Scholarly Project

An audit of cardiometabolic monitoring in an early psychosis intervention outpatient setting

De-identification clause:

All data which could potentially identify the patients, their families and other individuals has been removed from this Scholarly Project. The locations, names of hospitals, supervisors and dates of assessment have been modified and replaced with a pseudonym* (e.g. Jane*) the first time they appear in the text (excluding table of contents).

Word count: [4958]

Excluding all headings, footnotes, tables, appendices, figures, diagrams, de-identification clause, table of contents and references.

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Abstract

Background

Second-generation antipsychotics (SGAs) are widely prescribed medications which have potential cardiometabolic side effects. Routine cardiometabolic monitoring is recommended to minimise such risks. Existing literature suggests that monitoring practice commonly falls short of most clinical guidelines.

Objectives

The objectives are to (i) to measure the adequacy of the current practice of cardiometabolic monitoring in patients treated with SGAs at an outpatient early intervention in psychosis service within City District Health Board (CDHB*); and (ii) improve clinical practice through execution of an audit action plan.

Methods

The clinical audit cycle framework was utilised. A baseline audit was conducted against the following criteria: (i) monitoring of waist circumference, weight, height, body mass index (BMI), blood pressure, lipid profile and plasma glucose, (ii) random plasma sample or glycosylated haemoglobin (HbA1c) are acceptable, (iii) frequency of monitoring to be audited is one monthly and three monthly afterwards, (iv) height is an exception – a single measurement is sufficient. Compliance standard was set at 80%. A re-audit was conducted 8 months following the initiation of the action plan.

Results

61 cases were audited at baseline and 68 at re-audit. The baseline audit revealed the following compliance levels: 60.65% for height measurement, 40.4% weight, 34.84% BMI, 15.15% waist circumference, 31.81% blood pressure, 27.77% plasma glucose and HbA1c and 22.22% plasma lipids.

An audit action plan was developed and implemented within the team. The plan focused on staff education, dissemination of recommendations for monitoring, facilitating laboratory monitoring, designated nursing time for monitoring, team members sharing responsibility for monitoring, the use of a monitoring form and reminders. A follow-up audit after 8 months showed upward trends for all parameters: height 91.17%, weight 63.26%, BMI 61.9%, waist circumference 40.81%, blood pressure 59.18%, plasma glucose and HbA1c 49.65%, and plasma lipids 41.49%.

Conclusion

This audit demonstrated low rates of cardiometabolic monitoring in a first episode psychosis service, which improved through an audit process, using multitargeted interventions. The monitoring practices though remained behind most guidelines' recommendations. Further cycles of audits, could possibly provide sustained and additional improvement.

Background (Step 1 – Identify the problem)

Indications for antipsychotic medications in early psychosis intervention

First-episode psychosis (FEP) is a term used to describe the early phase of psychotic illness until there is diagnostic clarity[1,2]. The age of onset of FEP is typically during the late teenage years, through to early to mid-20s[3].

Antipsychotic medications, mainly second-generation antipsychotics (SGAs), are widely prescribed in the treatment of FEP[4], including in young populations[5]. SGAs are the first-line pharmacological treatment for FEP, recommended by the Royal Australian and New Zealand College of Psychiatrists (RANZCP)[6] and the Australian Clinical Guidelines for Early Psychosis[7].

Cardiometabolic side effects

The metabolic syndrome (MetS) is a well-described group of interconnected risk factors for the development of cardiovascular disease (CVD) and type 2 diabetes mellitus (T2DM). The elements of MetS are central obesity, hypertension, hyperglycaemia and dyslipidaemia[8,9]. Individuals with MetS have increased risk of myocardial infarction, cerebrovascular accident, and T2DM[10,11]. Use of antipsychotic medications, particularly SGAs, increases the risk of MetS and cardiometabolic abnormalities[12,13]. The relative risk of mortality in those with serious mental disorders is more than twice that of the general population[14], and 80% of the deaths are associated with physical health conditions[15].

Cardiometabolic side effects in first-episode psychosis

There is evidence suggesting that patients treated with antipsychotic medications develop cardiometabolic side effects at a younger age than peers of the same age who are not treated with antipsychotic medication[16-19]. Paediatric and adolescent patients develop cardiometabolic adverse effects more quickly and more severe than adult patients[16] and within weeks of initiating medication[16,17,20]. They are at a higher risk of MetS, and increased long-term risk of CVD and T2DM compared to same age group who are not on antipsychotic medication[21].

In recent years there has been increased focus on the cardiometabolic monitoring of young patients treated with antipsychotic medications[16,17,19,22]. The first year of psychotic illness is considered a vital period of intervention to prevent future physical illness and mortality[23,24]. Cardiometabolic monitoring in FEP is important[22,25] to enable prevention, early recognition and management of cardiovascular risk factors[25,26].

The evidence of benefit with interventions

The literature suggests that structured lifestyle interventions, including diet and exercise, can minimise weight gain and improve cardiometabolic parameters in those with serious mental illness[27-34] and those treated with antipsychotic medications[28-31,34]. Lifestyle interventions have been found to decrease antipsychotic-associated weight gain in patients with FEP[35-37], as well as improved diet[37,38].

The choice of antipsychotic medication is important to prevent weight gain[39], as the risk varies between medications[40,41]. When weight gain occurs, switching medications can attenuate weight gain and associated risk factors[42,43]. Metformin is recommended as an adjunctive treatment to prevent antipsychotic-associated weight gain[43-47], including in FEP[48].

Aripiprazole has a relatively low risk of weight gain compared with other antipsychotic medications[49] and may even cause weight loss[50]. Aripiprazole can be used as an adjunctive treatment with clozapine or olanzapine to limit the associated weight gain[43,47].

Rates of monitoring

Despite the existence of guidelines for cardiometabolic monitoring, rates of monitoring of patients on antipsychotic medication were generally reported to be low[51-54], including paediatric and adolescent patients[55-60] and the FEP population[55,58,59,61]. Only one relevant New Zealand study was identified. Ndukwe and Nishtala[62], reported low rates of monitoring for glycaemic control in a cohort of older adults newly treated with SGAs.

Monitoring guidelines

International and local guidelines recommend routine cardiometabolic monitoring for patients on antipsychotic medications. There is some variability between guidelines as to which parameters should be monitored and how often. The following are observed:

- Parameters common among all the guidelines are mainly those which pertain to the MetS risk factors.

- Lipid monitoring recommended can either be a full lipid panel (i.e. low density lipoprotein (LDL), high density lipoprotein (HDL), total cholesterol and triglycerides (TG) or a combination of any. Random lipid profile can be used if a fasting sample cannot be obtained (some guidelines exclude TG).
- Some of the guidelines accept random plasma glucose or HbA1c as an alternative for fasting plasma glucose.
- The frequencies are not absolute and should be guided by the clinical picture. Monitoring during the initial period of treatment should be more frequent, especially of weight. Consideration should be given to repeating the initial monitoring steps when medication is changed.
- Ethnicity should be taken into consideration when assessing BMI.

International guidelines

More recent guidelines[6,7,43,63,64,65] tend to be more extensive than older guidelines[66,67]. Monitoring recommendations for children[63,68], or for FEP[7] are usually more extensive than those of adults, as they recommend additional monitoring parameters and higher frequencies of monitoring. Some guidelines provide recommendations which depend on the SGA being used for treatment[65,68].

The 'positive cardiometabolic health' algorithm[22] was devised to provide a framework for the monitoring, and management of cardiometabolic risk factors in patients on antipsychotic medication. An adolescent version[69] of the algorithm has also been published.

The algorithm has been adapted as the Lester UK adaptation[70], embedded in the National Institute for Health and Care Excellence (NICE) clinical guidelines as an implementation resource[64], and recommended by the Australian Clinical Guidelines for Early Psychosis[7]. It is endorsed by many professional bodies including the UK Royal Colleges of Psychiatrists and Physicians, RANZCP and the UK Schizophrenia Commission[71].

Recommended monitoring by (RANZCP)[6] and the Australian Clinical Guidelines for Early Psychosis[7] are provided in tables 1-2, while detailed summaries and comparisons of other various international guidelines are provided in Appendix I.

Table 1: RANZCP recommended monitoring for patients on antipsychotic medications 2016[72]

Parameter	Baseline	4 weeks	8 weeks	12 weeks	24 weeks	Annually
Patient history	✓					✓
Weight or BMI	✓	✓	✓	✓	✓	✓
Waist circumference	✓			✓	✓	✓
Fasting plasma glucose, HbA1c	✓			✓	✓	✓
Fasting lipid profile	✓			✓	✓	✓

Table 2: The Australian Clinical Guidelines for Early Psychosis monitoring recommendations 2016[7]

Parameter	Baseline	1 month	3 monthly
Level of physical activity, smoking and diet	✓	✓	✓
Waist circumference	✓	✓	✓
Weight	✓	✓	✓
Height	✓	✓	✓
BMI	✓	✓	✓
Blood pressure	✓	✓	✓
Fasting pathology (lipid profile, glucose, vitamin D)	✓	✓	✓

Local guidelines

New Zealand has no national standards or guidance for cardiometabolic screening within mental health and addiction services[75]. Local guidelines exist, including CDHB guidelines and recommendations by Best Practice Advocacy Centre New Zealand (BPAC). They are not specific to FEP. (Table 3)

Table 3: Local guidelines for patients treated with antipsychotic medications

	Recommended monitoring	
Parameter	**CDHB 2015[73]**	**BPAC 2007[74]**
History of substantial weight gain and when rapid	➢ At baseline ➢ At 3 months ➢ Annually[a]	-
Weight	➢ At baseline ➢ 1-2 weekly (first 8 weeks) ➢ At 3 months ➢ Annually[a]	➢ At baseline ➢ Monthly
BMI	➢ At baseline ➢ At 3 months ➢ Annually[a]	➢ At baseline ➢ Monthly
Waist circumference	➢ At baseline ➢ At 3 months ➢ Annually[a]	-
Blood pressure	➢ At baseline ➢ At 3 months ➢ Annually[a]	-
Fasting glucose/HbA1c	➢ At baseline ➢ At 3 months ➢ Annually[a]	➢ At baseline ➢ Monthly for 3 months for those at risk ➢ At 3 months ➢ 3-monthly for a year for those at risk ➢ Annually
Lipids	➢ At baseline ➢ At 3 months ➢ Annually[a]	➢ At baseline ➢ 3-monthly for a year

[a] Unless there is an abnormal finding, which should then prompt appropriate action and/or continuing review at least every 3 months

Existing audits

There are many published audits on the cardiometabolic monitoring of patients with mental illness overall, in children or adults who are treated with antipsychotic medications, and in FEP. The audits took place in various settings[76-92]. (see Appendix II for non-FEP audits). The audited parameters included blood pressure, various measures of obesity, plasma glucose, HbA1c, lipid profile and height. Some audits required personal history, family history, smoking, substance misuse or alcohol use. Audits varied regarding which combinations of the above parameters were inspected. There was also variability in the frequency of monitoring audited. Most of the audits did not use the guidelines' recommendations of frequent monitoring during the early phase of treatment. Many audits chose to measure parameters once over a certain period, as the examined frequency, with periods ranging mostly from 3 to 12 months. Audits have shown that monitoring rates are generally lower than what most guidelines recommend. Some audits reported completion of an audit cycle with variable success in changing practice; variable interventions were used, including education, training of staff and the use of automatic reminders, posters, checklists or forms.

