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Getting evidence to and from general practice consultations for cardiovascular risk management using computerised decision support

Linda Susan Mary Wells

Abstract

Background

Cardiovascular disease (CVD) has an enormous impact on the lives and health of New Zealanders. There is substantial epidemiological evidence that supports identifying people at high risk of CVD and treating them with lifestyle and drug-based interventions. If fully implemented, this targeted high risk approach could reduce future CVD events by over 50%. Recent studies have shown that a formal CVD risk assessment to the systematically identify high risk patients is rarely done in routine New Zealand general practice and audits of CVD risk management have shown large evidence-practice gaps. The CVD risk prediction score recommended by New Zealand guidelines for identifying high CVD risk patients was derived from the US Framingham Heart Study using data collected between the 1960s and 1980s. This score has only modest prediction accuracy and there are particular concerns about its validity for New Zealand sub-populations such as high risk ethnic groups or people with diabetes.

Aims

The overall aims of this thesis were to investigate the potential of a computerised decision support system (CDSS) to improve the assessment and management of CVD risk in New Zealand general practice while simultaneously developing a sustainable cohort study that could be used for validating and improving CVD risk prediction scores and related research.

Methods

An environmental scan of the New Zealand health care setting’s readiness to support a CDSS was conducted. The epidemiological evidence was reviewed to assess the effect of decision support systems on the quality of health care and the types and functionality of systems most likely to be successful. This was followed by a focused systematic
review of randomised trials evaluating the impact of CDSS on CVD risk assessment and management practices and patient CVD outcomes in primary care.

A web-based CDSS (PREDICT) was collaboratively developed. This rules-based provider-initiated system with audit and feedback and referral functionalities was fully integrated with general practice electronic medical records in a number of primary health organisations (PHOs). The evidence-based content was derived from national CVD and diabetes guidelines. When clinicians used PREDICT at the time of a consultation, treatment recommendations tailored to the patient’s CVD and diabetes risk profile were delivered to support decision-making within seconds. Simultaneously, the patient’s CVD risk profiles were securely stored on a central server. With PHO permission, anonymised patient data were linked via encrypted patient National Health Index numbers to national death and hospitalisation data. Three analytical studies using these data are described in this thesis. The first evaluated changes in GP risk assessment practice following implementation of PREDICT; the second investigated patterns of use of the CDSS by GPs and practice nurses; and the third describes the emerging PREDICT cohort and a preliminary validation of risk prediction scores.

Results

Given the rapid development of organised primary care since the 1990’s, the high degree of general practice computerisation and the New Zealand policy (health, informatics, privacy) environment, the introduction of a CDSS into the primary care setting was deemed feasible. The evidence for the impact of CDSS in general has been moderately favourable in terms of improving desired practice. Of the randomised trials of CDSS for assessing or managing CVD risk, about two-thirds reported improvements in provider processes and two-fifths reported some improvements in intermediate patient outcomes. No adverse effects were reported.

Since 2002, the PREDICT CDSS has been implemented progressively in PHOs within Northland and the three Auckland regional District Health Board catchments, covering a population of 1.5 million. A before-after audit conducted in three large PHOs showed that
CVD risk documentation increased four fold after the implementation of PREDICT. To date, the PREDICT dataset includes around 63,000 risk assessments conducted on a cohort of over 48,000 people by over 1000 general practitioners and practice nurses. This cohort has been followed from baseline for a median of 2.12 years. During that time 2655 people died or were hospitalised with a CVD event. Analyses showed that the original Framingham risk score was reasonably well calibrated overall but underestimated risk in high risk ethnic groups. Discrimination was only modest (AUC 0.701). An adjusted Framingham score, recommended by the New Zealand Guideline Group (NZGG) overestimated 5-year event rates by around 4-7%, in effect lowering the threshold for drug therapy to about 10% 5-year predicted CVD risk. The NZGG adjusted score (AUC 0.676) was less discriminating than the Framingham score and over-adjusted for high risk ethnic groups. For the cohort aged 30-74 years, the NZGG-recommended CVD risk management strategy identified almost half of the population as eligible for lifestyle management +/- drug therapy and this group generated 82% of all CVD events. In contrast the original Framingham score classified less than one-third of the cohort as eligible for individualised management and this group generated 71% of the events that occurred during follow-up.

