life of IV insulin (3 minutes) and the importance of ensuring subcutaneous insulin has been given prior to stopping an insulin infusion. Ward junior doctors were rarely aware of the patient being transferred to the ward or the plan around the diabetes. Baseline audit demonstrated a significant lack of/ or poor quality communication between the anaesthetist, recovery nurse and ward staff postoperatively

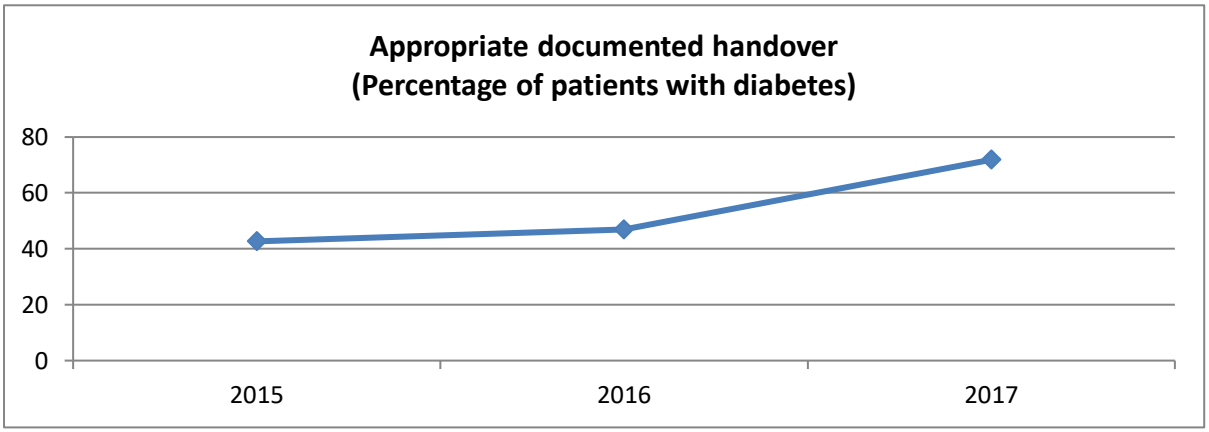
The intervention

The "Care of Diabetes on transfer to the ward" plan was developed which requires the anaesthetist to indicate the predicted plan for food and diabetes medication by a simple tick box form. Recovery /critical care staff need to sign to confirm that they have administered subcutaneous insulin prior to transferring the patient to the ward (appendix). This gave clear instructions on stopping GKIs, commencing oral intake and the restarting of diabetic medication depending on the patient's surgery and level of consciousness. The same form was introduced into critical care for patients being discharged to the medical or surgical wards.

The outcome.

Over the 3 years, documented handover improved by 30% (Figure 4).There was little improvement after the first year. Discussion with theatre teams revealed the form was not accessible enough so the form was placed in every anaesthetic room and all the recovery nurses were empowered to ask the anaesthetists to fill them in.

Figure 4



Improving the care of patients with diabetes on the surgical wards.

The challenge : The rising number of patients with diabetes and those on insulin on surgical wards.

Datasets were available from 2013 and 2015 prior to launch of the perioperative guidelines on 9/5/16 and 2016 and 2017, 4 months and 16 months after the launch date .

Number of patients with diabetes trust wide is rising and as is the number on surgical wards on the day of the NADIA audit.

	2013	2015	2016	2017
Patients with diabetes on surgical wards	65	68	87	100
Patients on insulin on surgical wards	24	29	n/a	59

In 2017, 10% of patients have Type 1 diabetes and 49% of those with type 2 diabetes are on insulin. Secondary diabetes now accounts for 8% of diabetes most due to pancreatitis and pancreatectomies.

Using technology to reduce patient harm.

The 2013 NADIA showed 22% of inpatients with diabetes in NUTH were exposed to a diabetes related prescription error with insulin related prescription errors in 53% of patients on insulin. Electronic prescribing had been introduced through e-record (cerner) in 2011 but insulin prescribing and blood glucose monitoring remained on a bedside blood glucose chart. Bar code scanning blood glucose meters were introduced trust-wide downloading directly onto the e-record patient chart and an insulin prescribing

field was developed using insulin prescribing safety standards set out by the National patient safety Agency (NPSA). This included the facility for patients to self-administer and self-adjust insulin doses and the prescribing of insulin around mealtimes. A blood glucose monitoring view in e-record was developed as the electronic blood glucose chart with all diabetes related medications (including steroids) displayed alongside blood glucose readings to facilitate insulin dose adjustment (Figure 5). Pop-up prompts on the records of patients with type 1 diabetes remind staff not to omit insulin.