<u>Audits specific to first-episode psychosis</u>

Audits focused specifically on the FEP population are considerably fewer compared with other populations. Furthermore, the overall reported monitoring rates in the FEP population were also reported low.

Table 4: Comparison of audit results performed in an FEP population treated with antipsychotic medication					
	Audits				
	RCPsych 2016[93]	**RCPsych 2019[94]**	**Batscha et al 2010[95]**	**Bozymski et al 2017[96]**	**Crabb et al 2009[97]**
Location	England, UK	England, UK	Chicago, USA	Indianapolis, USA	Glasgow, UK
Number[a]	2635	9527	40	163	90
Setting	National FEP services	National FEP services	Inpatient and outpatient	Outpatients	Outpatients
Frequency	Once within 12 weeks from the patient being accepted onto the caseload	Once within 12 weeks of starting treatment	Once within one month of starting treatment	Once	Once
BP	53%	83%	65%	60.1%	64%
Measures of obesity	52%(BMI)	81% (BMI)	65%(wt) 20%(WC)	68.7%(wt)	27%(BMI)
PG or HbA1c	40%	75%	40 %	65.6%	56%(FPG)
Lipids	37%(cholesterol)	73%	5%	65.6%	28% (fasting)
Smoking status	85%	92%	-	-	-
Alcohol intake	88%	92%	-	-	-
Substance misuse	91%	93%	-	-	-
Documented family history of ischaemic heart disease	-	-	-	-	27%
All measures monitored	22%	64%	-	-	-

[a] Number of patient records audited

RCPsych = The Royal College of Psychiatrists, BP = blood pressure, PG = plasma glucose, FPG = Fasting plasma glucose, Measures of obesity = waist circumference, BMI or weight, WC = Waist circumference, wt = weight

Hetrick et al[98] audited cardiometabolic monitoring in a FEP outpatient cohort who were treated with antipsychotic medication. Hetrick et al[98] utilised a higher monitoring frequency as the standard, in comparison with other audits in non-FEP population. (Table 5). The initial phase of the audit process involved interviewing psychiatrists to examine barriers to routine monitoring and develop strategies to improve practice. The audit demonstrated low rates of monitoring.

Table 5: Parameters and frequencies set by Hetrick et al[99] for assessing metabolic monitoring

Parameters assessed	Assessment time points
➢ Height and weight to estimate BMI ➢ Systolic and diastolic blood pressure ➢ Blood glucose (fasting, however, random accepted within EPPIC for practical reasons) ➢ Total cholesterol ➢ LDL and HDL ➢ Triglycerides	➢ Baseline (or as close to) ➢ 1 month (not required by clinical guidelines at the time of audit) ➢ 3 months ➢ 6 months ➢ 12 months ➢ 18 months

Following Hetrick et al[98], another audit was performed by Thompson et al[101] at the same service. Additional parameters were added. (Table 6). The audit completed a full cycle, with interventions based on the interviews performed by Hetrick et al[98] in identifying barriers. The interventions included the development of local guidelines, staff education, the provision of monitoring equipment, the use of wall posters, monitoring forms and prompts. The audit demonstrated a significant improvement following the interventions.

Table 6: Parameters and frequencies set by Thompson et al[102] for assessing cardiometabolic monitoring	
Parameters assessed	**Assessment time points**
➢ Obesity measures (BMI or weight and height or waist/hip ratio) ➢ Blood pressure ➢ Fasting blood glucose ➢ Fasting lipid profile (including total cholesterol, LDL, HDL and triglycerides) ➢ Number of cigarettes smoked daily ➢ Level of daily exercise	➢ Baseline ➢ 1 month ➢ 3 months ➢ 6 months ➢ 12 months ➢ 18 months

Table 7: Audit results reported by Thompson et al [101]					
	Number of patient records audited	**Duration audited**	**Time points audited**	**Minimum metabolic screening[a]**	**Minimum metabolic monitoring[b]**
Pre-intervention	106	18 months prior to first collection of data time point	■ Baseline ■ 1 month ■ 3 months ■ 6 months ■ 12 months ■ 18 months	22.2%	1.7%
Post-intervention	86	6 months prior to second collection of data time point	■ Baseline ■ 1 month ■ 3 months ■ 6 months	81.4%	39.5%
[a] Screening of all metabolic measures including obesity measures and blood tests at some point within 6 months of being prescribed an antipsychotic medication [b] Minimum metabolic screening plus the completion of all measures between 1 and 6 months following starting on antipsychotic medication (or 1 to 6 months after baseline)					

No patients had guideline-concordant metabolic monitoring completed in the 6 months following the initiation of antipsychotic medication at either audit.

Table 8: Breakdown of the monitoring rates of parameters post-intervention as reported by Thompson et al[103]		
Parameters	**Metabolic screening**	**Metabolic monitoring**
Obesity measures	84.9%	40.7%
Blood pressure recorded	81.4%	41.6%
Glucose level	74.4%	24.4%
Lipids	75.6%	26.7%

Vasudev & Martindale[104] audited the rates of cardiometabolic monitoring performed by the general practitioners of patients treated with antipsychotic medications. The intervention focused on staff and patient education, support of patients in obtaining physical health checks and improving liaison with primary healthcare.

Table 9: Vasudev & Martindale[104] audit results		
	Pre-intervention	**Post-intervention**
Number of patients audited	66	76
Percentage of patients who had undergone a physical health check in the previous year	20%	58%

Local practice

No published audits, including any on FEP, whether New Zealand based or from CDHB, were found in the literature; subsequently, no information was available on the standard of current practice.

Methods

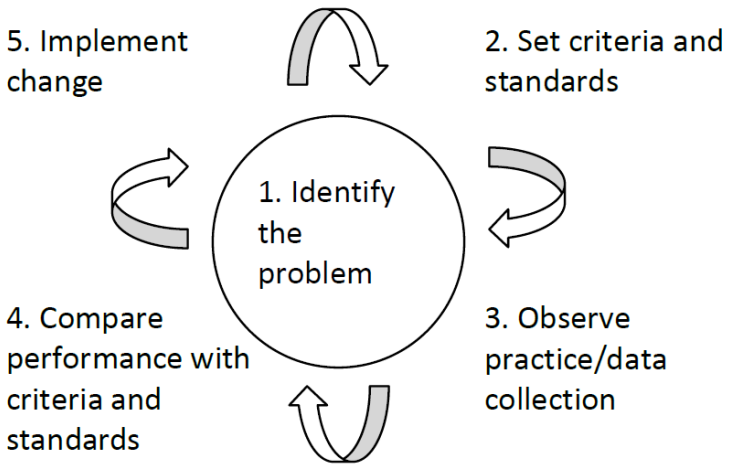
Selection of methodology

A clinical audit was selected as a suitable method to assess the practice of cardiometabolic monitoring in (PIE*), an outpatient early intervention in psychosis (EIP) service in the CDHB area, and compare it with the pre-set criteria and standards.

The literature review suggests that rates of cardiometabolic monitoring for patients on antipsychotic medications, including in those with FEP, were below the standard recommended by guidelines. Thus, it was hypothesised that this audit would produce similar outcomes.

A 5-step clinical audit cycle was utilised[105]. Descriptive statistics were used to report frequencies of monitoring.

Diagram 1: Clinical audit cycle



Setting of the audit

CDHB is situated in a large metropolitan city in New Zealand. There are approximately 600,000 people in the catchment area.

PIE is a service within the CDHB which accepts patients aged between 16 and 25 years presenting with FEP. Patients accepted by the service are assigned a case manager and a treating psychiatrist or a psychiatric registrar. A case manager can be a nurse, a social worker or an occupational therapist.

There are two electronic record-keeping systems at the CDHB: Mnotes*, where patient mental health notes and medication records are kept, and Lnotes*, where laboratory tests results are available.

Aims of the audit

1. To assess the current practice of cardiometabolic monitoring for patients treated with SGAs under the PIE service within the CDHB.
2. To improve practice where deficits, if any, are identified.

Audit questions

1. Is the service cardiometabolic monitoring consistent with established guidelines?

2. Is the service cardiometabolic monitoring consistent with international monitoring practices?

Audit registration

The audit was registered with the CDHB research office[a]. Ethics approval was not required as per the New Zealand National Ethics Advisory Committee.

Step 2 – Set criteria and standards

Criteria

The criteria chosen for the audit are based on the Australian Clinical Guidelines for Early Psychosis[7] with modifications (Table 2). Those guidelines were chosen given the paucity of guidelines specific to the FEP population and the absence of national or local guidelines. The local DHB guidelines recommend less frequent monitoring for all parameters, except weight; while BPAC guidelines do not include important physical parameters. (Table 3). Furthermore, the chosen guidelines are recommended by the RANZCP guidelines[6], are available on RANZCP website; and, in contrast to the RANZCP guidelines themselves (Table 1), they are more specific to the population and offer more frequent monitoring overall, which spans the whole period of treatment (rather than more frequent monitoring initially, which decreases after 6 months). Additionally, these guidelines cover parameters recommended by international guidelines, including the 'positive cardiometabolic health' algorithm[22].

Criteria were chosen following meetings held with the service, including the service manager and the lead psychiatrist, and with the author's scholarly project supervisor. The

[a] Reference number withheld for de-identification purposes.

aim was to improve the quality of the monitoring while setting realistic and practical goals; thus, certain criteria were excluded. (Table 10).

