Scientific Protocol

**Comparing NursE recording Accuracy and Time taken for blood glucose checks with different glucose meters (NEAT)**

**Study Title: Prospective audit comparing amount of nursing time taken and accuracy of blood glucose levels recorded in the electronic medical record for the standard AMSL glucose meter compared with the AMSL wi-fi connectivity Statstrip glucose meter.**

**Short Title: Comparing NursE recording Accuracy and Time taken for blood glucose checks with different glucose meters (NEAT)**

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**Location of Study***: Nepean Hospital wards E3H, E3I*

**Study Duration:** *1 year*

# Background/Introduction:

**Introduction:**

Diabetes presents a large burden of disease, with an Australian prevalence of diagnosed cases of 4.9% (1) and a similar estimated prevalence of undiagnosed diabetes (2). Morbidity and mortality associated with diabetes is high, contributing to 102,714 disease-adjusted life years lost in 2015 (1). While being the only principal diagnosis in 53,900 hospitalisations in Australia in 2017-18, diabetes was an additional diagnosis in 1,149,000 hospitalisations, representing 11% of all hospitalisations in Australia (1). An important component of diabetes management in hospital is regular blood glucose level (BGL) monitoring in order to inform glycaemic management. However, this procedure has many sources of error, including patient, environment and operator factors (3), with the majority of errors being operator related (4). Manual transcription of BGL results into electronic medical records, as is currently the practice in NSW public hospitals, can result in errors (3), including typographical errors, entering data in the wrong patient’s file, or entering data in the correct patient’s file, but in the incorrect section e.g. ketones instead of BGL or recording an incorrect time the BGL was taken. Point of Care Testing (POCT) connectivity meters, which automatically upload the measured BGL into the patient’s medical record, have been shown to reduce some of these clerical errors and reduce nursing labour costs (5). Glycaemic control in an Australian hospital has previously been assessed with wireless networked glucose meters (6). However, to our knowledge there are no studies in Australia that compare the nursing time taken to check finger prick glucose and record the level in the eMR and the accuracy of BGL recording in the inpatient electronic Medical Record (eMR) between non wi-fi connected glucose meters in routine clinical care with wi-fi connectivity glucose meters. Should the results found in a previous American study in 2003 (5), be shown to be similar in the current Australian Hospital inpatient setting, then these POCT connectivity meters would improve patient outcomes both by directly decreasing errors which can lead to incorrect glycaemic management and by increasing nursing efficiency (7).

# Aim:

**Primary:** To compare the composite nursing time taken to both measure a patient’s BGL and to document the BGL in the electronic medical record (Cerner PowerChart) using standard glucose monitoring equipment, versus wireless networked glucose monitoring equipment.

**Secondary:** To compare the accuracy of BGL recording in the electronic medical record (Cerner PowerChart) using standard glucose monitoring equipment versus wireless networked glucose monitoring equipment, including transcription errors, transposition errors and entry into incorrect patient file.

# Hypothesis:

We hypothesise that the direct upload of patient BGL data with wireless networked glucose monitoring equipment will result in increased nursing efficiency through time saved in glucose checking and recording and fewer errors in BGL recording in the eMR compared with traditional BGL measurement techniques.

# Methods:

This is a prospective open-label pilot study that will be conducted on wards E3H and E3I at Nepean Hospital. It will be conducted in 2 stages – an initial stage for power calculation, and a second stage for statistical analysis.

## Recruitment

Stage 1

Nurses will be recruited from E3H and/or E3I via study invitation email formulated by researchers and sent to all nursing staff by the Nursing Unit manager of each ward. Twenty measurements will be taken, one with each BGL meter type on 10 patients, by nurses who are familiar with using both types of meters and usually work on these wards. A minimum of 5 nurses will be recruited in this stage. Determining the difference in time taken between the 2 methods of glucose meter will inform a power calculation, so that we can determine how many patient BGLs via each glucose meter are needed for the study.

