Is our public research money well spent? Publication of research outputs from Health Research Council of New Zealand-funded studies: a cross-sectional study

Marian Showell, Cynthia M Farquhar, Grace Greenwood, Vanessa M B Jordan


ABSTRACT
Objective To evaluate the reporting of results from the projects and programmes funded by the Health Research Council (HRC) New Zealand.

Design A cross-sectional analysis.

Setting Research projects and programmes funded by the HRC New Zealand from 2006 to 2014.

Participants Publicly available data provided by the HRC.

Main outcome measures The number and proportion with evidence of publication and dissemination of a research output from HRC grants and the time taken to disseminate the results.

Results Of the 374 HRC grants from 2006 to 2014, there was no evidence of publication or reporting of any research output for 48 studies (13%). Of the 326 (87%) grants with research outputs, there was a mean dissemination time of 4.73 years (SD 2.37). The total funding provided by the HRC was NZ$471,663,336, while the 48 grants with no evidence of dissemination represented NZ$47,095,727 (10%).

Conclusions Thirteen per cent of the HRC projects and programmes from 2006 to 2014 have not contributed to the healthcare evidence as their results remain unknown.

INTRODUCTION
The timely reporting of the findings from research is important as it informs clinical practice, develops evidence based policymaking and potentially improves patient care. Unreported research results do not contribute to the evidence base or to patient care. This is a failure of our obligation, as researchers, to the trial volunteers who enter trials with the belief that their contribution will go towards helping others.

The AllTrials campaign, launched in 2013, advocated for trial registration and for the results of all trials to be publicly available within 1 year of trial completion. This stance has been strongly supported by many international trial stakeholders and a joint statement issued from The WHO in 2017 called on the 23 signatories from around the world to agree on and promote the prospective registration of trials and the prompt reporting of trial results. Sadly, however, non-publication and the timely reporting of results remains problematic, and many studies have shown that up to half of all trials are not fully published.

The decision to publish or delay can be influenced by the direction of study results, with papers with negative or null results less likely to be published in full than those with positive results. This influence over the publication and dissemination of results, known as publication bias, potentially misrepresents healthcare evidence, but also is a net loss to the public and other health stakeholders in terms of wasted evidence, time and money. Worldwide, billions of dollars are invested every year in biomedical research. Health research and development spending in the USA reached US$245.1 billion in 2020, an 11% increase from 2019. The UK’s Health Research Classification System (HRCS) reported that approximately GBP 4.8 billion was awarded to UK health research in 2018. There are vast amounts of publicly funded money at stake, which could reasonably be expected to be spent wisely in order to improve patient care.
to benefit patients. Yet, it is possible that up to 85% of research investment might be wasted.15 There are calls for the research community to be more accountable by asking why this waste has occurred and what we can do to improve the situation.16

The Health Research Council (HRC) of New Zealand (NZ), a Crown agency, being the principal public funder of health research in NZ, is currently investing NZ$126 million each year into projects and programmes.17 Programmes can be awarded up to NZ$5 million and support the long-term development of a health research field, while projects are generally shorter, usually over 2–5 years and can potentially be awarded up to NZ$1.2 million per project.18

The HRC signed the WHO joint statement19 20 in July 2020, thereby agreeing to prospective trial registration and the timely reporting of trial results, that being within 1 year of trial completion of all their funded trials. Their vision is ‘for New Zealand to be a world leader in high impact, high-value health research’, with a primary strategic objective of strengthening ‘networks between researchers and service providers to speed the translation of research into practice’.21 We know, however, that both high impact and speedy translation of research cannot occur if study results are delayed or go unreported.

Our project aims to study research waste in terms of the timely accessibility and availability of research outputs from the HRC publicly funded studies.

METHODS
This study did not require ethics approval as the data are publicly available.