Table 10: Audit criteria

Criteria to be audited	Criteria excluded
1) Waist circumference 2) Weight 3) Height 4) BMI 5) Blood pressure 6) Lipid profile 7) Plasma glucose 8) Random plasma sample or HbA1c are acceptable 9) Frequency of monitoring to be audited is 1 month following initiation of the antipsychotic medication and 3-monthly afterwards. Monitoring was performed at one month frequency to detect any early changes, as recommended by literature 10) Height is an exception; one measurement is sufficient	1) Level of physical activity, smoking and diet (data difficult to extract electronically or time consuming if done manually) 2) Vitamin D (felt to be unrealistic given that the blood test is expensive and is not common local practice) 3) The monitoring cycle should begin again whenever there is a change in antipsychotic medication (for practical reason of managing electronically extracted data) 4) Baseline frequency was excluded (most patients are established already on antipsychotic treatment by acute service or during inpatient admission prior to referral to PIE)

Standards

Following discussions with the service, the standard was set at 80% for each criterion.

Step 3 – Observe practice and collect data

Data extraction and protection

Data collection for the initial audit occurred on a selected date.[b] All data required for patients opened to the service over a 1-year period were extracted from the electronic clinical record into an Excel spreadsheet by a clinical information analyst. Data included demographics, physical health measurements, results of blood tests and medications prescribed. The data fields included patient age, gender and ethnicity and were de-identified. The spreadsheet was password protected and stored on a CDHB computer.

Inclusion/exclusion criteria

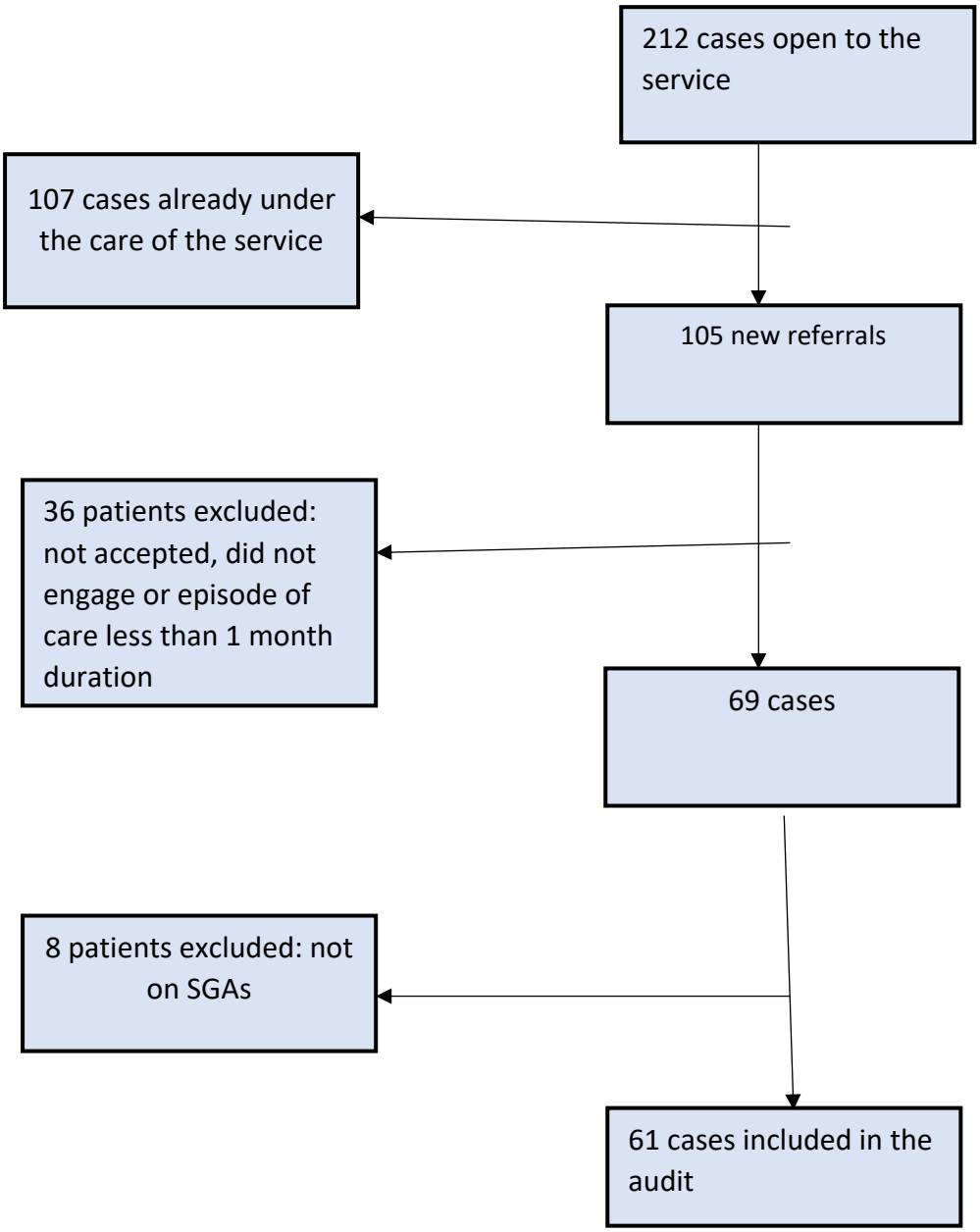
Inclusion criteria for the audit were: (i) patients referred to, accepted by and engaged with the service within the past 12 months, and (ii) at least 1-month long episode of care, and (iii) treatment with an SGA. Cases were excluded if they did not meet these criteria.

212 cases open to the service during the audit period were initially identified; 107 were excluded, as they had been already under the care of the service for a considerable period at the time of the emergence of the chosen guidelines.

Of the remaining 105 cases, 36 were not accepted by the service, did not engage with the service or had an episode of care of less than 1 month; and 8 were excluded as they were not on an SGA. Finally, 61 cases were included in the audit analysis.

[b] Date withheld for de-identification purposes.

Diagram 2: Baseline audit exclusion tree



Data collection process

Following initial extraction, data for several patients were missing and had to be extracted manually from patients' notes.

The process was completed in entirety by the author. To ensure accuracy of data collection and entry, each parameter was counted twice and checked a third time if there was discrepancy.

The frequency for any parameter was counted if it fell within the supposed point in time +/- 4 weeks, to allow flexibility given the difficulty to follow a rigid monitoring regimen in day-to-day clinical practice.

Baseline audit demographics

The mean age of patients was 19.52 (median = 19.5; range = 15–24). The gender profile was skewed towards a male predominance (70.49%). The largest ethnicity group was New Zealand Maori (34.42%), followed by New Zealand European (32.78%). Maori ethnicity was over-represented in the sample as they represent about 10% of the CDHB population[106].

This may be explained by the over-representation of Maori in mental health services,[107] increased rates of mental illness in Maori in general[108] or Maori being a young population with half the population is aged under 23 years[108].

Most patients had a primary diagnosis of psychotic disorder not otherwise specified (NOS) (80.32%), which was not unexpected, given the common uncertainty of the diagnosis during the initial period of psychotic illness.

Table 11: Baseline audit demographics			
		Number	**Percentage**
Gender	Male	43	70.49%
	Female	18	29.51%
Ethnicity	New Zealand Maori	21	34.42%
	New Zealand European	20	32.78%
	Other European	7	11.47%
	Asian	6	9.83%
	Pacific Island	4	6.55%
	Middle Eastern	2	3.27%
	Indian	1	1.63%
Primary diagnosis	Psychotic disorder NOS	49	80.32%
	Schizophrenia	5	8.19%
	Schizophreniform disorder	3	4.91%
	Bipolar affective disorder type I	2	3.27%
	Schizoaffective disorder	1	1.63%
	Major depressive disorder severe, with psychotic features	1	1.63%

Results

Step 4 – Compare performance with criteria and standards

Baseline audit results

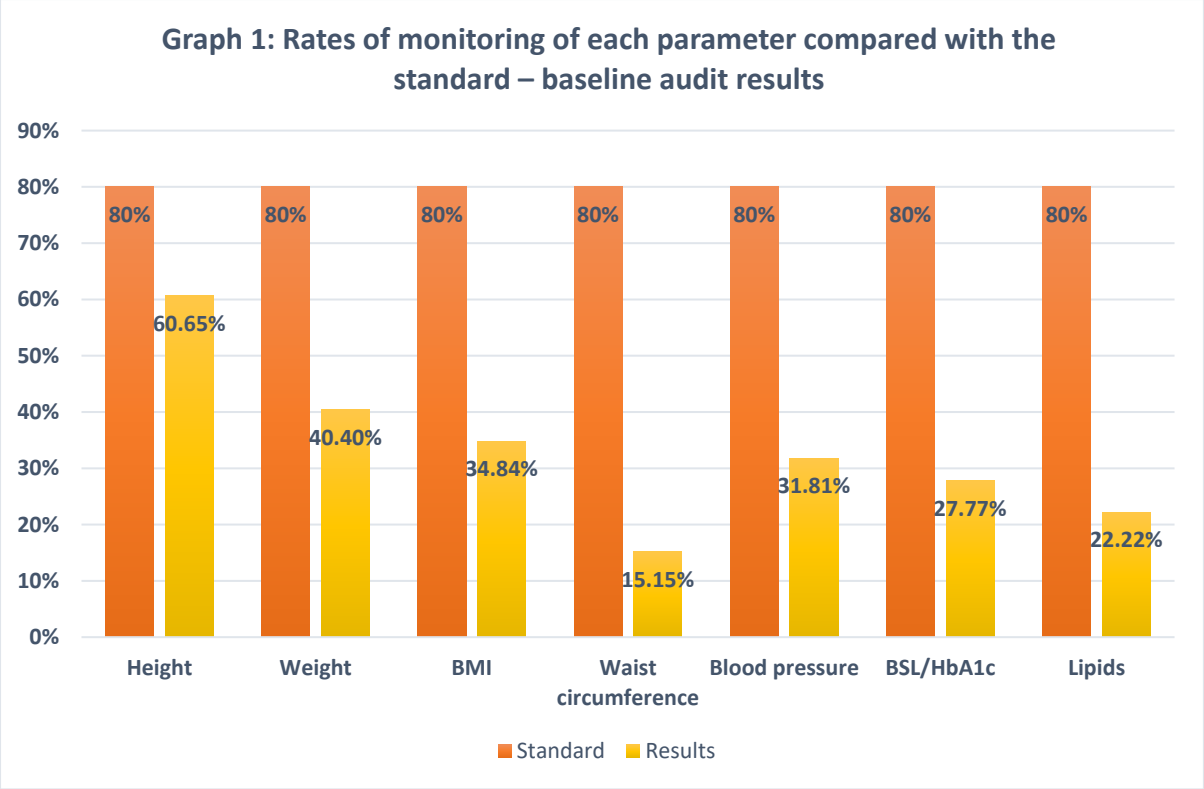
Overall, the performance was poor, with none of the monitoring rates meeting the audit standard and many falling substantially short of it. (Graph 1).

