BMJ Open Quality

Improving rates of metabolic monitoring on an inpatient psychiatric ward

Sarah Michael ,[1,2] Kirsty MacDonald[3]

To cite: Michael S, MacDonald K. Improving rates of metabolic monitoring on an inpatient psychiatric ward. *BMJ Open Quality* 2020;**9**:e000748. doi:10.1136/bmjoq-2019-000748

Received 5 June 2019
Revised 19 May 2020
Accepted 9 June 2020

[1]Mental Health Service, St Vincent's Hospital Sydney, Darlinghurst, New South Wales, Australia
[2]School of Medicine, University of New South Wales, Sydney, New South Wales, Australia
[3]Justice Health and Forensic Mental Health Network, Matraville, New South Wales, Australia

Correspondence to
Dr Sarah Michael;
sarah.michael1@svha.org.au

ABSTRACT

Objectives Cardiovascular disease is the leading cause of premature death in patients with mental illness. Metabolic syndrome is a cluster of co-occurring cardiovascular risk factors, seen in high frequency in severe mental illness. Despite ease of diagnosis, monitoring is often poor across psychiatric populations. This report details a quality improvement initiative undertaken on an inpatient psychiatric ward to improve rates of metabolic monitoring.

Methods Four key interventions were developed: (1) A nurse-led intervention, where nurses were upskilled in performing metabolic monitoring, (2) Education was provided to all staff, (3) Introduction of a suite of interventions to improve metabolic risk and (4) Ongoing consumer involvement. A pre–post intervention study design was used to measure effectiveness, with an audit of metabolic monitoring rates performed 12 months after the intervention began.

Results Rates of weight and height monitoring both increased from 46.0% to 69.5% (p=0.0185) and body mass index (BMI) recordings increased from 33% to 63% (p=0.0031). Rates of waist circumference monitoring increased from 44.2% to 65.2% (p=0.0498). Blood pressure (BP) measurements increased from 88.5% to 100% (p=0.0188). Lipid monitoring rates improved from 23% to 69.5% (p=0.001). Rates of glucose monitoring increased from 74% to 82.5% (p=0.8256), although this was not statistically significant.

Conclusions We found that metabolic monitoring improved following these simple interventions, with a statistically significant increase in measurement rates of weight, BP, height, lipids, BMI and waist circumference (p<0.05). Overall monitoring of glucose also improved, although not to significant levels. The intervention was acceptable to both patients and staff.

INTRODUCTION

There is now an abundance of literature, across multiple countries, confirming the reduced life expectancy and excess mortality of patients with mental illness, primarily due to physical illness. Patients with mental illness, particularly severe mental illness such as schizophrenia or bipolar disorder, die 10–30 years before the general population.[1–4] Physical health conditions account for around 80% of the excess mortality, with cardiovascular disease widely identified as the leading cause of death in this group.[2–7] Individual factors associated with this increased mortality include lifestyle factors, elevated cardiovascular risk factors and use of atypical antipsychotics which increases risk of metabolic syndrome and cardiac events. Systemic factors indicate that these patients are more likely to experience insufficient or deficit healthcare, have fewer invasive cardiac procedures for indicated conditions and have not experienced the same gains in cardiovascular treatment as the general population.[1]

The metabolic syndrome is a well-recognised cluster of co-occurring cardiovascular risk factors, whereby its presence increases the risk of cardiovascular disease twofold, and confers a 1.5-fold increase risk in overall mortality.[7 8] It consists of central obesity, insulin resistance, hypertension, elevated triglyceride levels and low high-density lipoprotein (HDL) levels. Insulin resistance and obesity are likely the underlying pathophysiology of the syndrome. In particular, it is the coupling of risk factors that likely increases the risks seen with metabolic syndrome.[9] Multiple definitions have been proposed and used over the past two decades, but a unified definition was agreed on in 2009 (see table 1).[10] The definition is helpful to identify those at risk of cardiovascular disease to provide early intervention and mediation of risk factors, before progression to macrovascular disease.

Unsurprisingly, using this standardised definition for metabolic syndrome finds high rates of metabolic syndrome in patients with severe mental illness, but these do vary according to location. Studies in Europe have found rates of 24.6%–32.3% in patients with schizophrenia or schizoaffective disorder.[11 12] Rates in Canada were 42.6% for males and 48.5% for females in patients with chronic schizophrenia on antipsychotic monotherapy,[13] and in the US Clinical Antipyschotic Trials of Intervention Effectiveness (CATIE) trial were 42.7%.[14] Literature looking for metabolic syndrome in patients with bipolar affective disorder reflected similar findings, with the

Table 1 Criteria for clinical diagnosis of the metabolic syndrome[10]