Outcome

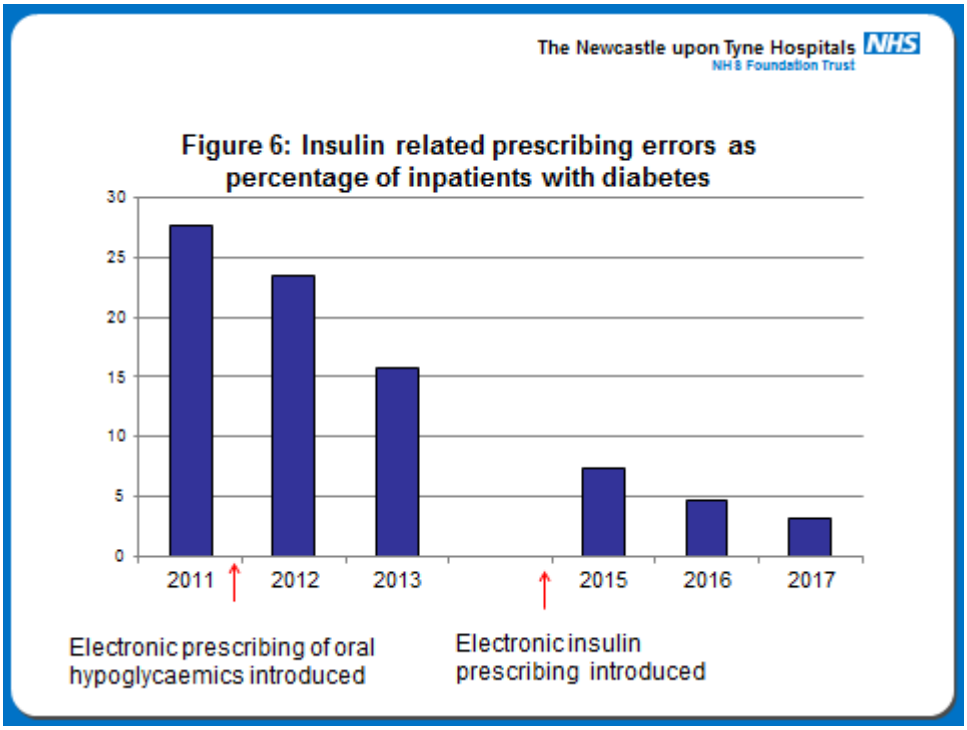
Despite significant reduction in inpatient insulin prescribing errors across the trust by 75% (Figure 6), frequency of diabetes related management errors, including failure to adjust doses of oral hypoglycaemics and insulin doses following inpatient hypoglycaemia, deteriorated.

Figure 5:Electronic diabetes management chart.

View ... Level: Glucose Monitoring View Table Group List

Last 15 Results in the Past 3 Years

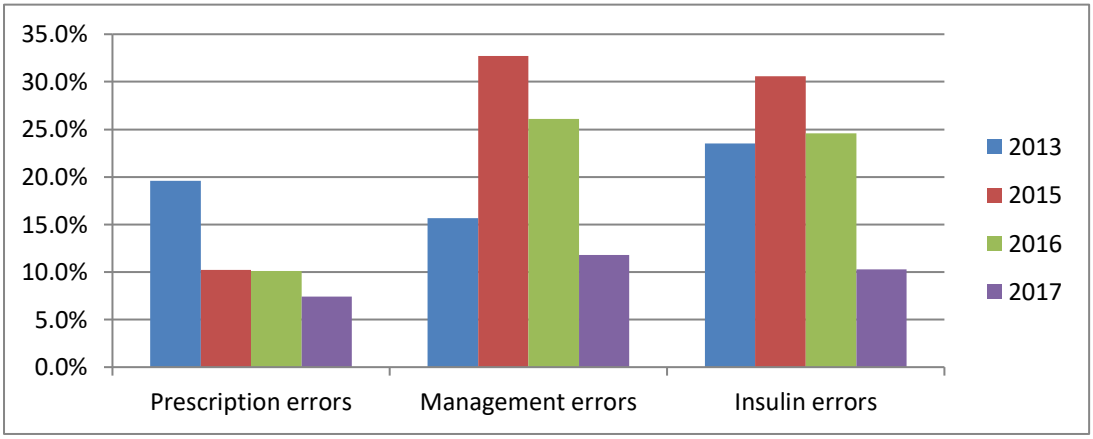
Glucose Monitoring View					
Glucose Monitoring View	Capillary Glucose	HbA1c	insulin glargine	Gliclazide	metformin
26/Jan/16 06:45 GMT	11.2				
26/Jan/16 08:16 GMT				160 mg	
26/Jan/16 08:18 GMT					500 mg
26/Jan/16 16:21 GMT	11.3				
26/Jan/16 17:48 GMT				120 mg	500 mg
26/Jan/16 17:56 GMT			8 unit(s)		
26/Jan/16 20:59 GMT	19.8				
26/Jan/16 23:08 GMT	11.0				
27/Jan/16 02:21 GMT	8.0				
27/Jan/16 06:15 GMT	8.1				
27/Jan/16 07:52 GMT	7.5				
27/Jan/16 08:23 GMT			8 unit(s)		
27/Jan/16 08:27 GMT				160 mg	500 mg
27/Jan/16 12:05 GMT	6.3				
27/Jan/16 16:13 GMT	7.5				
08/Feb/16 16:10 GMT		n 70			
12/Feb/16 09:28 GMT	7.8				
19/Feb/16 14:50 GMT	10.5				
19/Feb/16 22:00 GMT	11.6				
20/Feb/16 05:21 GMT	9.7				
20/Feb/16 09:45 GMT					500 mg