The rates of monitoring of the anthropometric measures were generally better; height was measured in 37 patients (60.65%), weight was monitored in 40.40%, BMI[c] in 34.84%. The parameter with the lowest rate of monitoring was waist circumference (15.15%). Blood pressure was monitored in 31.81%.

The rates of laboratory monitoring were only better than that of waist circumference, with plasma glucose and HbA1c at 27.77% and plasma lipids at 22.22%. Of the blood tests, 42.85% were non-fasting, 23.21% were fasting and in 33.92% this was not stated (Graph 2).

Seventeen patients (27.86%) had all the cardiometabolic parameters measured at least once at some point during the period audited. (Table 12 and Graph 3).

[c] Based on the availability of both height and weight measurements for each patient as BMI is not a parameter that is stored in patients' notes.


Graph 1: Rates of monitoring of each parameter compared with the standard – baseline audit results
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
80%
60.65%
80%
40.40%
80%
34.84%
80%
15.15%
80%
31.81%
80%
27.77%
80%
22.22%
Height
Weight
BMI
Waist circumference
Blood pressure
BSL/HbA1c
Lipids
Standard
Results

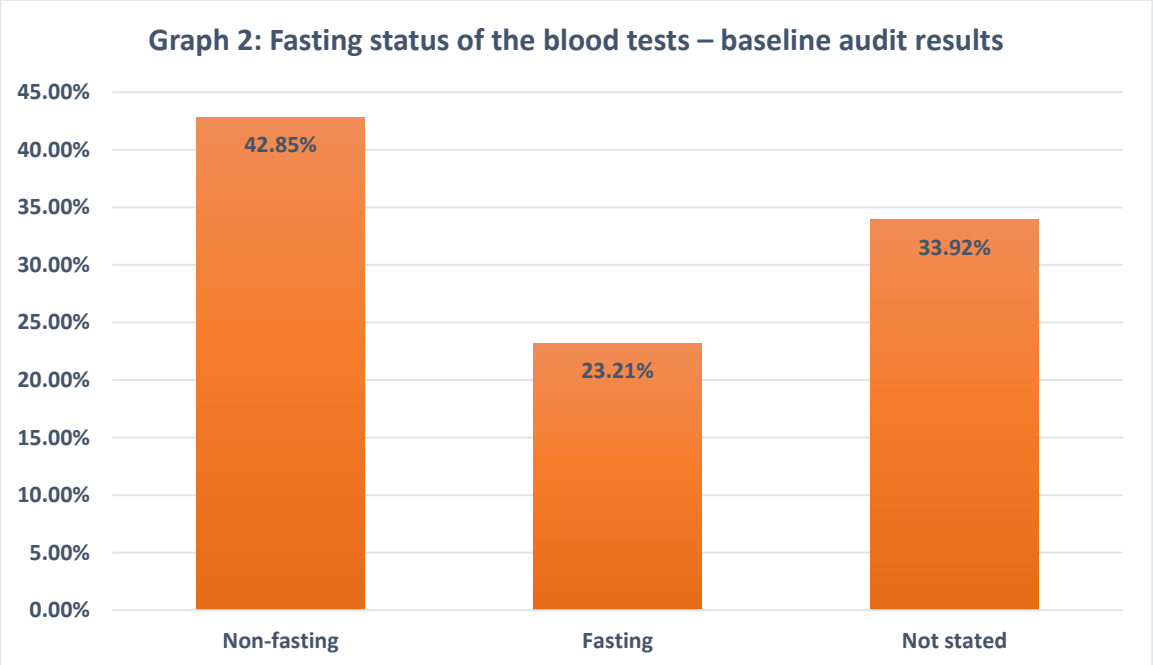
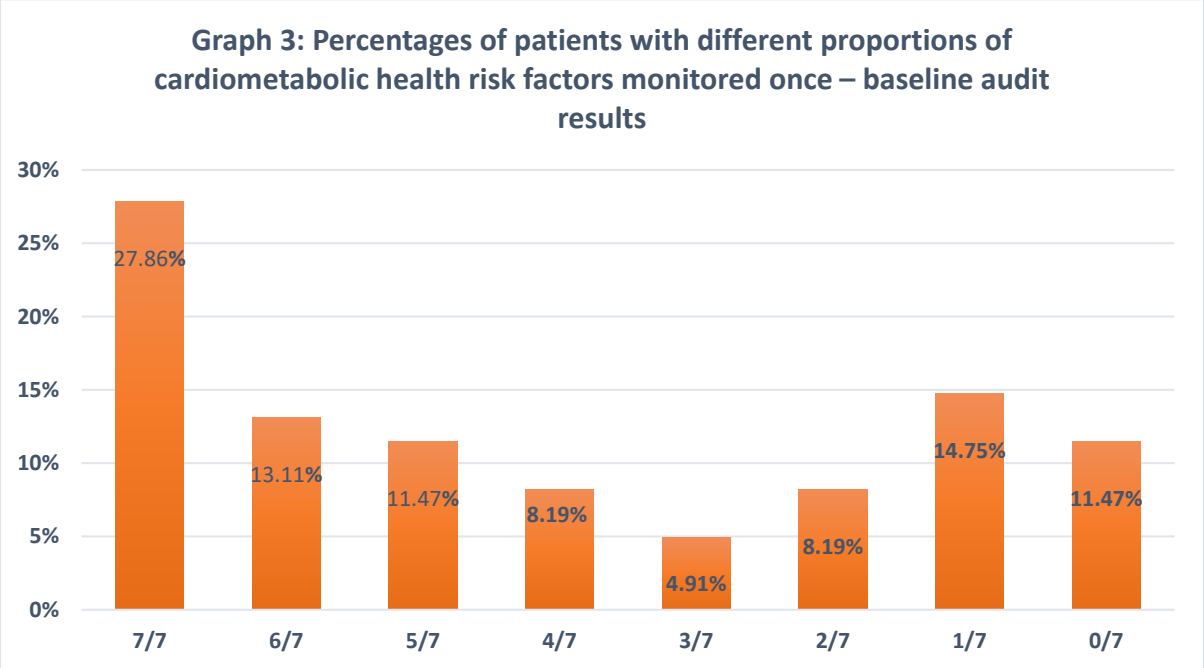

Graph 2: Fasting status of the blood tests – baseline audit results
45.00%
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
42.85%
23.21%
33.92%
Non-fasting
Fasting
Not stated

Table 12: Baseline audit results: numbers and percentages of patients with different proportions of cardiometabolic health risk factors monitored once in the audited period		
Parameters monitored	**Number of patients**	**Percentage**
0/7	7	11.47%
1/7	9	14.75%
2/7	5	8.19%
3/7	3	4.91%
4/7	5	8.19%
5/7	7	11.47%
6/7	8	13.11%
7/7	17	27.86%
Total	61	



Patients meeting all criteria

None of the patients had all cardiometabolic parameters monitored with required frequencies during their episode of care.

Action plan

Step 5 – Implement change

Presentation and discussion of results

The results were discussed with the author's scholarly project supervisor and in meetings held with the manager of the service, the service psychiatrist, a clinical nurse specialist and the quality improvement coordinator for the service portfolio. Barriers to regular cardiometabolic monitoring and possible solutions were discussed during the meetings, in addition to observations of work patterns. (Table 13).

The author presented the results to all staff at a multidisciplinary team meeting in an interactive setting. The presentation covered the cardiometabolic side effects of antipsychotic medication, the importance of monitoring, guideline recommendations, and the results of the audit. Barriers and possible solutions to improve the practice were discussed.

The full multidisciplinary team was chosen as the target audience to promote shared responsibility and to help break down possible barriers. Recommendations were made based on what was thought to be both effective and possible to implement.

Table 13: Potential barriers to cardiometabolic monitoring found at baseline audit		
Patient factors	**Clinician/team factors**	**System factors**
➢ Compliance ➢ Needle fear ➢ Education ➢ Patient refusal ➢ Lack of motivation or negative attitude towards monitoring ➢ Acutely unwell ➢ Cognitive, negative or disorganised symptoms ➢ Transportation	➢ Education ➢ Memory ➢ Role confusion regarding responsibility ➢ Laboratory forms availability ➢ Perceived extra workload ➢ Some of the measurements can be only performed by nurses e.g. blood pressure	➢ No guidelines when and what to screen ➢ No prompts or reminders to ensure monitoring takes place at appropriate times ➢ Lack of resources: lack of staff, vacant positions, competing demands, etc. ➢ Lack of a central location on the electronic system for metabolic monitoring information e.g. a metabolic monitoring electronic form

<u>Action plan recommendations</u>

- Cardiometabolic parameters and frequencies for monitoring to be disseminated to all staff. The criteria set were identical to the audit criteria.
- Nurses to register with the laboratory services so that they can write blood test forms without requiring a doctor's stamp.
- Psychoeducation to patients, families and carers on the cardiometabolic side effects of antipsychotics and the importance of cardiometabolic monitoring. Weekly recovery groups held by the service for the patients to be used as an opportunity for psychoeducation.
- Designated nurse time every week for cardiometabolic monitoring.

- Case managers to use the alerts/reminders function on Mnotes to set up a cardiometabolic monitoring schedule.
- A cardiometabolic monitoring form designed to keep track of monitoring parameters and intervals (Appendix III). Use of the form was not mandatory to start with; to be considered mandatory if found of value.
- Every team member to take responsibility for cardiometabolic monitoring, including doctors and case managers.
- Social workers or occupational therapists to take more responsibility in monitoring parameters they are approved to perform e.g. height, weight and waist circumference.