Implications

This research project has demonstrated that a CDSS tool can be successfully implemented on a large scale in New Zealand general practice. It has assisted practitioners to improve the assessment and management of CVD at the time of patient consultation. Simultaneously, PREDICT has cost-effectively generated one of the largest cohorts of Māori and non-Māori ever assembled in New Zealand. As the cohort grows, new CVD risk prediction scores will be able to be developed for many New Zealand sub-populations. It will also provide clinicians and policy makers with the information needed to determine the trade-offs between the resources required to manage increasing proportions of the populations and the likely impact of management on preventing CVD events.
Acknowledgements

Many people have been integral to this work. My special thanks to:

My supervisors, Prof Rod Jackson, Assoc Prof Roger Marshall, Prof Bruce Arroll for all their support and timely advice. I couldn’t have asked for better.

Prof Rod Jackson also had the vision to initiate the first electronic PREDICT prototype in the 1990s, he trusted me to build on what had been done and was with me all the way.

Dr Tania Riddell, my friend and HRC PREDICT co-principal investigator who has made this research and all our mahi a truly Māori/non-Māori partnership.

Dr Andrew Kerr, clinical mentor and co-investigator who for years has helped me to take guideline blanket statements and translate them into the excruciatingly tedious detail required by a machine to bring evidence to life for an individual.

Everyone at Enigma Publishing Ltd especially Mr Mark Buffey (PREDICT CVD) and Mr Chris Wiltshire (PREDICT CVD-Diabetes) my information technology partners. Together we combined clinical content, work flow and processes and turned them into machine-readable and stable functioning systems.

ProCare Health Ltd, our first primary health care organisation partners especially Paul Roseman, Kate Moodabe and Ken Leech. They and many other ProCare staff, doctors and nurses were integral to the design, development, sentinel site testing, implementation, safety monitoring and clinical programmes of care.

To each subsequent PHO that has worked with us, used the PREDICT tool, provided new insights and driven improvements. Thank you for participating in the research and sharing anonymised patient data from your clinical care.
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To Mrs Mildred Lee, HRC PREDICT research analyst and Mrs Elizabeth Robinson Biostatistician, who helped me battle through SAS statistical programming, Excel spread sheets, formulae and confidence intervals. And to Roger Marshall my biostatistical supervisor on sabbatical in Beijing who from thousands of miles away could immediately spot what was needed.

To my family— Gary, Chris, Michael and Robbie for so many things involved with having a PhD-writing wife and mother, for making the cupboard into a study and bringing me cups of tea.

Dedication

Every hour of every day in New Zealand, someone dies from or is admitted to hospital with cardiovascular disease. This thesis is dedicated to these people and their families.
# Table of Contents

ABSTRACT ....................................................................................................................... II

ACKNOWLEDGEMENTS ................................................................................................. V

TABLE OF CONTENTS .................................................................................................. VII

LIST OF TABLES ............................................................................................................ XII

LIST OF FIGURES ......................................................................................................... XV

LIST OF ABBREVIATIONS ............................................................................................ XX

1. INTRODUCTION ................................................................................................... 1

1.1 The burden of cardiovascular disease ............................................................... 1

1.2 The scope for CVD prevention .......................................................................... 2

1.3 The evidence — CVD risk factors, risk prediction & risk management strategies 4

1.4 The research gap and the evidence-practice gap ............................................... 5

1.4.1 CVD risk prediction research gap ................................................................. 6

1.4.2 CVD risk assessment and management evidence–practice gaps in New Zealand........ 8

1.4.3 A proposal to close the gaps .......................................................................... 9

1.5 This thesis ...........................................................................................................11

2. THE SETTING – FEATURES OF THE NEW ZEALAND HEALTH CARE
ENVIRONMENT RELEVANT TO CLINICAL DECISION SUPPORT SYSTEMS ........... 18

2.1 Introduction ......................................................................................................... 18