Review of the consequences.

Moving the blood glucose and diabetes medication chart to electronic format and moving from daily insulin prescribing to a system where an insulin prescription remained current unless the dose was altered, significantly reduced prescription errors but increased diabetes management errors and specifically insulin management errors on surgical wards (Figure 7). The absence of end of the bed paper charts resulted in it was less obvious to the ward team when blood glucose levels were out of range and diabetes medication doses required adjustment. A culture of communication about blood glucose levels had been disrupted. Since the introduction of the surgical diabetes pathway in 2016, patient safety briefings and targeted teaching on electronic glucose monitoring charts and initiatives such as the electronic white boards there has been a reduction in both diabetes management and insulin prescribing errors on surgical wards in the annual NADIA. (Figure 7).

Figure 7: Preventing avoidable harm: Diabetes prescription , management and insulin management errors in surgical patients in the annual NADIA audits.



Interventions to reduce hypoglycaemia: The electronic sugar cube.

It was recognised that tools to help facilitate the communication of blood glucose levels in ward handover were needed to reconnect those testing blood glucose, those administering insulin and those adjusting the prescription. The trust was developing an electronic ward handover board for patient specific communications including those linked to patient safety. The ability to link the downloaded blood glucose reading from e-record provided the perfect opportunity to be an early adopter to utilise this visual aid to use colour coded sugar cubes displayed to alert the team to both high and low blood glucose levels and highlight the need for adjustment of diabetes related medications. (details discussed in the vascular ward story).

Targeting the specialist team.

In view of the risk of patient harm associated with hypoglycaemia, further development an automatic hypoglycaemia alert message to the inpatient Diabetes nursing team following 2 consecutive hypoglycaemic episodes in a patient was developed. The nurses are able to target their support to those patients experiencing recurrent hypoglycaemia. On receiving an alert of hypoglycaemia, they are able to contact the ward team and support clinical decisions in adjustment of medication to prevent further hypoglycaemia.

Easy accessible guidance for junior surgical trainees (appendix)

All Foundation doctors undergo targeted training in insulin prescribing and are required to complete online training in insulin use in hospital. However vascular surgery F1s highlighted a need for a 1 page tool kit to managing diabetes on the ward including adjusting diabetes related medication, when to refer to the DSN,

things to consider for safe discharge etc. The SU2S group adapted the previously developed toolkit and incorporated it into the pathway including publishing it in the diabetes online handbook. All surgical trainees are signposted to this at their ward induction.