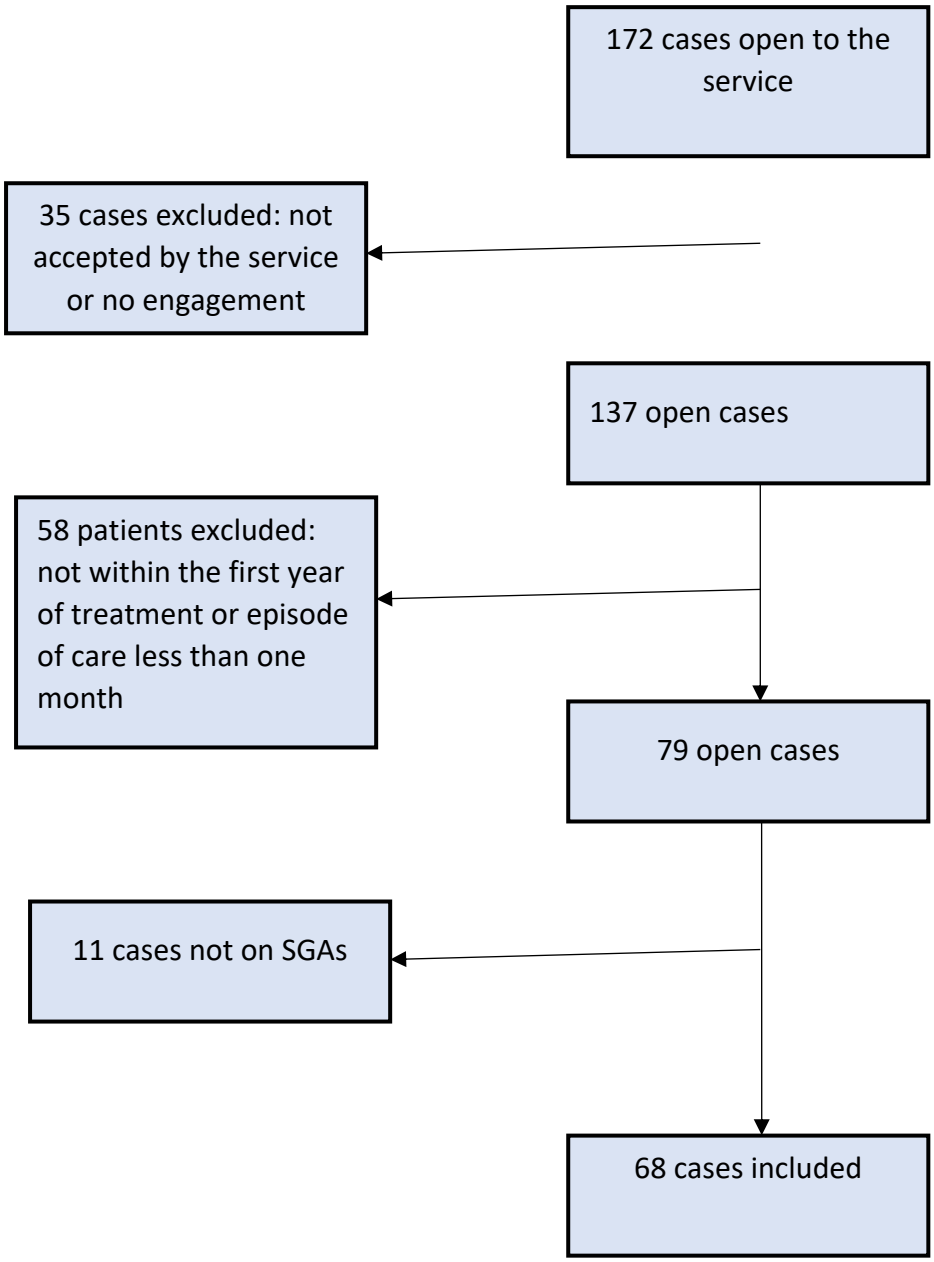
Re-audit

Data extraction, protection, inclusion/exclusion criteria and data collection

At 8 months following the initial implementation of the action plan, a re-audit was completed. This time period was chosen for practical reasons given time constraints.

The same data extraction, protection, inclusion/exclusion criteria and collection methods as for the baseline audit were used, with the following exception: patients already within their first year of treatment were included to increase the sample size to approximately that of the baseline, while still being mindful of the importance of monitoring within the first year of treatment.

Diagram 3: Re-audit exclusion tree



Demographics

The mean age of patients was 19.42 (median = 19.5; range = 15–24). The largest ethnicity group in the re-audit sample was New Zealand European (36.76%), followed by Maori (22.05%), who were still over-represented considering population size. The data suggest that the populations at the two points in time did not vary significantly. (Table 14).

Table 14: Patient demographics at re-audit compared with baseline					
		Re-audit		Baseline	
		Number	Percentage	Number	Percentage
Gender	Male	49	72.06%	43	70.49%
	Female	19	27.94%	18	29.51%
Ethnicity	New Zealand Maori	15	22.05%	21	34.42%
	New Zealand European	25	36.76%	20	32.78%
	Other European	3	4.41%	7	11.47%
	Asian	9	13.23%	6	9.83%
	Pacific Island	11	16.17%	4	6.55%
	Middle Eastern	1	1.47%	2	3.27%
	Indian	0	0%	1	1.63%
	African	1	1.47%	0	0%
	Not stated	3	4.41%	0	0%
Primary diagnosis	Psychotic disorder NOS	58	85.29%	49	80.32%
	Schizophrenia	5	7.35%	5	8.19%
	Schizophreniform disorder	1	1.47%	3	4.91%
	Bipolar affective disorder type I	1	1.47%	2	3.27%
	Schizoaffective disorder	0	0%	1	1.63%
	Major depressive disorder severe, with psychotic features	2	2.94%	1	1.63%
	Brief psychotic episode	1	1.47%	0	0%

Results: comparison with the baseline audit

An improvement from the baseline audit was observed in the overall monitoring performance at re-audit, in all criteria. However, results were still below the audit standard (Graphs 4 & 5).

Height monitoring improved the most and reached the standard: from 60.65% at baseline to 91.17% at re-audit; this was followed by blood pressure (from 31.81% to 59.18%) and BMI (34.84% to 61.90%).

There was also an upward trend for the weight monitoring rate, from 40.40% at baseline to 63.26%, and waist circumference (15.15% to 40.81%). However, it remained at the lowest rate of all parameters monitored.

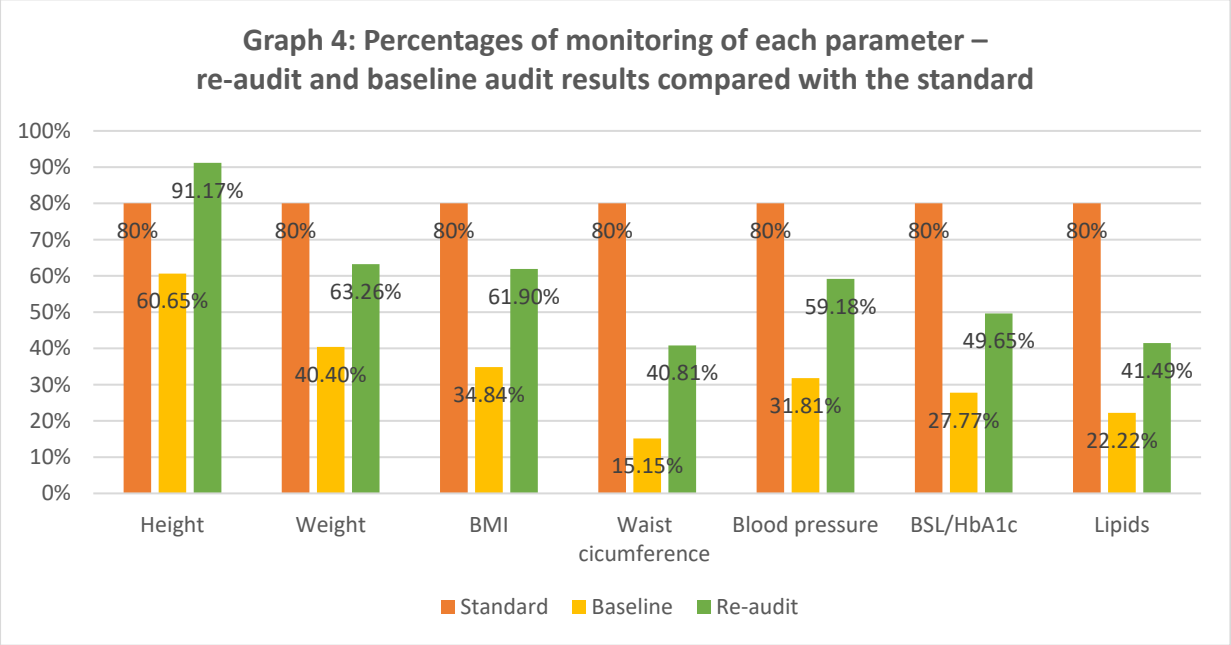
Improvements were also noted in the rate of laboratory monitoring: plasma glucose and HbA1c improved from 27.77% at baseline to 49.65%; plasma lipids from 22.22% to 41.49%; and fasting status from 23.21% to 32.50% (Graph 5). Laboratory monitoring rates remained better only than those of waist circumference.

In total, 29 (42.64%) patients had all the cardiometabolic parameters measured at least once at some point during the period audited, an improvement from 17 (27.86%) at baseline (Table 15, Graph 6).

Except for height, none of the monitoring parameters met the audit standard of 80% compliance with the criteria.

Patients meeting all criteria

Of the 68 cases included in the re-audit, 8 patients (11.76%) had all cardiometabolic parameters monitored at the intended frequencies during their episode of care. This was an improvement from baseline (0%).