Stage 2

Nurses will be recruited from E3H and E3I, such that the required number of BGL measurements can be performed, as calculated from stage 1, again selecting nurses who are familiar with both types of meters, and who usually work on these wards. The number of nurses recruited will depend on the power calculation in Stage 1, but will be a minimum of 8 nurses.

## Inclusion and exclusion criteria

Inclusion criteria include nurses who are:

* Working regularly on wards E3H or E3I at Nepean Hospital
* Involved in regular BGL measurements of patients and trained on and familiar with both types of BGL meter

Exclusion criteria include:

* Agency nurses
* Declining to give informed verbal consent to participate in the study

## Data collection

For each reading (for both stages 1 and 2)

1. Nursing stafflink number and patient Medical Reference Number and initials will be recorded
2. Timing of the procedure of checking the BGL to be recorded will occur as follows:
   1. Start time defined as
      * Conventional glucometers: the time that the nurse arrives at the patient’s

bedside with the BGL testing equipment (no data entry is allowed until then) and indicates that he or she is ready to start the procedure.

* + - Networked glucometers: the time that the nurse arrives at the patient’s

bedside with the BGL testing equipment and indicates that he or she is ready to start the procedure.

* 1. Finish times defined as the time that the BGL result appears on Cerner PowerChart for both types of glucose meters:

NB. Nurses will be asked to measure one patient’s BGL and then enter it into Powerchart before measuring the next patient’s BGL.

1. BGL readings will be collected from 2 sources, to determine whether there is any discrepancy in BGL values between the sources:
   1. BGL reading as shown on the glucose meter screen (true reading)
   2. BGL reading as recorded on PowerChart (entered via nurse transcription or wi-fi upload)
2. Assessment of any discrepancies will occur at time of data collection and will be recorded as follows:
   1. The BGL numbers recorded on the glucose meter and in the eMR
   2. The absolute difference in BGL readings between the glucose meter screen and the

patient’s PowerChart record.

* 1. Type of error eg. record of BGL in eMR missing, eMR BGL different from that recorded at the bedside, BGL recorded in incorrect patient eMR ( ? other?)
  2. Whether there were any specific circumstances that may have precipitated the error eg, nurse being interrupted during the BGL checking and recording procedure

1. Any difficulties occurring during the glucose checking procedure which slow down the process will also be recorded.
2. To help reduce potential investigator errors in time measurements, 20 concurrent time measurements with each meter will be taken independently by a second investigator, Dr Brian Tran or Dr Louis Levinson, to determine inter-rater reliability.

NB: in stage 1, BGL measurements will be paired, with both meters being tested on the same patients sequentially, while in stage 2, BGL measurements will not be paired.

## Consent

Stage 1

As patients will require an additional BGL test compared to standard clinical care, written consent will be requested. Verbal consent will also need to be obtained from the nurses. Nurses in Stages 1 and 2 will be provided with a participant information sheet and asked to notify the researcher(s) if they consent to participate in the study.

Stage 2

As checking of blood sugar levels is part of standard clinical care, no specific formal consent is required from patients or nurses, only verbal consent from nurses participating in the study for observation and timing of the glucose checking and recording procedure. Nurses will be asked to use a particular glucose meter (wi-fi or standard), which will be determined randomly through use of the online Research Randomizer [**https://www.randomizer.org/**](https://www.randomizer.org/)

Patients involved in stage 2 will not be asked to provide written consent. However, they will be provided with an information sheet by the observer with further explanation if requested, so that they understand what is involved in the study and why the nurse taking the blood glucose level is being observed and timed.

# Data Collection:

For both stage 1 and 2 all data identifying nurses and patients will be coded for analysis. Data collected will include timing of BGL measurement (date, start time, end time) BGL recorded on glucose meter, BGL recorded in eMR and, if there is a difference between BGL recorded on glucose meter and BGL recorded in eMR, the type of error (transcription, transposition etc.), if it can be identified, any interruption of the nurse while undertaking the procedure from start time to end time as defined above and any factors which slow down checking of the BGL and recording eg. glucose strip not working. In addition, when the BGL recorded on glucose meter differs from the BGL recorded in eMR, the absolute value of the deviation from the BGL recorded on the glucose meter itself from the recording on powerchart and whether the inaccurately recorded BGL prompts a change in management and what that change in management is (RMO review, administration of insulin) and whether there are any adverse consequences as a result of that inaccurate reading e.g. hypoglycaemia.