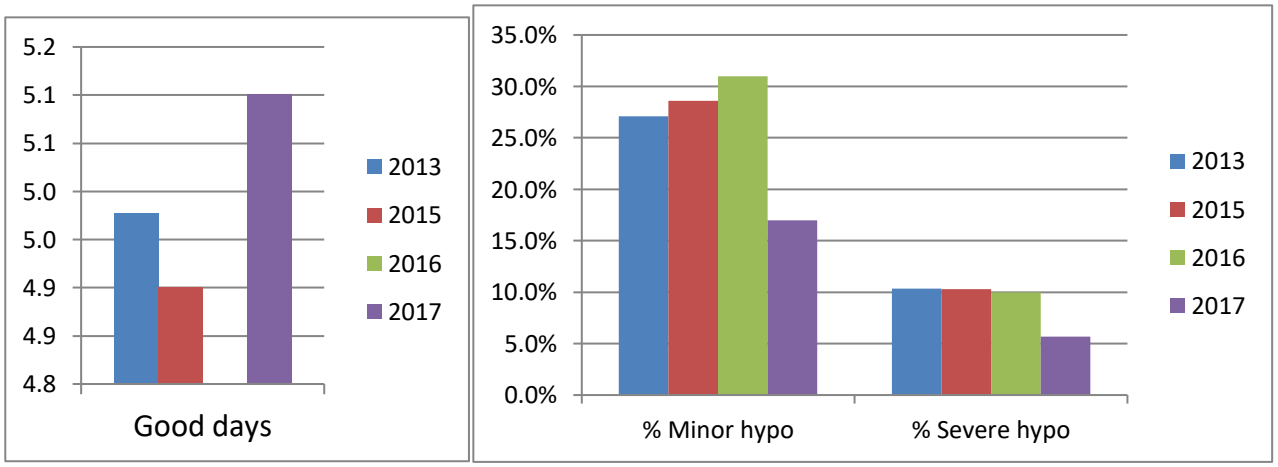
Outcomes.

Improvement in "Good diabetes days" and reduction in mild and severe hypoglycaemia experienced by patients on surgical wards.

Ideally blood glucose should be between 4-12 mmol/l in patients postoperatively unless it is specified that this target is not appropriate for clinical reasons. The number of good diabetes days as defined as appropriate level of Blood glucose monitoring and number/7 where blood glucose has been between 4-12mmol/l with no hypoglycaemia and no more than 1 blood glucose level more than 12mmol/l, has improved (no data reported for 2016) but there has been a reduction both hypoglycaemia and severe hypoglycaemia.

The initial launch of the surgical diabetes pathway did not seem to impact upon the incidence of inpatient hypoglycaemia or severe hypoglycaemia. Several surgical ward based initiatives were developed to target nursing and junior doctor's awareness of hypoglycaemia. Some of these are detailed in the vascular surgery story. Using a case of severe hypoglycaemia reflected through the eyes of an F1, we used junior doctor teaching, trust patient safety briefings, nurse diabetes updates to raise overall awareness of the problem. Specifically in 2016 we introduced the hypoglycaemia electronic alert system to the DSN team and the red sugar cube for hypoglycaemia on the ward electronic handover boards. Introduction of these measures precedes the reduction in hypoglycaemia in the 2017 NADIA audit (Figure 8).

Figure 8 Good diabetes days and incidence of minor and severe hypoglycaemia in annual NADIA.



Involvement of pharmacists in the safety chain .

When electronic insulin prescribing was rolled out in 2015, ward pharmacists were tasked with opening conversations with other ward staff around safe insulin prescribing and safe discharge of patients on insulin. The e-record system will generate a task to pharmacists for all patients prescribed insulin so they can be involved in prescribing review. The benefit has been focused particularly on reduction of errors around insulin and insulin related devices on discharge.

Using expert analysis of Datix reporting in a positive quality improvement cycle.

The inclusion of a senior pharmacist as part of the SU2S working group facilitated the review of insulin

related datix reports from the surgical unit. When errors occur with insulin prescribing, supply, administration and monitoring Trust staff are encouraged to submit a report of what occurred on the Trust Datix system. This allows detailed analysis to be carried out on all incidents that occur within the Trust including trending and grouping into common themes. In order to assess the impact of the many interventions put into place during this project all Datix incidents occurring on surgical and critical care wards and in theatre areas were reviewed for any changes in overall number, number by directorate and type of incident.

Examples of incidents from each category

Administration / supply

- Patient with type 1 diabetes arrived in theatre recovery with GKI unattached and machine stopped.
- Patient transferred from theatre to ward with GKI running, 30 units of Actrapid in bag. Rate was 180 ml/hour rather than prescribed rate of 80 ml/hour.
- 14 units of Actrapid was added to GKI bag in theatre instead of prescribed 18 units.

Advice / information

- Patient was not advised about their long acting insulin therefore took their usual full does on the morning of surgery. Given 10% glucose, reduced GKI but surgery had to be cancelled as the patient remained hypoglycaemic.
- Consultant advised patient in pre-assessment to take 10 units of usual insulin on admission. Patient was phoned by the pre-assessment nurse the day before admission and told not to take insulin. Patient ate breakfast, BM 14.8 on admission but no action taken. There were no notes on theatre list about diabetes management and the patient was last on the list.

Prescribing

- Insulin prescribed for the wrong patient as wrong patient chosen on e-record.
- Patient usually on insulin twice a day but not prescribed on e-record and BMs high.