Measure	Categorical cut points
Elevated waist circumference*	Population-specific and country-specific definitions
Elevated triglycerides (drug treatment for elevated triglycerides in an alternative indicator†)	≥150 mg/dL (1.7 mmol/L)
Reduced HDL-C (drug treatment for reduced HDL-C is an alternate indicator†)	<40 mg/dL (1.0 mmol/L) in males; <50 mg/dL (1.3 mmol/L) in females
Elevated blood pressure (antihypertensive drug treatment in a patient with a history of hypertension is an alternate indicator)	Systolic ≥130 mm Hg and/or diastolic ≥85 mm Hg
Elevated fasting glucose‡ (drug treatment of elevated glucose is an alternate indicator)	≥100 mg/dL (≥5.6 mmol/L)

Table 1 reproduced with permission from Wolters Kluwer Health, taken from Alberti. International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; International Association for the Study of Obesity: Harmonising the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention. *Circulation* 2009;120:1640–5. Can be accessed at https://www.ahajournals.org/doi/full/10.1161/CIRCULATIONAHA.109.192644?url_ver=Z39.88–2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed.

*It is recommended that the International Diabetes Federation (IDF) cut points be used for non-Europeans and either the IDF or American Heart Association/National Heart, Lung and Blood Institute (AHA/NHLBI) cut points used for people of European origin until more data are available.

†The most commonly used drugs for elevated triglycerides and reduced HDL-C are fibrates and nicotinic acid. A patient taking one of these drugs can be presumed to have high triglycerides and low HDL-C. High-dose-3 fatty acid presumes high triglycerides.

‡Most patients with type two diabetes mellitus will have the metabolic syndrome by the proposed criteria.

HDL-C, high-density lipoprotein cholesterol.

highest rates (64.2% prevalence) in Australian and New Zealand patients, and 49.3% in North America, and lower rates in European countries.[15] These rates are all significantly higher than the age-matched general population. The different findings may reflect differences in lifestyle between locations, particularly diet.

Treatment for metabolic syndrome rests on treating the individual risk factors. First-line interventions should target lifestyle, through weight reduction, decreased intake of saturated and trans-fatty acids, cholesterol and sodium, as well as increasing exercise.[7 16] Medications should be reviewed where they may be contributing, such as atypical antipsychotics, or where they can be used to treat individual risk factors of hypertension, hyperlipidaemia and hyperglycaemia.[16]

Despite ease of treatment and diagnosis, and frequency of occurrence in these populations, screening and monitoring of metabolic syndrome is poor, across both inpatient and outpatient psychiatric settings.[17–20] Barriers identified among psychiatrists and other members of the psychiatric team include a lack of protocols or guidelines about monitoring, a lack of knowledge on how to monitor or confidence in interpreting results, a lack of a reminder system and lack of basic equipment to perform monitoring.[21 22]

St Vincent's Hospital in Sydney has an acute psychiatric inpatient ward of 27 beds. Most patients admitted to the ward have severe mental illness. Physical examinations and investigations are usually performed to a high standard by the resident medical officer on their psychiatric rotation, with physical observations completed regularly by nursing staff. Unfortunately, prior to the intervention, metabolic monitoring was not seen as a routine investigation to perform on new patients, by either senior or junior medical staff, or nursing staff, and was rarely included in the initial physical health work-up. The barriers faced in introducing testing were similar to those identified elsewhere. The resident medical officers usually rotate every 5-6 weeks, sometimes more frequently, making it difficult to ensure they all receive appropriate education. Although many permanent medical and nursing staff were aware of the metabolic side effects of the medications used on the ward, most were unaware of recommended guidelines on when to perform metabolic monitoring. Finally, our lack of an electronic medical record meant there were no prompts to test patients, the result being that monitoring was performed inconsistently. This report details a quality improvement initiative which was undertaken to improve rates of metabolic monitoring on the ward.

METHODS

A Metabolic Monitoring Working Party was formed, consisting of multidisciplinary input from a psychiatrist, two psychiatric registrars (one from both inpatient and outpatient settings), a community case manager, and several inpatient nurses who took on the role of 'physical health champions'. The working party had the goal to effectively implement metabolic monitoring and appropriate intervention for all mental health service clients, starting with the inpatient ward, as well as to provide education to staff and perform regular audit to monitor progress. Initial activities consisted of process-mapping current patient care pathways to help determine where

Table 2 Patient characteristics across two psychiatric inpatient audit samples

	Preintervention (n=61)	Postintervention (n=46*)
Age (years)	36.6 (±11.3)	40.3 (±12.75)
Sex		
Male	39 (63.9%)	27 (58.7%)
Female	22 (36.1%)	19 (41.3%)
Length of stay (days)	12.0 (±22.7)	17.2 (±24.02)
Discharge diagnosis		
Psychosis	45 (73.8%)	32 (69.6%)
Mood disorder	3 (4.9%)	4 (8.7%)
Suicidal ideation/acute crisis	10 (16.4%)	8 (17.4%)
Other	3 (4.9%)	2 (4.3%)
Discharged on antipsychotic medication		
Yes	42 (68.9%)	36 (78.2%)
No	19 (31.1%)	10 (21.7%)