Data source and study sample
Inclusion criteria: all HRC projects and programmes that were funded from 2006 to 2014. The HRC provided publicly available data and approved budgets of projects and programmes in an excel spreadsheet for the years 2006–2014. This time frame allowed at least 8–16 years for the reporting of study results. The data were analysed to determine the publication of research outputs and the time taken to report results of HRC-funded studies.

Exclusion criteria: any funded programmes or grants that would not have resulted in a form of research publication, that is, setting up a research team.

Outcomes
We were interested in the following primary outcomes:
- The number and proportion of funded studies that reported their results publicly.
- The time to taken to report study results.

We also investigated whether the reporting of results and time to reporting were associated with:
- Total awarded budget.
- Type of study—human, animal or other.
- Healthcare discipline.

Search strategy to identify dissemination
Three investigators (MS, VMBJ and GG) independently determined the dissemination of study results by following a defined and systematic search strategy. The last search was conducted on 23 May 2022, allowing for a minimum 8 year time lag for the studies to be completed and disseminated.

We used the characteristics of the funded studies from the data provided by the HRC to create our search strategy. These characteristics included the research title, investigator name, subject area, year of funding and the lay summary.

We searched Google for the investigator names, looking for any online reports or corresponding ResearchGate and ORCHID profiles that could match the research title, lay summaries and year of publication supplied in the HRC data. If we could not find the correct publication, we searched the following bibliographic databases: CENTRAL, MEDLINE, Embase and ERIC, using investigators’ names and keywords as used in the research title and lay summary. We also checked the HRC website for any further information linked to the investigators, this included any media releases that might lead us to a source of dissemination.

Data collection
The HRC provided data for all projects that were funded from 2006 to 2014. These data included the research title, investigator name, associated health field, the year funded, the total budget awarded, the host affiliation and a lay summary of each programme or project.

For this study, we counted a funded grant award as published if we were able to find the study results in the public sphere. The format of disseminated studies with results could include reports, websites, newspapers, magazines, conference abstracts, or full-text journal publications.

Non-disseminated studies included those that were either unable to be located, were found without associated results or where the studies were difficult to find, that is, a thesis was categorised as non-disseminated as their results were not easily accessible.

The HRC provided the amount awarded to each study in NZ dollars. We considered these amounts in terms of dissemination or not, the types of study and the healthcare field.

We used the lay summaries to categorise the studies into three groups: human, animal and ‘other’. The combined group ‘other’ included molecular, cellular, genetics and computer or device modelling studies.

The studies in the original data set were in over 70 disciplines; we amalgamated similar disciplines into 26 standard healthcare fields.

Statistical analysis
The HRC provided an excel spreadsheet containing the grant information, and all data were analysed using Excel.22 Dichotomous data were expressed in numbers
and percentages. We calculated the number and proportion of studies with disseminated or non-disseminated results. Continuous data were expressed as mean values and SD. We calculated the time to dissemination from the year the grant was awarded until the year of publication or dissemination of results. If there were multiple publications, we used the earliest for the year of publication.

Public and patient involvement
This was an unfunded study using publicly available data from the HRC. No individuals were involved in this study and there are no plans to directly disseminate the results of the research to study participants.

RESULTS
The HRC awarded 374 grants from 2006 to 2014 that met the inclusion criteria; assessment of these projects confirmed that all should have been able to report their results and so there were no excluded programmes or projects: 38 were programmes and 336 were projects.

Reporting
We searched for corresponding publications or reports up to 23 May 2022 and found that 326 grants were published, 320 of which were full-text publications in peer-reviewed journals, four were conference abstracts with results only, with no other evidence of publication and two were online reports with results (figure 1).

The four conference abstracts were presented at the following conferences: The National Alliance to Stop Impaired Driving (NASID) Conference, The 13th International Symposium on Myelodysplastic Syndromes, The American Heart Association’s Epidemiology and Prevention/Physical Activity, Nutrition and Metabolism and The COMPASS Colloquium Statistics New Zealand.