Monitoring and follow-up

- BMs not checked while patient on GKI in Endoscopy

Incidents that mapped to a specific area of the pathway were discussed at the SU2S working group and fed back to invite ideas from the clinical teams involved in that part of the pathway on how process could be adapted or enhanced to reduce the possibility of repeat of the problem using a human factors approach. Clinical governance meetings were used as a forum to share the themes from datix data.

Figure 9

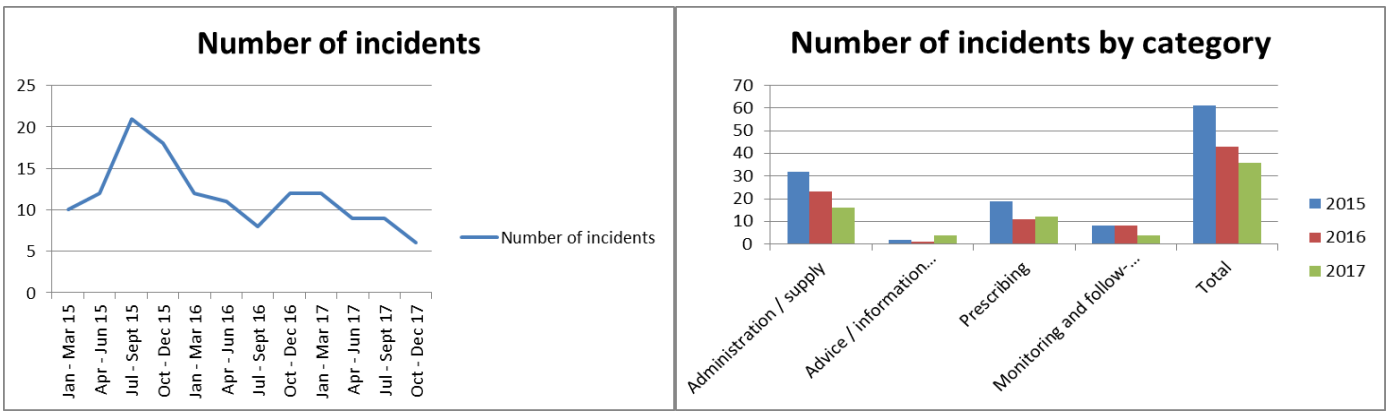
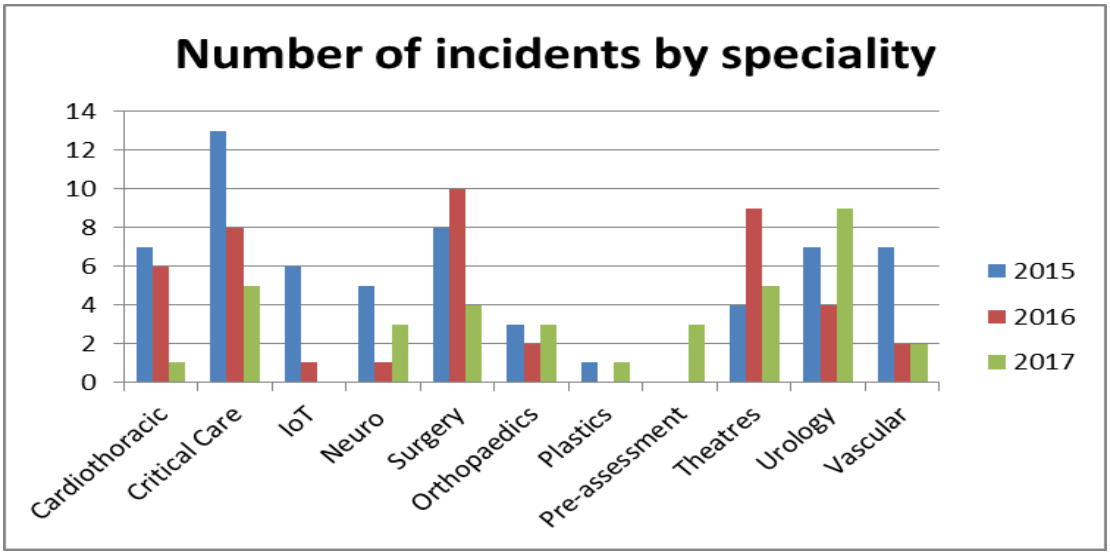


Figure 10



"Having the conversations" Use of the pathway to empower staff to get it right.