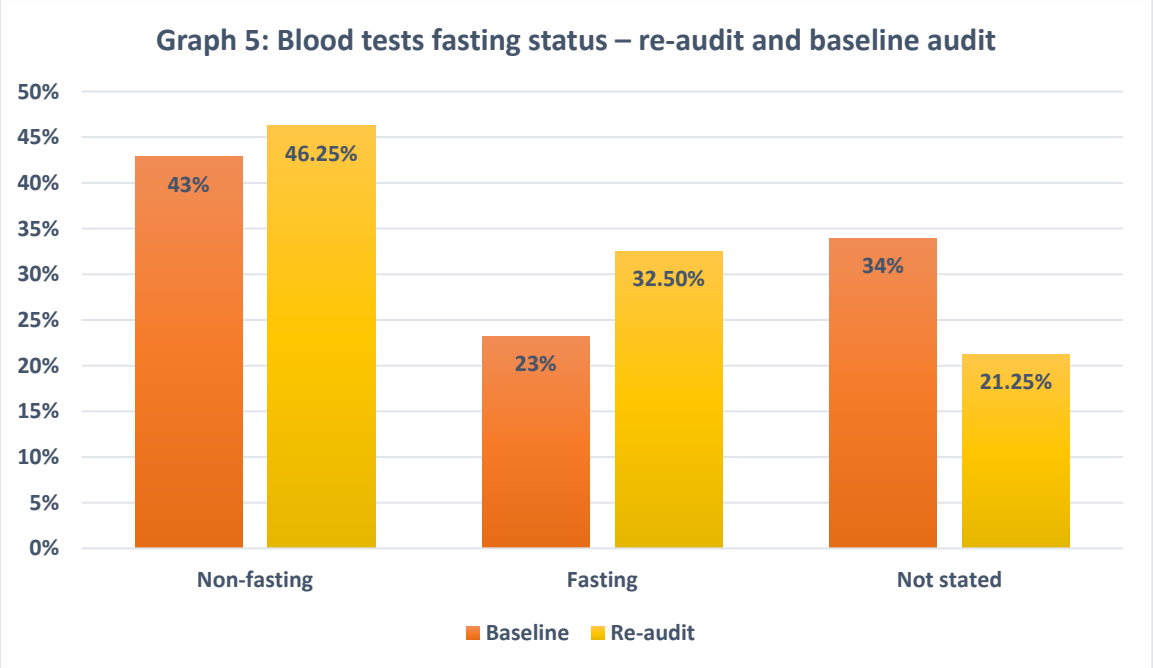
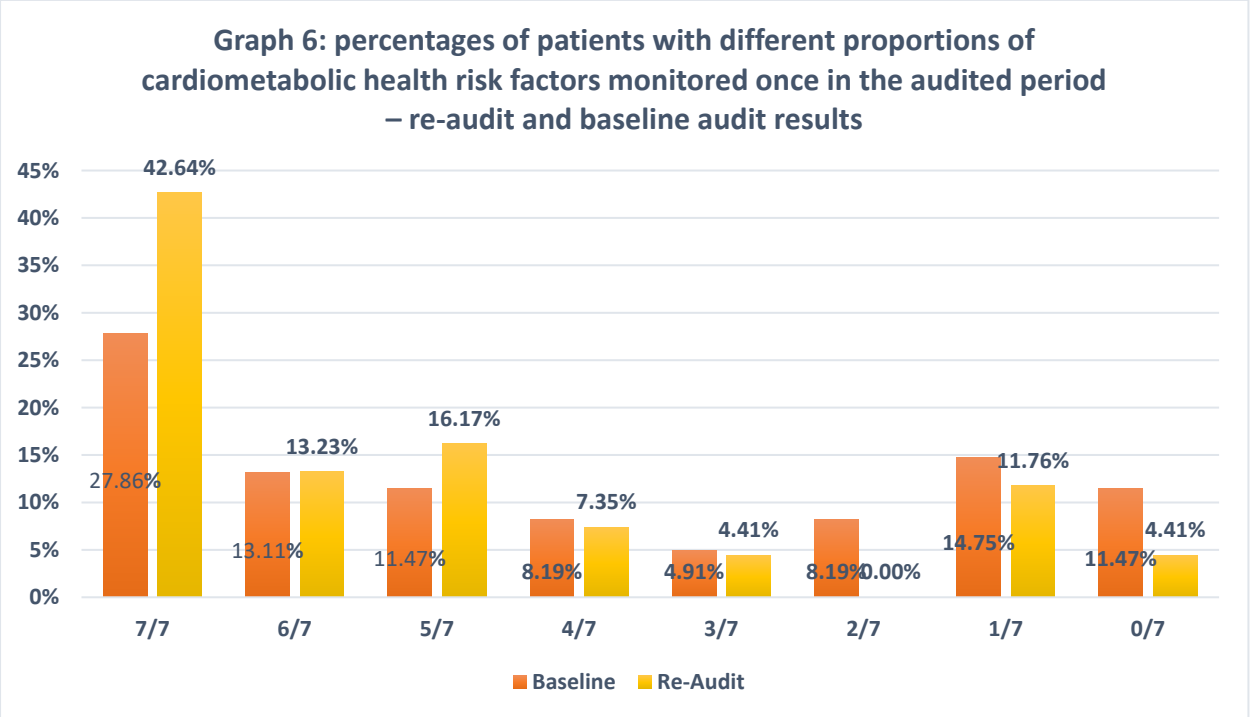


Table 15: Re-audit comparison with baseline audit: numbers and percentages of patients with different proportions of cardiometabolic health risk factors monitored once in the audited period				
	Re-audit		Baseline	
Parameters monitored	Number	Percentage	Number	Percentage
0/7	3	4.41%	7	11.47%
1/7	8	11.76%	9	14.75%
2/7	0	0%	5	8.19%
3/7	3	4.41%	3	4.91%
4/7	5	7.35%	5	8.19%
5/7	11	16.17%	7	11.47%
6/7	9	13.23%	8	13.11%
7/7	29	42.64%	17	27.86%
Total	68		61	



Feedback from case managers for the re-audit period

- Two case managers had left the service and eight case managers were contacted to provide feedback.
- Two did not respond.
- Overall feedback was that the presentation was a good reminder of the importance of cardiometabolic monitoring.
- Case manager vacant positions were filled, allowing increased clinician time and nurses' availability for monitoring.
- Two case managers reported initially using the form for keeping track of the monitoring. Some reported that they would have preferred the form was mandatory with a reminder functionality.
- The team reported using a wall poster version of the form as a reminder of monitoring recommendations.
- The reminder functionality on Mnotes was not used.
- Social workers and occupational therapists contributed by measuring parameters they are approved to perform.

Discussion

The primary aims of this audit cycle were to assess an important clinical issue, the current practice of cardiometabolic monitoring for FEP patients treated with SGAs within the PIE service at CDHB; and to improve on any identified deficits.

The baseline audit results demonstrated low rates of cardiometabolic monitoring in a FEP population treated with SGAs. Existing literature on cardiometabolic monitoring practice in FEP revealed similar overall poor adherence to criteria and guidelines. Cardiometabolic monitoring for those treated with SGAs is indicated due to the various cardiometabolic side effects. These tend to be more pronounced in younger populations like FEP patients, and are associated with avoidable mortality and morbidity.

The action plan attempted to improve cardiometabolic monitoring through multitargeted interventions including dissemination of the results, team education, facilitating blood testing, designating weekly time for metabolic monitoring, a pilot trial of a cardiometabolic monitoring form, recommended use of reminder functionality, and the involvement of, and taking on responsibility by, every team member in the process.

Compared with the baseline audit, the results of the re-audit showed an improvement of monitoring of all the parameters audited. However, except for the height parameter, the audit standard of 80% was still not met. This achievement is limited by the fact that a single measurement was acceptable. The rate of monitoring of the waist circumference was the lowest at baseline and re-audit, followed by the laboratory monitoring rates. This was not unexpected, as both were reported low in previous audits [74,76,78,86,88,93]. The low monitoring rate of the former can be due to the patient's or health provider's fear of physical contact, or the mental state of the patient may not allow such contact, for example due to persecutory delusions. Contributors to the low rates of laboratory monitoring may include the cost of transportation, mental state or fear of needles. Cost of laboratory monitoring was not a limitation as it is subsidised in New Zealand. Overall, 11.76% of the patients had all cardiometabolic parameters monitored at the expected frequency. This was an

improvement, as none had met the criteria at baseline. Further improvement was demonstrated, as 42.64% of the patients had all the cardiometabolic parameters measured at least once at some point during the re-audit, compared with 27.86% at baseline. However, practice is still far from consistent with the guidelines' recommendations, or the less stringent audit criteria. Parameter measures varied in this audit, in terms of which did and did not improve as considerably as reported by other audits performed in FEP populations.

Given the low baseline results, it was questionable whether the results of the re-audit would improve to meet the standard. According to a Cochrane systematic review [109], audit and feedback result in small improvements, with a median 4.3% absolute increase in desired practice. However, it also suggested that feedback may be more effective when: baseline performance is low; the provider of feedback is a colleague; feedback is delivered in verbal and written formats; or when explicit targets and an action plan are included. Additionally, according to another Cochrane systematic review[110], an interactive setting, where feedback is provided followed by a discussion, may further improve practice. In addition to change expected from the audit process and dissemination of the results, enabling nurses to write blood test forms meant less dependence on the doctors for the same and potentially contributed to the better outcome. Regular psychoeducation to patients, families and carers, including the weekly recovery group, plausibly reduced patient-related barriers to blood testing. The designated nurses' time for metabolic monitoring and the involvement of social workers and occupational therapists in the process may also have contributed to the positive result. According to the feedback from case managers, the cardiometabolic monitoring form accounted for some improvement directly, or indirectly as a wall poster and as a reminder of recommendations. Previous audits[76,78,84,86] used a metabolic

monitoring form with variable success at improving practice. It is, however, possible that the observed improvement in monitoring was not entirely caused by the interventions, but may have been due to confounding factors, e.g. vacant positions within the service filled during the re-audit period. Also, team members may have been more aware of their practice during the audit process, thus contributing to more frequent monitoring, i.e. the Hawthorne effect. Some of the strategies employed that contributed to the improvement are clinician-related and may not be sustained, given the change in clinicians over time, unless regular education and feedback continue and there is an enthusiastic group of clinicians supporting change.

The audit did not review the extent to which the potential barriers to cardiometabolic monitoring (Table 13) may have limited adherence to audit criteria.

Strengths of the audit

The audit, including the interventions devised, was easy to implement and cost-effective. The potential benefits to service users are substantial. The standardised data collection process by a single auditor helped ensure consistency both within and between baseline and re-audit. The audit involved a range of clinicians of the multidisciplinary team, reflecting everyday clinical practice. A full audit cycle was completed, including audit, intervention and re-audit. Notes for any patients with no extracted data available electronically were reviewed manually to ensure accuracy.

Limitations of the audit

A patient's refusal or non-adherence is not recorded and this may have contributed to the low reporting of some parameters. Blood testing performed outside of the CDHB was not available for inclusion in the electronic data extracted. A single height measurement was acceptable, a limitation given that some of the patients were still at an age where they were developing physically.

It is unlikely that the 8-month time period of the re-audit, in comparison to 12-months, had an impact on the integrity of the results as the rate of monitoring of each parameter was calculated in relation to the duration of treatment with antipsychotic medication. It might have caused the number of patients who had all the cardiometabolic parameters measured at least once during the period audited to be underestimated, as it is likely that this number would have increased if the re-audit period duration was 12 months.

Undocumented results, or results documented in places other than the designated section of the electronic notes, could not be captured. HbA1c evaluates longer-term control of blood glucose, while plasma glucose may provide a better estimate of glucose control early in the treatment. The PIE service may not resemble other services closely, and the rates reported may not resemble the rates of monitoring in other services. Finally, the literature review performed in this audit was limited to the available and accessible published resources. Unpublished audits and research were subsequently not included in the literature review.