2.2 Historical context of present day New Zealand health care system ................. 19

2.2.1 Health reforms .............................................................................................. 20

2.3 National Health Care Strategies ....................................................................... 22

2.4 New Zealand primary health care workforce ................................................... 24

2.4.1 Implementation of the Primary Health Care Strategy .................................. 26

2.4.2 National chronic disease management initiatives ......................................... 27

2.5 Measuring quality improvement in primary health care .................................. 29

2.6 Primary care information systems .................................................................... 31

2.6.1 Development of GP information systems in New Zealand ......................... 32
2.7 Towards an electronic health record: linking with health care delivery services and national datasets........................................................................................................ 35
2.7.1 The National Health Index (NHI) number ................................................................. 37
2.7.2 The Health Provider Index (HPI) number ................................................................. 37
2.7.3 National data collections .......................................................................................... 38
2.7.4 Information sharing ................................................................................................. 39
2.7.5 Semantic interoperability ....................................................................................... 39
2.7.6 Clinical coding standards ....................................................................................... 41
2.7.7 Messaging standards .............................................................................................. 42
2.7.8 Health information privacy and security .................................................................. 43
2.8 Conclusion .................................................................................................................. 44
3 COMPUTERISED CLINICAL DECISION SUPPORT SYSTEMS: DEFINITION, TYPES, AND IMPACT ON HEALTH CARE OUTCOMES ........................................................................... 45
3.1 Introduction .................................................................................................................. 45
3.2 Definition of CDSS ...................................................................................................... 45
3.3 Types of CDSS ............................................................................................................ 47
3.3.1 Rules-based systems ............................................................................................... 47
3.3.2 Probabilistic systems ............................................................................................. 49
3.4 Evidence that the use of CDSS tools improves quality of health care ................ 50
3.5 Conclusion .................................................................................................................. 62
4 SYSTEMATIC REVIEW OF COMPUTERISED DECISION SUPPORT SYSTEMS FOR CVD RISK ASSESSMENT AND MANAGEMENT IN PRIMARY CARE ........................................................................ 64
4.1 Introduction .................................................................................................................. 64
4.2 Criteria for considering studies for this review ....................................................... 64
4.2.1 Types of participants .............................................................................................. 65
4.2.2 CDSS knowledge content and target medical conditions ...................................... 66
4.2.3 Types of outcome measures .................................................................................. 67
4.3 Search strategy and identification of studies ............................................................. 68
4.4 Methods of review ..................................................................................................... 72
4.4.1 Selection of studies and data extraction ................................................................. 72
4.5 Results of search ......................................................................................................... 75
4.5.1 Characteristics of excluded studies (n = 88) .......................................................... 76
4.5.2 Description of Included studies ............................................................................. 78
7.2 Methods for Sub-study ................................................................. 162
7.2.1 Study design ............................................................ 162
7.3 Results .................................................................................. 164
7.4 Discussion ............................................................................... 172

8 THE PREDICT COHORT STUDY: METHODS ...................................................... 176
8.1 Introduction ............................................................................. 176
8.2 Study design ........................................................................... 176
8.3 Study setting ........................................................................... 179
8.4 Eligible population for the PREDICT Cohort study .................... 182
  8.4.1 Study population ............................................................ 182
8.5 Recruitment of participants into the PREDICT cohort ................. 184
8.6 Exposure (risk factor) data and linkage to NZHIS ....................... 185
8.7 Accrual of person-time of follow-up ......................................... 187
8.8 Cohort study outcome measures ............................................. 187
8.9 Projected participant numbers in the PREDICT cohort ............... 188
8.10 Data management and analysis .............................................. 189
8.11 Statistical analysis ............................................................... 192
8.12 Conclusion ............................................................................. 196