Datix reporting increased in surgery and in particular in theatres soon after the launch of the surgical pathway (Figure 10). Theatre nurses and health care assistance now had written guidance on the standards for diabetes care in their area and they were keen to get things right. Dialogue with the inpatient DSNS occurred frequently initially when they felt that that diabetes care suggested by more senior members of the clinical team did not match the guidelines. The use of reporting and feedback facilitated the SU2S leads in that area to work alongside senior colleagues to help them adopt a more standard practice and improve patient safety.

Targeted diabetes interventions on a single ward : The vascular surgery story.

Interventions:

A primary aim to reduce to reduce the prevalence of hypoglycaemia, insulin management errors and patient harm events in vascular surgery patients by 50% over the three year SU2S campaign (2015-17) was identified, whilst providing continual feedback to SU2S working group to benefit all surgical patients across the trust. We sampled vascular patients undergoing lower limb amputation patients as a high risk group with predictable extended lengths of hospital stay, enabling effective evaluation of day-to-day standards of diabetes care on the vascular surgery ward. Appropriate patients were identified from the hospital vascular activity database and data was collected from electronic prescribing records and case-note review.

We used a multi-disciplinary approach, involving key stakeholders including a senior ward sister, consultant vascular surgeon, diabetes specialist nurse, together with rolling representatives from ward medical and nursing staff. We generated a series of interventions which we tested by completing three plan, do, study, act (PDSA) cycles over the three year period. After each intervention, we completed a further six month evaluation of standards of diabetes care delivered according to NaDIA, JBDS and NCEPOD guidelines [1-3].

Measurement/Outcome:

Our SMART aims were to reduce hypoglycaemia, insulin management errors and patient harm events in vascular patients by 50% over a three year period. We undertook a baseline audit followed by three PDSA test cycles.

Baseline Audit (2014): Data was collected over a six-month period for consecutive patients with diabetes

undergoing lower limb amputation. Standards for monitoring, glycaemic control, medication errors and specialist input were taken from NCEPOD recommendations, the National In-patient Diabetes Audit (NaDIA) and the Joint British Diabetes Societies (JBDS) Guidelines[1-3].

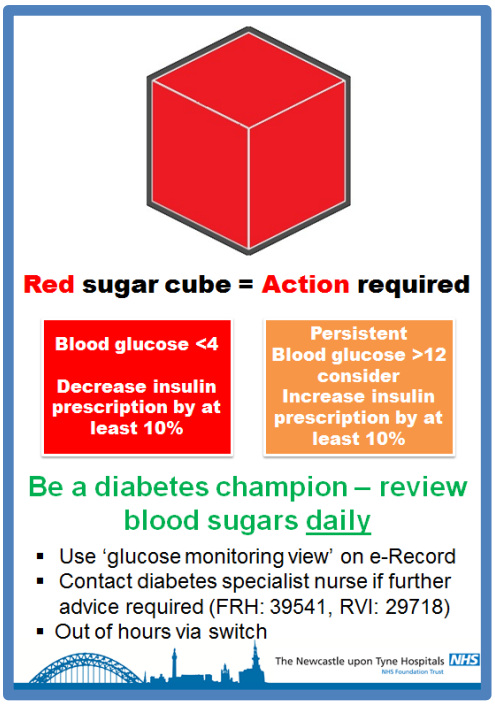
Over six months, 751 in-patient diabetes days were evaluated. Poor glycaemic control was evident in 293 (39%) days and 80% of patients were exposed to medication errors. Pre and post-operative specialist input was received by 15% of patients and 20% of patients suffered patient harm events, requiring third party assistance for hypoglycaemia. It was clear from this data collection that the quality of diabetes care needed to be improved.

PDSA cycle 1 (2015): Our initial intervention was to provide clear guidelines for diabetes care and diabetes specialist nurse referral on surgical wards. These were incorporated into the departmental handbook and published on the intranet. Junior doctors were provided with a hard copy of the guidelines on induction and diabetes care was specifically included in their induction package. A mandatory e-learning package of safe insulin prescribing was introduced. Monthly diabetes education meetings were implemented, attended by members of the ward MDT. Key topics included basic glycaemic control, insulin prescribing, management of hypoglycaemia and diabetes emergencies. Additional teaching was provided to the ward nursing staff by the diabetes specialist team. The vascular guidelines were adapted as part of the SU2S strategy for inclusion in the trust diabetes handbook.

Although the guidelines and educational strategy were very positively received, there was little impact on standards of diabetes care provided on the vascular ward. Levels of adequate diabetes monitoring improved to 82% on the surgical ward, but hypoglycaemia rates remained high and patient harm events increased. Diabetes specialist input remained low at 20% of appropriate patients. Concerns were raised about the lack of face-to-face leadership on surgical wards to promote safe diabetes care and inadequate levels of diabetes specialist input.