1. Nurse identifier (numerical value)
   * Whether the nurse has been trained on networked glucometers
   * Whether the nurse has performed at least 10 readings with networked glucometers independently before the trial
2. Patients’ name and MRN
   * Will be used for assessment of accuracy of the BGL recording in the electronic medical record. A master coding sheet will be used to ensure that only de-identified coded data are analysed.
3. Time taken for the BGL sample to be taken and recorded as defined above
4. Accuracy of data upload onto Cerner PowerChart
   * Accuracy of BGL reading
     + BGL reading as shown on the glucose meter screen (true)
     + BGL reading as on PowerChart
     + Is there a discrepancy between the results? Yes / No
     + What type of discrepancy is there?
       - Transcription error - Incorrect glucose level

* Time taken incorrectly recorded
  + - * Transposition error - Incorrect patient: recorded in incorrect

patient eMR

* Recorded in incorrect section of eMR eg in ketone section
  + - Absolute value of discrepancy if glucose level incorrectly transcribed
    - Whether the eMR recorded BGL value is higher or lower than the glucose meter value
    - Whether the inaccurately recorded BGL prompts a change in management
    - What the change in management was
    - Whether there were any adverse consequences as a result of that change in management e.g. hypoglycaemia.
  + Accuracy of data entry location
    - Was the result recorded in the correct patient’s eMR? Yes / No
  + Delays in checking and recording BGL e.g. glucose strip did not work, insufficient blood drop obtained
  + Circumstances of the inaccuracy of the recording of BGL
    - If there is a specific reason for the inaccuracy e.g. nurse got interrupted, this will also be recorded and type of interruption (free text)

# Statistical Analysis:

For both stage 1 and 2, descriptive statistics will be performed. Depending on the data distribution, either a paired T-test (parametric) or a Wilcoxon signed-rank test (non-parametric) will be used to compare between the time taken between the conventional BGL test to be charted and the automated electronic update. To assess the agreement of two the blood glucose value taken from the two, a Bland-Altman plot will used to clinically interpret the agreement. Additionally, intraclass correlation coefficient will be performed to assess correlation between the two.

# Ethical considerations:

Information collected for this project will be identified at the data collection stage and recruitment. Patient and nurse participant identifiers will be linked with a unique code in a master participant sheet containing nurse participant name and stafflink no, patient name, date of birth and medical record number, all linked with the patient's unique code (this master participant sheet will be stored as a password protected file on a Nepean Blue Mountains Local Health District Server). All other information will be stored in the master data sheet, in which individual participants will be identified by their unique code only. The master data sheet will also be stored as a password protected file on a Nepean Blue Mountains Local Health District Server. The spreadsheets/databases will be located on an LHD hosted server, which is the diabetes service server at Nepean Hospital. Data will be kept for a period of a minimum of 15 years. Data will be deleted/purged following this period.

In any publications arising from the research all data will be de-identified. No individual patient or nurse will be identifiable.

Information needed to assess accuracy of data entry will be gathered from the medical/health records at Nepean Hospital of individuals who have been inpatients at the hospital. This will require consent from the agency holding the records through the health information record system manager. All data will be de-identified for analysis.

# Conclusion/Outcomes:

Comparing the real-world usage of conventional versus wireless networked blood glucose meters will allow identification of the optimal method for BGL measurement and recording in the inpatient hospital setting. We hypothesise that wireless networked blood glucose meters will result in fewer errors in recording and reduce the amount of time taken for measurements to be taken and results to be available. Improvements in these factors may thereby reduce adverse patient events and outcomes. These data may support the case for a full roll out of the wireless networked glucometers as a new standard of care for inpatient blood glucose monitoring and management.

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