9 RESULTS OF THE PREDICT COHORT STUDY .............................................. 197
9.1 Introduction ............................................................................. 197
  9.1.1 Overview ......................................................................... 197
9.2 Baseline characteristics of cohort ............................................. 201
  9.2.1 Demographic profile of patients and type of data template submitted ................................................................. 201
  9.2.2 Baseline profile by participant history and CVD risk characteristics ................................................................. 203
  9.2.3 NZGG guideline modifications to the Framingham CVD risk score ................................................................. 209
  9.2.4 Representativeness of the PREDICT cohort ......................... 213
  9.2.5 Drug management at baseline ............................................ 216
9.3 Follow-up time and CVD events .............................................. 218
  9.3.1 Follow-up time .................................................................. 218
  9.3.2 CVD events during follow-up ............................................ 219
  9.3.3 CVD events from baseline ................................................. 220
9.4 Incidence rates of first CVD events during follow-up ................. 224
  9.4.1 Incidence rates of first CVD events for participants with no prior CVD ................................................................. 225
9.4.2 Incidence rates of first CVD events during follow-up among participants with a prior history of CVD............................................................................................................................ 228
9.5 Performance of the Framingham equation: calibration ........................................ 231
9.6 Performance of the Framingham equation: discrimination............................... 245
  9.6.1 Threshold discrimination................................................................................... 248
9.8 Summary of key findings .................................................................................... 252

10 DISCUSSION: THE PREDICT COHORT STUDY ............................................. 256
  10.1 Introduction ........................................................................................................ 256
  10.1.1 Representativeness / Recruitment ................................................................. 256
  10.1.2 Allocation of participants to risk categories: measurement of exposures .... 260
  10.1.3 Length and completeness of follow-up.......................................................... 264
  10.1.4 Measurement of outcomes (blind or objective) .............................................. 265
  10.1.5 Study analyses ............................................................................................... 267

11 CONCLUSION ..................................................................................................... 269

BIBLIOGRAPHY .......................................................................................................... 279

APPENDICES ............................................................................................................. 305
  Appendix 4.1 Evidence tables for systematic review of CDSS for CVD risk assessment and management .................................................................................................................. 307
  Appendix 4.2 Systematic review excluded references .............................................. 361
  Appendix 5.1 CVD-Diabetes risk assessment, adjustment and classification .............. 372
  Appendix 5.2 Statistics New Zealand Ethnicity Classification and PREDICT ethnicity coding. 373
  Appendix 5.3 Templates of PREDICT-CVD and templates and examples of PREDICT CVD-
                    Diabetes decision support output ........................................................................ 377
  Appendix 5.4 Description CVD risk Assessment and management variables and functionality of 
                    the templates ........................................................................................................ 387
  Appendix 5.5. Valid data entry ranges ...................................................................... 400
  Appendix 5.6. PREDICT data security- submission, access and storage ..................... 401
  Appendix 6. PREDICT-CVD (Prompt) Evaluation Study audit form......................... 403
  Appendix 8.1. PREDICT Study practice waiting room poster and Patient information sheet ... 404
  Appendix 8.2 Rules of eNHI matching for PREDICT and NZHIS ......................... 405
  Appendix 10 Published papers from PREDICT research and awards........................ 407
List of Tables