*Eight files were unavailable for review in this sample.

interventions could be targeted. Subsequent ward-based interventions were broken into four key areas:

Nurse-led intervention

The physical health champions led a process among the nursing staff to ensure that all testing was performed. This involved up-skilling a number of ward nurses in phlebotomy, and empowering them to perform the monitoring and ensure all their patients on a shift had had this testing, and to prompt doctors about missing or abnormal results. A number of checks were developed as a way to ensure results were consistently collected, including one of the physical health champions nominating 1 day of the week to check all results, and the use of a whiteboard as a visual prompt in a prominent space on the ward to write down tests which were not completed. Missing results were often raised in the morning handover as a task which needed completion. When staffing permitted, an extra nurse was rostered on 1 day each week to follow up on physical health needs, including metabolic monitoring.

Education

The working party identified that many staff were unaware of guidelines and best practice in this area, despite the existence of state-wide guidelines.[23] Education was, therefore, provided to staff, at all levels of seniority and across disciplines, about the importance of metabolic monitoring. This was done through multiple modalities, many informal and opportunistic. Senior medical officers were contacted via email to seek their support of the intervention by the senior medical lead of the working party. The importance of metabolic monitoring was included in regular orientation to junior medical officers, both via PowerPoint in a longer presentation given to the registrars, and as part of the discussion which occurred with the more-junior resident medical officers who commenced every 10–12 weeks (who rotated through 5–6 weeks on the ward). These orientations included why metabolic monitoring was important for this patient group, what testing should occur, and some options for both pharmacological and non-pharmacological treatment. Education was provided to nursing staff through nursing in-services, involving a similar PowerPoint with more detail, including how to perform the actual measurements. Posters of metabolic guidelines were also put up on the ward for easy access for all staff.

Introduction of a suite of interventions to improve metabolic risk

The working party and staff on the ward initiated a number of interventions to facilitate treatment of metabolic risk, both from a prevention and treatment perspective. First, the ward diet, which consisted of quite high-calorie food served from a bain-marie, was reviewed. There was initially hope of changing the menu to include healthier meals. Unfortunately, due to limitations within

Table 3 Metabolic findings across two psychiatric inpatient audit samples

	April 2015 (±SD)	N	April 2016 (±SD)	N
BMI (kg/m^2)	27.2 (±8.7)	20	22.6 (±5.2)	29
Waist circumference (cm)	96.3 (±17.9)	27	87.6 (±12.5)	30
Blood pressure (mm Hg)				
Systolic	117.7 (±11.9)	54	118.8 (±10.1)	46
Diastolic	74.8 (±7.8)	54	75.8 (±8.8)	46
Lipids (mmol/L)				
Triglycerides	1.35 (±0.64)	14*	1.4 (±0.94)	32
HDL	1.33 (±0.34)	13*	1.44 (±0.35)	32
Glucose (includes random+fasting) (mmol/L)	5.9 (±1.2)	45	6.2 (±5.0)	38

*At the time of the first audit, not all laboratory lipid samples routinely included HDL and triglycerides if the total cholesterol was normal and these were not specifically requested.
BMI, body mass index; HDL, high-density lipoprotein.

Table 4 Comparing differences in rates of monitoring for metabolic parameters across two samples taken 1 year apart, after introduction of an intervention to improve monitoring rates

	Preintervention n=61 n (%)	Postintervention n=46 n (%)	P value
Weight	28 (45.9)	32 (69.6)	0.0185
Height	28 (45.9)	32 (69.6)	0.0185
BMI	20 (32.7)	29 (63.0)	0.0031
Waist circumference	27 (44.3)	30 (65.2)	0.0498
BP	54 (88.5)	46 (100.0)	0.0188
Lipids	15 (24.6)	32 (69.6)	<0.001
Glucose	45 (73.8)	38 (82.6)	0.8256

BMI, body mass index; BP, blood pressure.

our hospital about how food was delivered to the ward, alternative menu options were unable to be pursued. Instead, the ward staff worked with food services to increase the amount of salad available, and have more fruit as snacks. Additionally, a nurse joined the kitchen staff during meal-time, while food was being served, to help reduce and monitor portion size.

Second, given our limited resources and lack of extra funding for this initiative, the working party reached out to other hospital staff in the dietetics and health promotion fields to look at the option of dietetics and exercise physiology students. We were fortunate enough to commence student placements in both these fields, adding to our existing workforce. While the dietetics student placement ended after one term for reasons outside of our control, and was not pursued further, the exercise physiology placement continued and we were ultimately able to access a small amount of grant funding to have a part-time paid position. The work across both of these disciplines has been invaluable in helping to provide education to the ward, as well as a tailored service to patients around diet and exercise, both in individual and group settings.