Critique of methodology and analysis

Clinical audit is the preferred method to assess current practice against agreed criteria and implement changes to improve the practice to meet the standard[111].Therefore, an audit was an appropriate approach to meet the primary objectives of this project – to evaluate the current practice of cardiometabolic monitoring for patients under the PIE service and to improve practice where deficits were identified.

Analysis of results in a clinical audit is evaluated by basic statistical measures, where possible, and through use of easily interpretable data applicable to the service audited[112]. Thus, advanced statistical analyses were not utilised.

Contribution to the field

This audit adds to the existing literature by supporting the findings of other international audits. It showed low rates of cardiometabolic monitoring in FEP populations treated with SGAs and variable improvements following interventions. This is the first audit targeted at an FEP population in the CDHB. The literature review highlighted that there are no published local audits of cardiometabolic monitoring in New Zealand including FEP populations.

Future plans

The clinical audit cycle recommends repeated cycles until desired clinical change is established. The findings of the re-audit will be presented to the service. Another

supplementary audit at 12 months following the initial re-audit is planned to review progress and to assess whether measures put in place maintain the improvements. Changes to the standards, inclusion of previously excluded criteria and an audit of interventions will be considered. Information on cardiometabolic monitoring practices and their impact will be included in the orientation pack for new staff starting with the service. Formal incorporation of a mandatory cardiometabolic monitoring form with automatic reminders will be considered.

Conclusion

The audit showed an improvement of cardiometabolic monitoring practices at the PIE service within the CDHB following an execution of an action plan. The practice was still behind the guidelines' recommendations and requires further improvements, and the change needs to be maintained. Clinical audit has the potential to improve practice but it can take several cycles before a desired clinical change is established[113]. The action plan continues to be implemented, and future plans include a supplementary audit in 12 months' time.

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Appendix I: Summarisation and comparisons of various international guidelines

(Only cardiometabolic parameters are included in the following guidelines, e.g. monitoring of prolactin has been excluded)

Table i: Metabolic monitoring recommended by NICE, BAP and APA guidelines					
Parameter	**Baseline**	**Ongoing monitoring frequency**			
		NICE children 2013[a,63]	**NICE adults 2014[64]**	**BAP 2016[b,43]**	**APA 2004[66]**
Weight and BMI	✓	➢ Weekly for first 6 weeks ➢ At 12 weeks ➢ Every 6 months (plotted on a growth chart) (BMI not included)	➢ Weekly for first 6 weeks ➢ At 12 weeks ➢ At 1 year ➢ Annually (plotted on a chart) (BMI not included)	➢ Weekly for first 4–6 weeks ➢ Every 2–4 weeks up to 12 weeks[c] ➢ At 6 months ➢ Annually	➢ BMI every visit for 6 months ➢ Quarterly[d]
Height	✓	Every 6 months (plotted on a growth chart)	-	Needed for BMI	Needed for BMI
WC[e]	✓	Every 6 months (plotted on a percentile chart)	Annually (plotted on a chart)	-	-
BP	✓	➢ At 12 weeks ➢ Every 6 months (plotted on a percentile chart)	➢ At 12 weeks ➢ At 1 year ➢ Annually	➢ At 12 weeks ➢ At 6 months ➢ Annually	➢ As clinically indicated, especially during titration
FPG/HbA1c	✓	➢ At 12 weeks ➢ Every 6 months	➢ At 12 weeks ➢ At 1 year ➢ Annually	➢ At 12 weeks ➢ At 6 months ➢ Annually	➢ At 4 months ➢ Annually

Lipid profile	✓	➢ At 12 weeks ➢ Every 6 months	➢ At 12 weeks ➢ At 1 year ➢ Annually	➢ At 12 weeks ➢ At 6 months ➢ Annually	➢ Every 5 years

[a] Additionally, the guidelines recommend monitoring nutritional status, diet and level of physical activity at baseline and regularly especially during titration

[b] Additionally, the guidelines recommend to enquire about tobacco smoking and alcohol use at baseline and at all opportunities are also included in the guidelines

[c] As a minimum, once every 4 weeks for first 12 weeks

[d] Except for patients with a BMI of <18.5, an increase of 1 BMI unit would suggest a need for intervention by monitoring weight more closely

[e] Waist circumference is not included as a parameter for BAP and APA guidelines

NICE = National Institute for Health and Care Excellence, BAP = British Association for Psychopharmacology, APA = American Psychiatric Association, WC = waist circumference, BP = blood pressure, FPG = fasting plasma glucose, HbA1c = glycosylated haemoglobin

Table ii: Metabolic monitoring for patients on SGAs recommended in the American Diabetes Association and APA consensus statement 2004[67]

Parameter	Baseline	4 weeks	8 weeks	12 weeks	Quarterly	Annually	Every 5 years
Personal/family history	✓					✓	
Weight (BMI)	✓	✓	✓	✓	✓		
Waist circumference	✓					✓	
Blood pressure	✓			✓		✓	
Fasting plasma glucose	✓			✓		✓	
Fasting lipid profile	✓			✓			✓

Table iii: Cardiometabolic monitoring recommended by Maudsley 2018[65]			
Parameter	**Baseline**	**Ongoing monitoring**	**Clozapine and olanzapine**
Blood lipids (cholesterol, triglycerides)[a]	✓	➢ At 3 months ➢ Annually	➢ 3-monthly for first year ➢ Annually
Weight[b]	✓	➢ Weekly for the first 3 months at least ➢ Annually	➢ Frequently for 3 months ➢ 3-monthly for first year ➢ Annually
BMI and waist circumference	✓	➢ Every 6 months	-
Plasma glucose[a,c]	✓	➢ At 4–6 months ➢ Annually	➢ 1 month[d] ➢ 4–6 monthly ➢ Annually
Blood pressure	✓	➢ Frequently during dose titration	-

[a] Fasting sample, if possible

[b] Include waist circumference and BMI, if possible

[c] Random sample or HbA1c are acceptable

[d] Also, if using chlorpromazine or if other risk factors present

Maudsley = The Maudsley prescribing guidelines in psychiatry

Table iv: Comparison of the positive cardiometabolic health algorithm (adolescent version)[114] and the Lester Positive Cardiometabolic Health Resource[70] recommendations						
Parameter	**Baseline**	**1–2 weekly (first 6–8 weeks)**	**3 months**	**6 months[a]**	**9 months[a]**	**12 months**
Personal/family history[b]	✓					✓
Smoking, diet and physical activity review	✓	✓	✓	✓	✓	✓
Weight	✓	✓	✓	✓	✓	✓
Height (BMI)[a]	✓					
Waist circumference	✓			✓	✓	✓
Blood pressure	✓			✓		✓
FPG/RPG/HbA1c	✓			✓		✓
Lipid profile	✓			✓		✓
Vitamin D[a]	✓			✓		✓

[a] Parameters and frequencies included only in the positive cardiometabolic health algorithm adolescent version and not included in the adult version

[b] Substantial or rapid weight gain, polycystic ovary syndrome and gestational diabetes. Family history (diabetes, obesity, CVD in first degree <55 years male relatives and <65 years female relatives)
FPG = fasting plasma glucose, RPG = random plasma glucose

Table v: An example of the Canadian Alliance for Monitoring Effectiveness and Safety of Antipsychotics in Children (CAMESA) recommendations for monitoring of metabolic side effects in children 2011: olanzapine[115]							
Parameter	**Baseline**	**1 month**	**2 months**	**3 months**	**6 months**	**9 months**	**12 months**
Height and height percentile	✓	✓	✓	✓	✓	✓	✓
Weight and weight percentile	✓	✓	✓	✓	✓	✓	✓
BMI and BMI percentile	✓	✓	✓	✓	✓	✓	✓
Waist circumference and waist circumference percentile	✓	✓	✓	✓	✓	✓	✓
Systolic and diastolic blood pressures and their percentiles	✓	✓	✓	✓	✓	✓	✓
Fasting plasma glucose	✓			✓	✓		✓
Fasting insulin	✓			✓	✓		✓
Fasting cholesterol[a]	✓			✓	✓		✓
Fasting LDL[a]	✓			✓	✓		✓
Fasting HDL[a]	✓			✓	✓		✓
Fasting triglycerides[a]	✓			✓	✓		✓

[a] If 6-month screening laboratory tests are normal, the BMI has remained under the 85th percentile and the waist circumference has remained under the 90th percentile, repetition of lab work for cholesterol, LDL-C, HDL-C and triglycerides can be made on a yearly basis

Appendix II: International audits performed in non-FEP populations

Table vi: Comparison of results of three international audits of cardiometabolic monitoring in patients with serious mental illness						
	Audits					
	Murtagh et al 2011[a,76]		**Barnes et al 2015[b,77]**		**O'Callaghan et al 2011[c,78]**	
	Baseline	Re-audit	Baseline (2006)	SUP (2012)	Baseline	Re-audit
Number of patients	255	241	1966	1591	64	64
Setting	Inpatient and outpatient		Outpatient		Outpatient	
Antipsychotic medication treatment	Not all cohort		Yes		Yes	
Frequency of monitoring audited	Once per 6 months		Once per year		Once per 3 months	
BP	69.8%	53.1%	26%	59%	4.7%	55.6%
Measures of obesity	0% (WC)	46.9% (WC)	17%	58%	1.6%(wt) 1.6%(WC)	61.1%(wt) 38.9%(WC)
PG or HbA1c	26.3% (FPG)	31.9% (FPG)	28%	52%	15.6% (FPG)	27.8%(FPG)
Lipids	21.6%	31.9%	22%	50%	12.5%(TG) 12.5% (HDL)	20.4%(TG) 24.1%(HDL)
Height	-	-	-	-	0%	41%
Form*	-	80.9%	-	-	-	-
All measures monitored			11%	34%	-	-

[a] A Physical Health Form was designed to provide a record for metabolic monitoring, measuring tapes, and laminated poster were also among the interventions

[b] Clinical audits were conducted in 2006 (baseline) and 2007 (re-audit), and supplementary audits were performed in 2008–2010 and 2012. Results of 2006 and 2012 are presented. Interventions included a 'lifestyle management pack' for staff and patients which provided information on physical health, and a physical health check reminder card

[c] Interventions included a checklist for components and risk factors of metabolic syndrome

SUP = supplementary audit, BP = blood pressure, PG = plasma glucose, FPG = fasting plasma glucose, HDL = high density lipoprotein, TG = triglycerides, LDL = low density lipoprotein, WC = waist circumference, wt = weight, Measures of obesity = waist circumference, BMI, weight or not specified