Table 2.1 PHO Performance Management Programme\textsuperscript{96} .................................................. 30
Table 4.1. Classification of computerised decision support systems ......................................... 79
Table 4.2. Included trials categorised according to the classification in Table 4.1 ............. 80
Table 5.1. Time line of development and implementation .................................................... 122
Table 6.1. Characteristics of participating and non-participating GPs .................................. 149
Table 6.2. Characteristics of audited populations before and after PREDICT-CVD installation ................................................................. 150
Table 6.3. Characteristics of Māori and non-Māori audited populations ......................... 151
Table 6.4. CVD risk & risk factors documented before & after PREDICT-CVD installation ................................................................................................................ 153
Table 6.5. CVD risk and risk factors documented before and after PREDICT-CVD installation for Māori and non-Māori patients ........................................ 154
Table 6.6. Variation in data collection and data entry for 14 key audit variables ........... 155
Table 7.1. PREDICT adopters and non-adopters by GP or practice nurse ..................... 165
Table 7.2. PREDICT GP users categorised by overall number of patients assessed .. 169
Table 8.1. PHO-enrolled populations within the four northern district health boards (grey shading indicates PHOs that started using PREDICT from 2002–2006) ........... 181
Table 8.2. Population 35 years and over in the Greater Auckland and Northland DHBs in 2005 ................................................................................................................ 183
Table 8.3. Estimated population aged over 35 years in the PHOs using PREDICT between 2002-2006 ................................................................. 184
Table 8.4. Outcomes for PREDICT cohort study and corresponding ICD-10-AM codes ................................................................................................................. 188
Table 9.1. PREDICT cohort: numbers of assessments, health practitioners and participants.......................................................................................................................... 200
Table 9.2. Baseline demographic profile of PREDICT cohort participants by data template submitted (risk assessment only or risk assessment and management) ...... 202
Table 9.3. Baseline CVD risk factors and predicted CVD risk of PREDICT cohort...... 204
Table 9.4. Male participant characteristics by age group.............................................. 207
Table 9.5. Female participant characteristics by age.................................................... 208
Table 9.6. Participants eligible for an upward adjustment of their Framingham-predicted CVD score according to NZGG CVD risk guidelines ................................................................. 209
Table 9.7. Framingham score compared with NZGG-adjusted Framingham score among men............................................................................................................................... 210
Table 9.8. Framingham score compared with NZGG-adjusted Framingham score among women............................................................................................................................... 210
Table 9.9. Framingham risk and NZGG-adjusted Framingham risk by age in men......211
Table 9.10. Framingham risk and NZGG-adjusted Framingham risk by age in women 212
Table 9.11. Estimated prevalence of CVD and CVD Framingham risk distributions from New Zealand population estimates compared with the PREDICT cohort........ 215
Table 9.12. Drug therapy at baseline by prior CVD and CVD risk score ................. 217
Table 9.13. Follow-up time............................................................................................ 218
Table 9.14. Proportion of assessments compared to proportion of events occurring by follow-up time ................................................................................................................... 220
Table 9.15. Categories of CVD events experienced during follow-up.......................... 221
Table 9.16. Percentage of fatal and non-fatal events by event type and history of prior CVD...................................................................................................................................... 222
Table 9.17. Number and percentage of fatal CVD events by history of prior CVD, age group and gender................................................................. 223
Table 9.18. First events by CVD category ................................................................. 224
Table 9.19. Crude and age-standardised incidence rates and relative risks of first CVD event from baseline assessment among participants with no prior CVD – by demographic factors................................................................. 226
Table 9.20. Crude and age-standardised incidence rates and relative risks of first CVD event from baseline assessment among participants with no prior CVD – by selected personal clinical history and CVD risk factors ................................................................. 227
Table 9.21. Crude and age-standardised incidence rates and relative risks of first CVD event during follow-up in participants with prior CVD – by demographic factors........ 229
Table 9.22. Crude and age-standardised incidence rates and relative risks of first CVD event from baseline assessment in those with prior CVD – selected personal history and examination variables ................................................................. 230
Table 9.23. Number of first CVD events, crude incidence rate, cumulative incidence rate and mean predicted risk scores of participants stratified by age, gender, ethnicity and deprivation in participants aged 30-74yrs without prior CVD or CVD risk equivalent or missing data precluding estimation of Framingham risk ........................................ 232
Table 9.24. Number of first CVD events, cumulative incidence rate and mean predicted risk scores of participants stratified by diabetes and NZGG adjustment factors........ 233
List of Figures

Figure 1.1. Annual deaths from CHD per 50,000 middle-aged (50–64 yrs) men and women: selected Asia Pacific countries ................................................................. 3

Figure 1.2. The New Zealand CVD risk chart – example for men................................. 8

Figure 2.1. Trends in general practice computerisation from 1988 to 2004 .................... 32

Figure 2.2. New Zealand distributed Electronic Health Records Model as described in the New Zealand Health Information Strategy 2005 ................................................... 36

Figure 4.1. GATE framework for study design and validity criteria ............................... 73

Figure 4.2. CDSS systematic review flow diagram with results of search, publication retrieval and included studies ................................................................. 76

Figure 4.3. CDSS trials for CVD risk assessment and management in primary care or ambulatory services by publication year ................................................................. 81

Figure 4.4. Summary results of automatic computerised reminders compared with usual care at the time of patient consultation ................................................................. 105