Finally, in addition to these preventative endeavours, the ward established a close relationship with the hospital Endocrinology department, including a specific 'Metabolic Clinic' which provided free services for patients with metabolic syndrome or risk factors. This relationship ensured patients recording any abnormal metabolic results could be referred on for specialist treatment, and had the option of continuing this treatment even after their inpatient stay.

Consumer involvement

Patients were involved through regular community meetings and groups on the ward, which allowed staff to explain the changes occurring and the reason for extra monitoring, and to canvas feedback from the patients. Once the intervention was embedded on the ward, informal education was provided regularly to the patients from the nursing staff about why the monitoring was being performed. A range of ward activities with a focus on healthy lifestyle and reducing metabolic risk were also commenced, including a walking and cooking group, regular 'exercise games' and yoga. Nursing, occupational therapy, exercise physiology and outside yoga instructors are all involved in these initiatives.

Patient and public statement

As described above, patients were involved early-on in this quality improvement initiative, after the formation of the working party and in parallel with the other interventions. Despite its importance, metabolic monitoring was not routinely performed on inpatient wards, so was a change from usual practices for the patients, which had to be explained. Changes to meals, with healthier portions and options, was also a change which had be explained. Burden of intervention and acceptability were not formally measured, but were assessed through informal discussions with patients in community meetings and groups, and overall high rates of patients agreeing to have the monitoring performed.

Aside from this, the research questions about whether the suite of interventions would help improve rates of metabolic monitoring were not discussed with patients or the public, nor were they involved in the design or dissemination of the study or results. Recruitment was not involved in this study.

A pre–post intervention study design was used to evaluate effectiveness of the initiative.

Evaluation

Preintervention data were collected on all patients discharged from the inpatient psychiatric unit in a 1-month period before the intervention was commenced in April 2015, by auditing their patient records, to determine what metabolic testing had been performed. Postintervention data were collected on all patients discharged from the inpatient psychiatric unit in a 1-month period in April 2016, 12 months after the intervention had begun. Data were collected on brief demographic and diagnostic variables, metabolic parameters and their completion rates. This is presented in tables 2–4. Confidentiality was upheld by use of medical record numbers rather than names, and data were stored securely on a password-protected computer account.

Patient characteristics of discharge diagnoses and whether they were on antipsychotic medication at discharge were obtained through a review of the discharge summary. The discharge summary does not always comply with official nomenclature, but certainly provides an indication of diagnostic category. Some discharge summaries had multiple diagnoses, so for the purpose of this study, the primary admission diagnosis was used. Diagnoses were clustered into psychosis, mood disorder (which included depression, bipolar and persistent dysthymic disorder), suicidal ideation/acute situational crisis (which included

self-harm) and 'other' which included psychosocial factors such as housing difficulties and organic disorders. It was also recorded whether patients were discharged on antipsychotic medication—regardless of type (first or second-generation antipsychotics) and regardless of their diagnosis and reason for admission. This crude data was collected to confirm that this patient cohort fit into the severe mental illness category (for this purpose taken as a diagnosis of psychosis).

Weight, height, body mass index (BMI), waist circumference and blood pressure (BP) were obtained by looking at three forms in the patient file that are available for use in our state to record this information as an inpatient:

- Standard Adult General Observations Chart.[24]
- Mental Health Metabolic Monitoring form.[25]
- Mental Health Physical Examination form.[26]

As our hospital does not have an electronic medical record, all of these charts and forms are kept in the patient's paper file. Of these, the Standard Adult General Observations Chart is used for all inpatient observations and would be expected to be in every inpatient's file. The Mental Health Physical Examination form is also routinely used for the initial physical assessment of a patient receiving inpatient psychiatric care. The Mental Health Metabolic Monitoring form was not routinely used or kept in patient files at start of this quality improvement project. If the weight, height, BMI or waist circumference were recorded on any of these three forms, it was recorded as being completed.

Lipid and glucose levels were accessed through an online pathology laboratory system at the hospital. Lipid and glucose levels were recorded as taken even if it was not recorded on the any of the three monitoring forms. There was no discrimination between a random or fasting sample.

Evaluation was performed using GraphPad statistical analysis to check completion of monitoring of the measures used to determine metabolic syndrome.[10]

RESULTS

Files from 61 patients discharged in the month preintervention (April 2015), and 46 patients discharged in the same month 12 months later (April 2016), were reviewed. All patient files discharged in the month preintervention were included (61 files in total, 100%). In the postintervention audit, 43 files were audited out of a total of 51 discharged patients (84%), as eight files were not available for audit. These files were either at an outside location or could not be located despite several attempts involving audit personnel and medical records staff. Data accuracy was checked by a second researcher prior to statistical analysis being performed.