Table vii: Cotes et al 2015[a,79] audit of cardiometabolic monitoring in outpatients treated with antipsychotic medications						
Patient records audited Adults/children	**Frequency audited**	**Parameters audited**	**Baseline audit results**		**Re-audit results**	
			Adults	**Children**	**Adults**	**Children**
Baseline = 193/37 Re-audit = 203/62	Once per year	**Glucose**	45%	19%	43%	23%
		Triglycerides	32%	14%	37%	19%
		Cholesterol	32%	14%	37%	19%
		Weight	52%	68%	65%	71%
		Blood pressure	33%	35%	38%	44%
		Waist circumference	7%	0%	7%	0%

[a] Interventions included education on improving monitoring, summaries of antipsychotic prescribing and monitoring practices, describing the audit, its goals and its recommendations, as well as antipsychotic prescribing and side effect monitoring

Table viii: Further comparison of results of several international audits of cardiometabolic monitoring in patients with serious mental illness					
	Audits				
	Coyle et al 2011[80]	**Organ et al 2010[81]**	**Hardy et al 2014[a,82]**		**Khatana et al 2011[83]**
			Pre-intervention	Post-intervention	
Number of patients	21	618	400	400	1401
Setting	Inpatient	Inpatient and outpatient	Outpatient		Outpatient (military veterans)
Antipsychotic medication treatment	Not all cohort	Not all cohort	Yes		Not all cohort
Frequency of monitoring audited	Once per 6 months	➢ Baseline ➢ 3 months ➢ 6-monthly (over last 12 months)	Once a year		Once
BP	100 %	44 %	61%	75%	98.4%
WC	61.9%	7%	-	-	-
Measures of obesity	-	54%(wt)	47%(BMI)	55%(BMI)	96.7%(BMI)
Plasma glucose or HbA1c	47.6% (FPG)	60%(PG)	31%(PG)	45%(PG)	91.9%(PG) 46.3%(HbA1c)
Lipids	47.6% (fasting)	63% (cholesterol)	36%(cholesterol)	44% (cholesterol)	81.2%(HDL) 79.4%(TG) 82.1% (cholesterol) 73.1%(LDL)
All parameters	28.6%	-	20%	23%	99.1%

[a] Intervention included training of practice nurses to provide them with a better understanding the increased risk of cardiovascular disease in patients with serious mental illness, and confidence in performing physical health checks

BP = blood pressure, WC = waist circumference, wt = weight, PG = plasma glucose, FPG = fasting plasma glucose, HDL = high density lipoprotein, TG = triglycerides, LDL = low density lipoprotein

Table ix: Further comparison of two international audits of laboratory cardiometabolic monitoring in patients treated with antipsychotic medications				
	Audits			
	Gonzalez et al 2010[a,84]		**DelMonte et al 2012[b,85]**	
	Pre-intervention	Post-intervention	Pre-intervention	Post-intervention
Number	126	106	171	157
Setting	Outpatient		Inpatient	
Frequency	Baseline and every 6 months		Once[c]	
Plasma glucose or HbA1c	Baseline: 24.6%(PG) 3.2%(HbA1c) 6 months: 19.8%(PG) 3.2%(HbA1c)	Baseline:72.6%(PG) 5.7%(HbA1c) 6 months: 47.2%(PG) 5.7%(HbA1c)	RPG: 92.4% FPG: 46.8%	RPG: 100% FPG: 70%
Lipids	Baseline: 7.1% 6 months: 9.5%	Baseline: 52.8% 6 months: 34%	RPG: 28.7% FPG: 18.7%	RPG: 74.5% FPG: 59.9%

[a] Intervention included presentation of bassline audit results, meetings with psychiatrists and education of junior doctors. Also, local guidelines were developed, and a monitoring tool was employed. This tool was a physical monitoring page to be filed in the patients' files as a prompt for the physical monitoring

[b] Intervention was a pop-up alert designed to remind the prescriber of an SGA of laboratory metabolic monitoring of patients

[c] Within the previous 12 weeks of an SGA treatment start or prior to discharge from psychiatric inpatient unit

PG= plasma glucose, FPG = fasting plasma glucose, HDL = high density lipoprotein, TG = triglycerides, LDL = low density lipoprotein

Table x: Wiechers et al 2012[a,86] audit of cardiometabolic monitoring in a cohort of outpatients treated with antipsychotic medications				
Number of patient records audited	**Frequency audited**	**Parameters audited**	**Baseline audit results**	**Re-audit results**
206 patients with variable durations of treatment within the year audited	Once over last 12 months	**BMI**	5%	44%
		BP	4%	39%
		FPG	15%	55%
		Fasting lipid panel	14%	55%
90 patients treated by an antipsychotic medication for the duration of the year audit period	Once over last 12 months	**BMI**	7%	49%
		BP	4%	43%
		FPG	17%	59%
		Fasting lipid panel	18%	62%
		All criteria measured	1%	31%

[a] Intervention included input from junior doctors' focus groups, education and the creation of a Metabolic Screening template as part of the psychiatry progress notes

Table xi: Kioko et al 2016[87]audit of cardiometabolic monitoring in a cohort of outpatients treated with antipsychotic medications		
	Pre-intervention	**Post-intervention**
Number of patients	50	50
Weight, height and blood pressure	76.0%	82.0%
FPG or HbA1c and lipid panel	22.0%	62.0%

FPG = fasting plasma glucose

Table xii: Happell et al 2016[88] audit of cardiometabolic monitoring and use of metabolic monitoring form in inpatients and outpatients with serious mental illness			
Number of patients	**Percentage of patients with electronic form filled**	**Parameters**	**Percentage of parameters included in the filled forms only**
721	36%	**Height**	85.4%
		Weight	87.4%
		BMI	73.6%
		WC	54.4%
		BP	83.5%
		FPG	60.2%
		Cholesterol	56.3%
		LDL	48.7%
		HDL	51.7%
		TG	55.2%

WC = waist circumference, BP = blood pressure, PG = plasma glucose, FPG = fasting plasma glucose, LDL = low density lipoprotein, HDL = high density lipoprotein, TG = triglycerides

Table xiii: Wilson et al 2014[a,89] audit of cardiometabolic monitoring of a cohort of patients on clozapine			
	Baseline	**Post-intervention T1**	**Post-intervention T2**
Number	107	224	232
Weight	48.6%	96.8%	88.7%
WC	Not assessed	91.0%	94.0%
TG	Not assessed	92.3%	94.7%
HDL	Not assessed	92.3%	97.4%
Fasting lipids (either TG or HDL cholesterol recorded)	13.1	92.3%	97.4%
BP	15.9	94.8%	92.7%
FPG	13.1	89.7%	87.4%
All parameters	Not assessed	53.6%	50.9%
No monitoring data	Not assessed	30.8%	34.9%

[a] Designation of 2 months annually, steps to facilitate monitoring e.g. investigation order forms, written information to patients, necessary equipment and proforma
T1 = point in time 6 months following baseline, T2 = point in time 6 months following T1
WC = waist circumference, TG = triglycerides, HDL = high density lipoprotein, BP = blood pressure, FPG = fasting plasma glucose

Table xiv: Cotes et al 2017[a,90] audit of cardiometabolic of children on antipsychotic medications		
	Pre-intervention	**Post-intervention**
Number	37	145
Frequency	Once over 12 months	
BP	35.1%	49%
Waist	0%	28%
Weight/BMI	67.6%	84.1%
Glucose	18.9%	42.1%
Lipids	13.5 %(TG) 13.5%(cholesterol)	31%(TG) 33.1%(cholesterol)

[a] Intervention included education for prescribers, auditing metabolic monitoring, and feedback to teams regarding their monitoring
BP = blood pressure, TG = triglycerides

Table xv: Ronsley et al 2012[a,91] audit of cardiometabolic of children on antipsychotic medications						
	Baseline		**3 months**		**6 months**	
	Pre-intervention	**Post-intervention**	**Pre-intervention**	**Post-intervention**	**Pre-intervention**	**Post-intervention**
Number Pre = 1114 Post = 1262						
Weight	18.1%	51.9%	12.8%	33%	12.5%	31.4%
Height	13.5%	43.2%	6%	25%	6.3%	26.7%
WC	2.3%	21%	0.7%	11.4%	0%	9.3%
BP	9.4%	33.3%	4.7%	19.3%	3.1%	19.8%
FPG	13.5%	49.4%	8.1%	19.3%	7%	19.8%
Cholesterol	11.7%	49.4%	6%	17%	6.3%	19.8%
TG	11.7%	44.4%	6%	17%	5.5%	18.6%
LDL or HDL	9.9 %	43.2%	5.4%	14.8%[b]	4.7%	18.6%

[a] Intervention included 'Metabolic Monitoring Training Program Implementation' (MMTP) which included the MMT, a physician handbook for metabolic monitoring and training workshops for all staff
[b] Differences between pre- and post- did not reach statistical significance
WC = waist circumference, BP = blood pressure, FPG = Fasting plasma glucose, TG = triglycerides, LDL = low density lipoprotein, HDL = high density lipoprotein

Table xvi: Comparing findings of three national audits of cardiometabolic monitoring of patients with psychosis[a] in the UK RCPsych 2018[92]					
Number of patient records audited	**Frequency audited**	**Parameters audited**	**NAS1**	**NAS2**	**NCAP**
NAS1 = 4805 NAS2 = 5396 NCAP =7773	Once per year	**Monitoring of smoking**	87%	89%	86%
		BMI/weight	48%	52%	65%
		Glucose control	50%	57%	59%
		Lipids	48%	58%	57%
		Blood pressure	57%	62%	66%
		All parameters monitored	27%	34%	42%

[a] Patients with first episode psychosis were excluded

RCPsych = The Royal College of Psychiatrists, NAS1 = National Audit of Schizophrenia, published 2012, NAS2 = National Audit of Schizophrenia, published 2014, NCAP = National Clinical Audit of Psychosis, published 2018

Appendix III: Form designed by author for cardiometabolic monitoring

Name:

National identification number:

Parameter	Baseline	1 month	3 months	6 months	9 months	12 months
Blood pressure	☐	☐	☐	☐	☐	☐
Weight	☐	☐	☐	☐	☐	☐
Height	☐	☐	☐	☐	☐	☐
Waist	☐	☐	☐	☐	☐	☐
Fasting glucose/Hba1c	☐	☐	☐	☐	☐	☐
Fasting lipids	☐	☐	☐	☐	☐	☐