The total budget awarded to the 374 grants was NZ$471 663 336. We could not find publications for 48 grants (13%); this represented NZ$47 095 727 (10%). This number included one PhD thesis that is considered non-disseminated due to difficulty in access.

Of the three categories of study types, human studies, animal and a combined group of molecular/cellular/genetics/computer or device modelling, all had similar proportions of dissemination (85%–88%) (table 1).

The healthcare discipline with the highest number of grants was public health (n=65), with 82% of these published. The disciplines with the lowest number of grants were gastrointestinal disease, surgery and vision, each with three grants. Gastrointestinal disease published 67%, surgery and vision published 100% of their grants.

Thirteen of the 26 healthcare disciplines published 100% of the results. Of the 13 disciplines with unpublished results, the child and women’s health fields were more likely to be published (93% and 78%, respectively) than those in the field of mental health and biomedical engineering (60% and 50%, respectively) (table 2).

Time to publication
The mean time to a publication from a grant award overall was 4.73 years (SD 2.37), with a range from 1 year (24 grants) to 12 years (three grants). The mean time to

Figure 1 The publication of Health Research Council (NZ)-funded projects and grants (n=374). HRC, Health Research Council.
Open access


Open access publication for the 36 programme grants from the grant award was 4.03 years (SD 2.37), and the average time for the 290 project grants was 4.81 years (SD 2.35). Human studies took longer to publish than animal-based and laboratory-based studies, with a mean of 5.11 years (SD 2.29), 4.16 (SD 2.21) and 3.64 (SD 2.49), respectively.

By healthcare specialty, the longest mean time to publication was 6.33 years (SD 2.89) in the healthcare field of vision, with three grants. The gastrointestinal disease group had the shortest mean time to the publication of 3 years (SD 1.41), three grants of which one was not published.

**DISCUSSION**

**Main findings**

Our results show that despite an extensive search and an acceptance of any source that contained study results as evidence of publication, we did not find any evidence of publication or reporting of results in 13% of HRC-funded studies 8–16 years after funding was awarded. The studies that have not reported data were awarded a total of NZ$47,095,727 of publicly funded money over a 9-year period. The proportion of studies that did not report their outcomes did not improve 2006 to 2014. Of the studies with reported results, the mean time to publication was 4.73 years (SD 2.37) from the funding year, with human studies taking the longest time to report their findings.

**STRENGTHS AND LIMITATIONS**

The major strength of this study is the rigorous and systematic search over multiple bibliographic databases, search engines and websites that we used to match the dissemination avenue to the grant. Another strength was that the study design allowed sufficient time (8 years or more) for the results to be visible.

A significant limitation of our study is that we did not approach the individual investigators to enquire about any possible dissemination or apply for access to final grant reports, which would provide further information on dissemination from the study investigators. However, the objective of our study was to assess whether the results from publicly funded studies were easily discoverable. Enquiring of investigators may have provided more insights into why there was no publication of results and may be explored in the future. Other research suggests that contacting authors does not add very much to the information available. It is also possible that the time for publication was too short as some more extensive longitudinal studies may not have had adequate time to report their follow-up results.

**Research in context**

Our result of 13% non-dissemination was similar to a recently published study looking at randomised controlled trials (RCTs) funded by the HRC, where they found that 11% of trials remained unpublished after a median of 43.6 months. NZ compared favourably to an Australian study which looked at 77 RCTs that were funded by the National HRC of Australia between 2008 and 2010; they found that 49% of the RCTs were not published and the median time to publication after funding was 7.1 years (95% CI 6.3 to 7.6). Furthermore, a study of National Institutes of Health (NIH)-funded trials, completed by 2008, found that 32% of the trials