PDSA cycle 2 (2016): Our second cycle involved establishing a daily diabetes specialist nurse in-reach service to the vascular ward to provide daily face-to-face leadership for medical and nursing staff to promote safe and effective diabetes care. Diabetes patients with poor glycaemic control were identified to the diabetes specialist nurse by ward nursing and medical staff to enable effective management based on specialist advice.
The impact of the specialist diabetes in-reach service was evaluated over a six month period. Despite further improvements in diabetes monitoring to 96% and improved diabetes specialist nurse input, hypoglycaemia rates and medication errors continued to rise. The problem seemed to be at the basic level of the ward connection between abnormal blood glucose measurement and taking appropriate action, whether altering medication to improve poor glycaemic control or positively identifying patients with poor glycaemic control to the diabetes nurses for specialist support.

PDSA cycle 3 (2017): Our third cycle focused on the ward connection – positively identifying those patients with poor glycaemic control and ensuring appropriate action was taken to manage hypoglycaemia and persistent hyperglycaemia. A highly visible red sugar cube prompting mechanism was implemented to readily identify any patients who were experiencing hypoglycaemia or persistent hyperglycaemia. When a blood glucose measurement was outside the acceptable range, the responsible nurse was informed and a red sugar cube placed next to the patient's name on the ward whiteboard by the central nursing station. Intended actions were clearly defined in a poster campaign used to promote the red sugar cube intervention, with the emphasis on medication management and involvement of the diabetes team (Figure 1).



The red sugar cubes remained on the white board until the senior ward sister was satisfied that glycaemic control had been reviewed, appropriate changes to diabetes medication had been made and appropriate patients had been referred to the diabetes specialist nurse team according to ward guidelines. The red sugar cube prompts were incorporated into daily morning board rounds attended by all members of the ward MDT and were readily visible to the in-reach diabetes nurse service, maintained through cycle 3. Education in regard to intended actions was provided to current and all new-starting ward staff.

Each intervention cycle had a positive impact on standards of adequate diabetes monitoring on the surgical ward, which consistently improved from 75% to 98% during the course of the project. The combined educational and guideline intervention from PDSA 1 was not effective in reducing hypoglycaemia rates or patient harm events for patients with diabetes. Diabetes specialist nurse input was highest during the PDSA 2 cycle, but hypoglycaemia rates continued to rise and there was no overall improvement in insulin management errors.

The overall aims of this project were achieved PDSA cycle 3. Introduction of the red sugar cube prompting mechanism whilst continuing educational and diabetes specialist nurse in-reach initiatives reduced hypoglycaemia rates by more than 50%. Overall insulin management errors for hypoglycaemia were reduced by 70% and insulin errors in association with severe hypoglycaemia were abolished, with a 75% reduction in patient harm events. Key data are summarised in figure 2.

Recommendation	Baseline 2014	PDSA 1 2015	PDSA 2 2016	PDSA 3 2017
Adequate monitoring	75%	82%	96%	98%
DSN input	15%	20%	71%	50%
Hypoglycaemia/1000 insulin days	312	302	339	157
Hypo on insulin management errors	80%	67%	67%	20%
Severe hypo management errors	-	-	59%	0%
Patient harm events	20%	33%	20%	6%

Lessons & Limitations:

Educational initiatives and guidelines are an essential foundation to improve clinical practice but were not effective in isolation in achieving the aims of our project. Medical and nursing staff displayed increasing knowledge of optimal medication management for poor glycaemic control in educational settings, but in practice appropriate actions were seldom taken.

We had assumed that increasing diabetes specialist input would improve outcomes and were surprised by the lack of impact of the daily in-reach specialist diabetes service on hypoglycaemia rates, medication errors and patient harm events. On reflection, we felt ward staff may have been falsely reassured by the daily presence of the diabetes specialist nurse team, with the impression that all diabetes patients were receiving high standards of care. In reality, only patients positively identified by ward staff to the diabetes team were being actively reviewed. Opportunities to improve diabetes care by involvement of the diabetes nurses for appropriate patients were being missed. The second cycle intervention was limited by unreliable identification of patients with poor glycaemic control by the ward and specialist diabetes team.

The most effective intervention was a simple but powerful visual red sugar cube prompting system, readily identifying patients with diabetes with poor glycaemic control to ward staff and the diabetes nurse team. Intended actions were clearly defined with a focus on diabetes medication management, aiming to reduce the risk of medication errors and subsequent patient harm events. Strong clinical leadership was provided throughout the project by the senior ward sister and vascular consultants to promote intended actions.