Figure 4.5. Summary results of automated audit and feedback compared to usual care ................................................................................................................. 108

Figure 4.6. Summary of provider-initiated CDSS integrated with the EMR at time of patient consultation ............................................................................................................. 113

Figure 5.1. Overview of the key developmental and continuous quality improvement steps of the PREDICT CDSS tool ................................................................. 126

Figure 5.2. Eligibility criteria for CVD risk assessment according to CVD risk guidelines ............................................................................................................. 128

Figure 5.3. PREDICT exposure data collection via routine practice .............................. 135

Figure 6.1. Flow chart of PREDICT-CVD audit .......................................................... 148
Figure 7.1. Adoption by GPs & nurses; cumulative count of first-time users ............... 166
Figure 7.2. Adoption of PREDICT by doctors and nurses; monthly count of first time users ............................................................................................................................. 167
Figure 7.3. Total number of patients assessed using PREDICT per month by GP or practice nurse between August 2002 and January 2007 .................................................. 168
Figure 7.4 A–D. Examples of the four types of usage pattern by GPs who conducted CVD risk assessment on 90 or more patients ............................................................... 170
Figure 8.1. Map of the Greater Auckland and Northland Regions by District Health Board and indicating regional townships ............................................................................. 180
Figure 8.2. Data linkage process with encrypted NHI ................................................... 186
Figure 9.1. Overview of participant numbers (by PHO source and PREDICT tool) matching by NZHIS and subsequent CVD outcomes .............................................................. 198
Figure 9.2. The percentage of the PREDICT cohort with both risk assessment and management templates completed, categorised by % CVD risk, risk factors including diabetes and family history and history (Hx) of prior CVD ......................................... 205
Figure 9.3. Percentages of men and women in NZGG-adjusted Framingham risk groups or with prior CVD age-standardised to the 2006 NZ population ≥35 years .............. 213
Figure 9.4. Follow-up of participants with no prior CVD until event or date of NZHIS linkage ........................................................................................................................................ 219
Figure 9.5. Follow-up time for those with prior CVD until next event or date of NZHIS linkage ........................................................................................................................................ 219
Figure 9.6. Percentage of the 2655 people who had a single or multiple CVD events occurring over the follow-up period divided into those with and without prior CVD event at baseline ........................................................................................................................................ 221
Figure 9.7. Calibration of the Framingham score against the cumulative incidence of CVD event in 5 years (with 95% confidence intervals) in participants aged 30-74 years without prior CVD or CVD equivalent condition. ........................................................... 234

Figure 9.8. Calibration of the Framingham score by gender against the cumulative mean incidence of CVD event in 5 years (with 95% confidence intervals) in participants aged 30-74 years without prior CVD or CVD equivalent condition. ............................................... 235

Figure 9.9. Calibration of the Framingham score by NZ Dep Index Quintiles in participants aged 30-74 years without prior CVD or CVD equivalent condition. .................................. 236

Figure 9.10. Calibration of the Framingham score by diabetes status in participants aged 30-74 years without prior CVD or CVD equivalent condition. .................................................. 237

Figure 9.11. Calibration of the Framingham score by high and low risk ethnicities (according to NZGG criteria) in participants aged 30-74 years without prior CVD or CVD equivalent condition. .......................................................... 238

Figure 9.12. Calibration of Framingham by family history of premature ischaemic CVD in participants aged 30-74 years without prior CVD or CVD equivalent condition. .................. 239

Figure 9.13. Calibration of the Framingham score by 'very high blood pressure' (BP170/100 mmHg or over) status in participants aged 30-74 years without prior CVD or CVD equivalent condition. .......................................................... 240

Figure 9.14. Calibration of the Framingham score by 'very high total cholesterol or TC/HDL' (TC or TC/HDL 8 or over) status in participants aged 30-74 years without prior CVD or CVD equivalent condition. .......................................................... 240

Figure 9.15. Calibration of the Framingham score compared with NZGG-adjusted score for participants aged 35–74 years with no prior CVD or CVD equivalent condition. ...... 241
Figure 9.16. Calibration of the Framingham score compared with the NZGG adjusted score in participants with a positive family history of premature CVD (248 events in 22,670 participants)....................................................................................................... 242