Both audits confirmed that the most common diagnosis was psychosis, accounting for 73.7% of all inpatients in our preintervention audit and 69.6% in our postintervention audit. Acute situational crisis/suicidal ideation was the second most common diagnosis, followed by mood disorders. Most patients were discharged with antipsychotic medication—68.9% of patients from the first audit were on antipsychotic medication at discharge, compared with 78.2% on the second audit. There is a relatively short length of stay in both groups, but with a small number of longer admissions skewing the data to a non-normal distribution. These results are displayed in table 2.

Metabolic findings for both audits are presented in table 3. These are presented solely for descriptive purposes. The mean BMI and waist circumference in the first audit were elevated, with a larger SD, consistent with the raw data confirming two outlier BMIs of >40 kg/m^2. Such outliers were not seen in the second sample resulting in the lower mean BMI. BP and lipid means across both samples were within normal limits, likely reflective of the young age of both samples. The glucose result unfortunately does not differentiate between random and fasting glucose levels. As mentioned in our methodology, random blood glucose was often collected as part of the initial physical work-up, which was the more common collection method in our first sample. By our second audit most checks of glucose were fasting, but a review of the raw data confirms one outlier result of 34.9 mmol/L which has skewed the result and reflects the high SD.

The preintervention and postintervention data in regard to metabolic monitoring were analysed using a Fisher's Exact test, due to the small sample size. The data were categorical, assessing binary outcomes and made no assumptions about normal distribution. Two-tailed tests were used to compare p values, with significance determined at <0.05.

Rates of weight and height monitoring both increased from 46.0% to 69.5% (p 0.0185) and BMI recordings increased from 33% to 63% (p=0.0031) after the intervention. Rates of waist circumference monitoring increased from 44.2% to 65.2% (p=0.0498). BP measurements increased from 88.5% to 100% (p=0.0188). Lipid monitoring rates improved from 23% to 69.5% (p=0.001). Rates of glucose monitoring increased from 74% to 82.5% (p=0.8256), although this was not statistically significant. These results are displayed in table 4.

DISCUSSION

This study examined the effectiveness of a quality improvement project using a pre–post intervention experimental design in a single-site psychiatric inpatient facility. We found there was a trend that metabolic monitoring improved following the intervention. There was a statistically significant increase in measurement rates of weight, BP, height, lipids, BMI and waist circumference (p<0.05). Overall monitoring of glucose also improved, although not to significant levels. The intervention was acceptable to both patients and staff, and did not require additional staffing or funding (although we were fortunate to later receive some funding for a part-time exercise physiology position). The cost of performing the extra pathology tests was considered beyond the scope of this project.

The rate of psychotic illness in our study is difficult to compare with national rates due to the lack of official nomenclature in our study. The most recent Australian data for inpatient psychiatric admissions at public acute hospitals shows that 30.4% of admissions have a principal diagnosis of a primary psychotic disorder, namely schizophrenia, schizotypal and other delusional disorders, persistent delusional disorders, acute and transient psychotic disorders, and schizoaffective disorders, as per the International Classification of Diseases, Tenth Revision (ICD-10).[27] This is markedly lower than our rate of 69.5%–73.9%, but could be explained as the nationwide rate does not include mood disorders with psychosis or drug-induced psychosis. Additionally, our inner city hospital has a distinct patient demographic, with a catchment consisting of a relatively large number of patients experiencing homelessness and comorbid substance abuse, likely making psychosis more common in presentation. This is representative of an inner city mental health unit within an Australian capital city, rather than a nationwide representation of all mental health admissions. Regardless, this high rate of psychosis, taken with the high rate of antipsychotic use at discharge, confirms that this cohort appear to suffer severe mental illness, is therefore at high risk for cardiovascular risk, and should have access to appropriate monitoring.

We have provided the metabolic findings for descriptive purposes only. We did not expect that our intervention would improve metabolic results for patients across the preintervention and postintervention samples, as the average length of stay of these patients is generally too short to have time for any metabolic intervention to take effect, and these were not paired samples. We would hope that the intervention and increased rates of metabolic monitoring might benefit patients over time, particularly those who are treated consistently over several episodes at our service, including with community follow-up as well. Of interest, we note the remarkably consistent nature of metabolic findings across both samples once outliers are removed from each sample, and also that most of the variables are within the normal range. We hypothesise whether these normal and near-normal results are one driver for poor rates of testing in the psychiatric population, as it may not be overtly obvious to treating staff that these patients are high risk for metabolic syndrome.

The greatest improvement in monitoring rates was seen in BMI and lipids (both in absolute increase of monitoring rates and in p values). These had very low measurement and documentation rates in the initial audit as they were not routinely performed as part of initial investigations. The increase in weight and height monitoring rates, perhaps prompted by their inclusion on the Mental Health Metabolic Monitoring form[25] which increased in use, invariably contributed to the improved BMI monitoring. The high level of BP and glucose measurements in both audits is likely due to routine observations being taken on the ward by nursing staff as part of standard nursing care, prior to the intervention. This is routinely completed in the emergency department and repeated on the ward. Despite this high baseline, the intervention still appears to have increased rates of testing of both these risk factors.