We realised the effectiveness of the red sugar cube whiteboard prompt intervention could be impacted on by human factors in the longer term as it relied on the red sugar cubes being reliably noted on the whiteboard by ward nursing staff. This limitation has since been overcome by incorporating electronic sugar cube alerts into a new electronic whiteboard system rolled out across our trust. Sugar cube alerts are automatically generated for hypoglycaemia and hyperglycaemia on the electronic whiteboard as soon as patient blood glucose measurements are out of range, providing a 100% sustainable and reliable prompting system.

What happens next

Hypoglycaemia rates, medication management errors and patient harm events were successfully reduced in our vascular unit during the course of the SU2S campaign using a combined strategy of guidelines, educational initiatives, a diabetes nurse in-reach service and a simple whiteboard alert system for poor glycaemic control. The whiteboard alert system provided the final key to achieving safer and more effective diabetes care and has now been adopted throughout our trust to promote safer care for all in-patients with diabetes. Promotion and clinical engagement with the whiteboard alert system are essential to achieve intended behaviors.

Building upon the SU2S platform to make surgery safer for patients with diabetes.

SU2S provided a unique catalyst, bringing together a diverse group of health care professionals with a common aim to make surgery safer for patients with diabetes. The individual reports from each team reflect how the knowledge of skills of each clinical area have been essential to put together a workable pathway and address the specific limitations of implementation in each clinical area . Clinical leadership in each clinical area has worked with their own teams to address concerns and feedback required modifications. This has “allowed the conversations” needed for both implamentation and quality

improvement learning from the good and the negative outcomes.

We have highlighted specific areas of clinical practice and implementation of technology which have mapped to improvement of outcomes measured using several tools such as national and local audit and datix reporting to feed back into the quality improvement cycle . We will continue to maintain these tools and maintain the feedback channels.

There are areas identified for further work. Priorities include

- Working with primary care to develop the first step of the pathway providing a framework to help GPs optimise diabetes control prior to referral for surgery.
- Review the opportunity for lifestyle changes discussed and implemented at POAC to improve peri-operative fitness and diabetes control.
- Share learning and ideas more widely eg through the regional training and education of peri-oprative care group TEPOT.
- Development of apps and podcasts targeted for specific staff groups involved in any part of the peri-operative pathway to guide them through diabetes specific surgical safety issues.
- Continued learning and quality improvement by maintaining the diabetes surgical safety working group to review DATIX and audit outcomes and update the pathway where appropriate.
- Continuation of a FAQs "blog" or newsletter to all staff.
- Maintaining adequate levels of pro-active diabetes specialist support in high risk areas on a long term basis
- To continue to embed the electronic whiteboard alert system trust-wide and embrace new technological initiatives that may be utilised towards diabetes safety.

- Strong clinical leadership by senior nursing and medical staff remains essential to support ongoing change in diabetes culture, where high quality diabetes care is recognised as a vital element in the management of surgery patients, rather than a secondary or overlooked element of peri-operative ward care.

In Newcastle Hospitals NHS Foundation Trust we believe that "insulin is not my thing" should not be believed by any member of staff but "making Surgery safe for patients with diabetes is everyones thing" !

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References:

1. National Diabetes In-patient Audit 2013.
2. Dhatariya K, Levy N, Kilvert A et al. NHS Diabetes guideline for the perioperative management of the adult patient with diabetes. *Diabetic Medicine* 2012; 29:420-33.
3. NCEPOD 2014.
4. Frisch A, Chandra P, Smiley D e al. Prevalence and clinical outcome in the perioperative period in non-cardiac surgery. Diabetes Care 2010; 33(8): 1783-1788.
5. Jhanji S, Thomas B, Ely A, Watson D, Hinds CH, Pearce RM. Mortality and utilisation of critical care resources amongst high-risk surgical patients in a large NHS trust. *Anaesthesia* 2008; 63: 695-700.
6. Pearce RM, Harrison DA, James P et al. Identification and characterisation of the high-risk surgical population in the United Kingdom. *Diabetic Medicine* 2007; 24:643-9.
7. George JT, Warriner D, McGrane DJ et al. Lack of confidence among trainee doctors in the management of diabetes: the Trainees Own Perception of Delivery of Care (TOPDOC) Diabetes Study. Quarterly Journal of Medicine 2011; 104:761-6.
8. Kwon S, Thompson R, Dellinger P, Yanez D, Farrohki E, Flum D. Importance of perioperative glycaemic control in general surgery: a report from the surgical care and outcomes assessment program. Annals of Surgery 2013; 257:8-14.