Figure 9.17. Calibration of the Framingham score compared with the NZGG adjusted score in the 'high risk ethnicity' category (i.e. Māori. Pacific and South Asian peoples) who suffered 442 events in 13,579 participants........................................................................ 243

Figure 9.18. Comparison of observed cumulative 5 year incidence (%) by 5-year Framingham CVD risk group for those with and without a prior CVD event aged 30-74 years ........................................................................................................................................... 244

Figure 9.19. ROC curves of the Framingham and NZGG adjusted scores, age, systolic blood pressure, TC/HDL and the NZ Dep Index in participants aged 30-74 years without prior CVD or CVD equivalent condition........................................................................................................ 246

Figure 9.20. ROC curves of risk scores and risk factors for men................................................. 247

Figure 9.21. ROC curves of risk scores and risk factors for women............................................. 248

Figure 9.22. The percentages of PREDICT participants in Framingham risk categories and the subset of people by risk category who experienced an event during follow-up (cohort aged 30–74 years without prior CVD event or CVD equivalent risk). .......... 249

Figure 9.23. The percentages of people by NZGG-adjusted Framingham score categories and the subset of people by risk category who experienced an event during follow-up (cohort aged 30–74 years without prior CVD event or CVD equivalent risk). 250

Figure 9.24. The percentages of people in Framingham risk categories and with prior CVD and the subset of people by category who experienced an event (Cohort aged 30–74 years where CVD equivalent groups are excluded)........................................ 251
Figure 9.25. The percentages of people in NZGG-adjusted Framingham risk categories and with prior CVD and the subset of people by category who experienced an event (cohort aged 30–74 years with and without a prior CVD event; CVD equivalent groups are excluded). .......................................................... 252

Figure 11.1. Cycles of CVD and diabetes health care quality improvement, the axis revolving around the patient (and their family) .................................................... 274
**List of Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC</td>
<td>Accident Compensation Corporation</td>
</tr>
<tr>
<td>AUC</td>
<td>Area under the curve</td>
</tr>
<tr>
<td>BP</td>
<td>Blood pressure</td>
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<tr>
<td>CDSS</td>
<td>Computerised decision support system</td>
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<tr>
<td>CHD</td>
<td>Coronary heart disease</td>
</tr>
<tr>
<td>CHE</td>
<td>Crown Health Enterprise</td>
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<tr>
<td>CHF</td>
<td>Congestive heart failure</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>CMDHB</td>
<td>Counties Manukau District Health Board</td>
</tr>
<tr>
<td>CPOE</td>
<td>Computerised physician order entry</td>
</tr>
<tr>
<td>CSC</td>
<td>Community Services Card</td>
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<tr>
<td>CVD</td>
<td>Cardiovascular disease</td>
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<td>District Health Board</td>
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<td>DBP</td>
<td>Diastolic blood pressure</td>
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<td>EHR</td>
<td>Electronic Health Record</td>
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<tr>
<td>EMR</td>
<td>Electronic Medical Record</td>
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<tr>
<td>FTE</td>
<td>Full time equivalent</td>
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<tr>
<td>GMS</td>
<td>General Medical Benefits System</td>
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<tr>
<td>GP</td>
<td>General Practitioner</td>
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<tr>
<td>HDL</td>
<td>High-density lipoprotein</td>
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<td>HPI</td>
<td>Health Practitioner Index</td>
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<tr>
<td>HUHC</td>
<td>High Use Health Card</td>
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<tr>
<td>ICD</td>
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<td>ICVD</td>
<td>Ischaemic cardiovascular disease</td>
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<tr>
<td>IPA</td>
<td>Independent Practitioner Association</td>
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<tr>
<td>LDL</td>
<td>Low density lipoprotein</td>
</tr>
<tr>
<td>LOINC</td>
<td>Logical Observations, Identifiers, Names and Codes</td>
</tr>
<tr>
<td>NHI</td>
<td>National Health Index</td>
</tr>
<tr>
<td>NMDS</td>
<td>National Minimum Data Set</td>
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<td>NZDep</td>
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