Lessons and limitations

While all four components of the initiative were synergistic, the core intervention was the nurse-led protocol for performing the monitoring. Nurse-led interventions have shown promise in a number of areas of chronic disease management,[28–30] including screening for cardiovascular risk in patients with severe mental illness.[31] There is also evidence that a number of interventions can be both acceptable and effective in the management of cardiometabolic risk in patients with a severe mental illness.[32–34] We believe this report adds to this literature.

There are several limitations of internal validity in this study. Clustering the diagnoses into four categories based on the discharge summary gives an easily-obtained overall picture of the conditions treated on our ward. However, discharge summaries do not always align with official diagnostic nomenclature. In terms of obtaining data on the rates of monitoring there are other limitations. Eight files were missing from the final audit, which may affect results, although we have no reason to believe the characteristics of those patients with missing files would be any different to those whose files were included in the analysis. We were unable to access whether patients had had the monitoring performed elsewhere, as our results database is hospital-based only. It is possible that patients had external laboratory testing that was not accessed during their inpatient stay and were, in fact, receiving appropriate cardiometabolic monitoring through external providers as an outpatient. This information may have been more easily accessible with a comprehensive electronic medical record as available at other hospitals. Another disadvantage of not having an electronic medical record is the use of multiple charts and forms as a source of data, not giving a clear picture of whether the correct form for metabolic monitoring[26] was being used, which may have inflated actual results for specific metabolic testing compared with simply routine physical observations. Similarly, we have not differentiated between fasting and non-fasting glucose and lipid levels, as obtaining accurate information about whether a patient was fasting would be difficult. We have assumed that the testing done was for the purpose of metabolic monitoring, but for glucose especially the result may have just been part of a routine physical work-up, especially at the time of our first audit. Fortunately in regard to lipid levels, non-fasting baseline samples may become the standard as a screening tool as fasting levels may not be that different,[35 36] and in our ward lipid levels were unlikely to have been done for any other purpose than metabolic screening.

Other limitations to the study are around the education which was provided. As this was provided in different ways across multiple modalities, including opportunistically, no formal evaluation of the quality of education was

performed. As the content of education provided to staff was relatively informal, and thus has not been made available here, this also makes it more difficult to reproduce. Additionally, we were unable to monitor any external factors that may have altered the staff awareness of the importance of cardiometabolic monitoring aside from the intervention, through the absence of a control group. This includes increased awareness of this issue being highlighted within professional bodies,[37] and larger statewide campaigns to highlight the importance of metabolic monitoring within mental health populations.[38–40] While we believe these factors may have increased awareness of the issue, we also believe that the change in monitoring rates would not have occurred without a sustained and targeted intervention, due to a lack of any formalised system, guidelines or reminders,[21] a lack of confidence or prior experience performing this monitoring by existing staff,[22] and frequent rotation of junior doctors who had previously held the responsibility for this testing before the intervention.

In terms of external validity, there is a chance that our population may not be representative of other inpatient mental health units, due to its high acuity and unique inner city characteristics. Additionally, we recognise that the intervention also relied on the high motivation of physical health champions and additional nursing staff available on our ward.

Finally, we recognise a limitation in this study's review of process rather than outcome. The intervention implements monitoring of cardiometabolic risk factors, but does not follow-up results and treatment. We believe creating a good process is key to improving outcomes. Measuring metabolic health in a fixed sample known to our service over time would be the next step in ensuring that the intervention was improving patient care and reducing morbidity and mortality.

CONCLUSION

We identified a need to improve rates of metabolic monitoring on our inpatient mental health unit, due to the elevated risk of cardiovascular disease for these patients, and the existing low rates of screening. A simple intervention which encouraged nurse-led monitoring in addition to education, a number of interventions for metabolic risks, and ongoing consumer involvement, has shown an improvement in monitoring rates. Importantly, this intervention was also acceptable to patients and staff, and still continues over 36 months since first initiated, as verified by regular repeat audits on our ward. Additionally, we continue to build on our suite of interventions for metabolic risk. All initial interventions remain in place, and the option to embed a regular metabolic clinic on our ward in collaboration with our Endocrinology colleagues is currently being piloted.

These results are consistent with existing literature which shows that similar interventions can be successful, and we believe this simple intervention can be implemented in other inpatient mental health settings. For our service, the next step will be a similar intervention in the outpatient setting. As our study primarily reviewed a quality improvement initiative to improve our process around metabolic monitoring, further research could also consider whether such best practice monitoring is associated with better health outcomes for patients, particularly looking at metabolic risk factors, as well as examining cost-effectiveness.

Acknowledgements The authors wish to acknowledge Marianna Milosavljevic, Director of Research, Illawarra Shoalhaven Local Health District, for assistance with statistical analysis of the results. We also wish to acknowledge the members of the working party and physical health champions on Caritas ward for their dedication and work in this quality improvement project.

Contributors Both authors included in this paper fulfil the criteria of authorship. In addition, we can confirm that there is no one else who fulfils the criteria but has not been included as an author. SM planned and led the intervention with assistance from KM. KM performed the audits and data evaluation. SM finalised this article with assistance from KM.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not required.

Ethics approval Ethics approval was obtained through the St Vincent's Hospital Sydney Health, Research and Ethics Committee (reference number LNR/16/SVH/127) prior to the collection of data.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon request.

ORCID iD

Sarah Michael http://orcid.org/0000-0002-8238-847X

REFERENCES

1 Laursen TM, Munk-Olsen T, Vestergaard M. Life expectancy and cardiovascular mortality in persons with schizophrenia. *Curr Opin Psychiatry* 2012;25:83–8.
2 Lawrence D, Hancock KJ, Kisely S. The gap in life expectancy from preventable physical illness in psychiatric patients in Western Australia: retrospective analysis of population based registers. *BMJ* 2013;346:f2539.
3 Colton CW, Manderscheid RW. Congruencies in increased mortality rates, years of potential life lost, and causes of death among public mental health clients in eight states. *Prev Chronic Dis* 2006;3:A42.
4 Laursen TM. Life expectancy among persons with schizophrenia or bipolar affective disorder. *Schizophr Res* 2011;131:101–4.
5 Brown S, Kim M, Mitchell C, *et al*. Twenty-Five year mortality of a community cohort with schizophrenia. *Br J Psychiatry* 2010;196:116–21.
6 Hennekens CH, Hennekens AR, Hollar D, *et al*. Schizophrenia and increased risks of cardiovascular disease. *Am Heart J* 2005;150:1115–21.
7 Grundy SM. Pre-Diabetes, metabolic syndrome, and cardiovascular risk. *J Am Coll Cardiol* 2012;59:635–43.
8 Mottillo S, Filion KB, Genest J, *et al*. The metabolic syndrome and cardiovascular risk a systematic review and meta-analysis. *J Am Coll Cardiol* 2010;56:1113–32.

9 Sherling DH, Perumareddi P, Hennekens CH. Metabolic syndrome: clinical and policy implications of the new silent killer. *Journal of Cardiovascular Pharmacology and Therapeutics* 2017;22:365–7.
10 Alberti KG. International diabetes Federation Task force on epidemiology and prevention; National heart, lung, and blood Institute; American heart association; world heart Federation; international atherosclerosis Society; international association for the study of obesity: Harmonizing the metabolic syndrome: a joint interim statement of the International diabetes Federation Task force on epidemiology and prevention. *Circulation* 2009;120:1640–5.
11 Bobes J, Arango C, Aranda P, *et al*. Cardiovascular and metabolic risk in outpatients with schizophrenia treated with antipsychotics: results of the CLAMORS study. *Schizophr Res* 2007;90:162–73.
12 De Hert MA, van Winkel R, Van Eyck D, *et al*. Prevalence of the metabolic syndrome in patients with schizophrenia treated with antipsychotic medication. *Schizophr Res* 2006;83:87–93.
13 Cohn T, Prud'homme D, Streiner D, *et al*. Characterizing coronary heart disease risk in chronic schizophrenia: high prevalence of the metabolic syndrome. *Can J Psychiatry* 2004;49:753–60.
14 McEvoy JP, Meyer JM, Goff DC, *et al*. Prevalence of the metabolic syndrome in patients with schizophrenia: baseline results from the clinical antipsychotic trials of intervention effectiveness (CATIE) schizophrenia trial and comparison with national estimates from NHANES III. *Schizophr Res* 2005;80:19–32.
15 Vancampfort D, Vansteelandt K, Correll CU, *et al*. Metabolic syndrome and metabolic abnormalities in bipolar disorder: a meta-analysis of prevalence rates and moderators. *Am J Psychiatry* 2013;170:265–74.
16 Harris MF. The metabolic syndrome. *Aust Fam Physician* 2013;42:524.
17 Paton C, Esop R, Young C, *et al*. Obesity, dyslipidaemias and smoking in an inpatient population treated with antipsychotic drugs. *Acta Psychiatr Scand* 2004;110:299–305.
18 Taylor D, Young C, Mohamed R, *et al*. Undiagnosed impaired fasting glucose and diabetes mellitus amongst inpatients receiving antipsychotic drugs. *J Psychopharmacol* 2005;19:182–6.
19 Mackin P, Bishop DR, Watkinson HMO. A prospective study of monitoring practices for metabolic disease in antipsychotic-treated community psychiatric patients. *BMC Psychiatry* 2007;7:28.
20 Jennex A, Gardner DM. Monitoring and management of metabolic risk factors in outpatients taking antipsychotic drugs: a controlled study. *Can J Psychiatry* 2008;53:34–42.
21 Laugharne J, Waterreus AJ, Castle DJ, *et al*. Screening for the metabolic syndrome in Australia: a national survey of psychiatrists' attitudes and reported practice in patients prescribed antipsychotic drugs. *Australas Psychiatry* 2016;24:62–6.
22 Barnes TRE, Bhatti SF, Adroer R, *et al*. Screening for the metabolic side effects of antipsychotic medication: findings of a 6-year quality improvement programme in the UK. *BMJ Open* 2015;5:e007633.
23 Curtis J, Newall H, Samaras K. Positive cardiometabolic health: an early intervention framework for patients on psychotropic medications. *Early Intervention in Psychiatry* 2010;4:60.
24 NSW Health. Adult General observation chart. Sydney; health education and training Institute, 1999. Available: http://www.heti.nsw.gov.au/Global/District-HETI/SAGO-Chart.pdf [Accessed 1 Oct 2016].
25 NSW Health. *Metabolic monitoring, new mental health clinical documentation module*. Sydney: Ministry of Health, 2012. http://www0.health.nsw.gov.au/policies/ib/2012/pdf/IB2012_024.pdf
26 NSW Health. *Redesigned mental health clinical documentation: notification of availability*. Sydney: Ministry of Health, 2008. http://www0.health.nsw.gov.au/policies/ib/2008/pdf/IB2008_047.pdf
27 Australian Institute of Health and Welfare. *Mental health services in Australia: specialised overnight admitted patient mental health care*. Canberra, ACT (Australia: Australian Institute of Health and Welfare, 2018. https://www.aihw.gov.au/reports/mental-health-services/mental-health-services-in-australia/report-contents/overnight-admitted-mental-health-related-care/specialised-overnight-admitted-patient-mental-health-care. Table ON.7, Overnight admitted mental health separations, with specialised psychiatric care, by principal diagnosis in ICD-10-AM groupings and by hospital type, 2016-17
28 Carey N, Courtenay M. A review of the activity and effects of nurse-led care in diabetes. *J Clin Nurs* 2007;16:296–304.
29 Clark CE, Smith LFP, Taylor RS, *et al*. Nurse led interventions to improve control of blood pressure in people with hypertension: systematic review and meta-analysis. *BMJ* 2010;341:c3995.
30 Stephen C, McInnes S, Halcomb E. The feasibility and acceptability of nurse-led chronic disease management interventions in primary care: an integrative review. *J Adv Nurs* 2018;74:279–88.
31 Osborn DPJ, Nazareth I, Wright CA, *et al*. Impact of a nurse-led intervention to improve screening for cardiovascular risk factors in people with severe mental illnesses. Phase-two cluster randomised feasibility trial of community mental health teams. *BMC Health Serv Res* 2010;10:61.
32 De Hert M, van Winkel R, Silic A, *et al*. Physical health management in psychiatric settings. *Eur Psychiatry* 2010;25 Suppl 2:S22–8.
33 Newall H, Myles N, Ward PB, *et al*. Efficacy of metformin for prevention of weight gain in psychiatric populations: a review. *Int Clin Psychopharmacol* 2012;27:69–75.
34 Curtis J, Watkins A, Rosenbaum S, *et al*. Evaluating an individualized lifestyle and life skills intervention to prevent antipsychotic-induced weight gain in first-episode psychosis. *Early Interv Psychiatry* 2016;10:267–76.
35 Sparke C. Path Labs move to non-fasting lipid testing. Australian doctor, 2016. Available: https://www.australiandoctor.com.au/news/path-labs-move-non-fasting-lipid-testing [Accessed 30 Oct 2016].
36 Nordestgaard BG, Langsted A, Mora S, *et al*. Fasting is not routinely required for determination of a lipid profile: clinical and laboratory implications including flagging at desirable concentration cut-points-a joint consensus statement from the European atherosclerosis Society and European Federation of clinical chemistry and laboratory medicine. *Eur Heart J* 2016;37:1944–58.
37 The Royal Australian and New Zealand College of Psychiatrists. *Keeping the body and mind together*. Melbourne: Royal Australian and New Zealand College of Psychiatrists, 2015. https://www.ranzcp.org/Files/Publications/RANZCP-Keeping-body-and-mind-together.aspx
38 NSW Health. *The physical mental health Handbook*. Sydney: NSW Health, 2009. https://health.nsw.gov.au/mentalhealth/programs/mh/Publications/phmh-handbook.pdf
39 Mental Health Commission of NSW. *Physical health and mental wellbeing: evidence guide*. Sydney: Mental Health Commission of NSW, 2016. https://nswmentalhealthcommission.com.au/sites/default/files/publication-documents/Physical%20health%20and%20wellbeing%20-%20final%208%20Apr%202016%20WEB.pdf
40 NSW Ministry of Health. *Physical health care of mental health consumers*. Sydney: NSW Ministry of Health, 2017. https://www1.health.nsw.gov.au/pds/ActivePDSDocuments/GL2017_019.pdf