**Table 1** Characteristics of HRC programme and project grants awarded between 2006 and 2014 (n = 374)

<table>
<thead>
<tr>
<th>Studies funded by HRC</th>
<th>Number of studies with results reported (%)</th>
<th>Total number of studies (n = 374)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programmes</td>
<td>36 (95)</td>
<td>38</td>
</tr>
<tr>
<td>Projects</td>
<td>290 (86)</td>
<td>336</td>
</tr>
<tr>
<td>Total</td>
<td>326 (87)</td>
<td>374</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of study</th>
<th>Number of studies reported (%)</th>
<th>Total number of studies (n = 374)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td>223 (87)</td>
<td>255</td>
</tr>
<tr>
<td>Animal</td>
<td>56 (88)</td>
<td>64</td>
</tr>
<tr>
<td>Other (molecular/cellular/computer or device modelling)</td>
<td>47 (85)</td>
<td>55</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HRC funds awarded to studies per 1 million NZ$</th>
<th>Funds associated with non-result reporting (%)</th>
<th>Total funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;$999,999</td>
<td>$130,070 887 (3)</td>
<td>$97,923,199</td>
</tr>
<tr>
<td>$1,000,000–$1,999,999</td>
<td>$253,915 559 (5)</td>
<td>$227,180,414</td>
</tr>
<tr>
<td>&gt;$2,000,000</td>
<td>$86,332 281 (2)</td>
<td>$146,560,603</td>
</tr>
<tr>
<td>Total</td>
<td>$470,957 277 (10)</td>
<td>$471,663,336</td>
</tr>
</tbody>
</table>

The proportion of non-disseminated grants from 2006 to 2014 is reported in figure 2.

*One meta-analysis.

HRC, Health Research Council.

**Figure 2** Percentage of unpublished grants from 2006 to 2014 (n = 48).
remained unpublished after a median of 51 months and similar results were found in the other US publicly funded studies, Gordon et al,27 and a recent study on neurological disorders by Brown et al28 found a 36% (within 25 months) and a 20% (within 4 years) non-publication rate, respectively. Other studies however showed better results; a large study published in 2020 by Riley et al29 looked at 27 000 NIH-funded projects and found that only 2.4% of projects had not reported their research outputs in the 5 years since the start of the projects. This study included similar funding years (2008 to 2014) to our project (2006 to 2014). This study also found that human research took, on average, 7 months longer than animal research to be disseminated. This was reflected in our findings with human research taking, on average, nearly a year longer than animal research. This might be due to the more complex issues of ethics procedures, informed consent, recruitment and retention issues and the longitudinal study designs, in human research.29

Two studies from the UK reporting on Health Technology Assessment (HTA)-funded projects also had low non-dissemination rates of around 6%–7%.30 31 The National Institute for Health and Care Research (NIHR) publishes the Health Technology Assessment (HTA) journal in which investigators are strongly encouraged to publish, so this may be the reason for the low non-dissemination rate.

### Implications
Any non-reporting of study results, for any reason, both compromises future healthcare with the introduction of publication bias and misrepresentation of the evidence,9 13 and it is also an ethical failure to those who have volunteered their time and possibly risked their health for the benefit of others. In addition to these important factors,

### Table 2
Publication status and approved budgets for funded projects/programmes according to healthcare discipline (n=374)

<table>
<thead>
<tr>
<th>Healthcare discipline</th>
<th>Grants funded (n=374)</th>
<th>Grants (%) with results not reported (n=48)</th>
<th>Total awarded budget (NZ$)</th>
<th>Awarded budget to studies with no reported results (NZ$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomedical engineering</td>
<td>6</td>
<td>3 (50)</td>
<td>$9115849</td>
<td>$5515418 (60)</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td>24</td>
<td>5 (21)</td>
<td>$31090929</td>
<td>$7864828 (25)</td>
</tr>
<tr>
<td>Child health</td>
<td>28</td>
<td>2 (7)</td>
<td>$34877609</td>
<td>$1395210 (4)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>8</td>
<td>1 (13)</td>
<td>$8703489</td>
<td>$1658677 (19)</td>
</tr>
<tr>
<td>Drug design/therapy</td>
<td>21</td>
<td>(0)</td>
<td>$25011006</td>
<td>(0)</td>
</tr>
<tr>
<td>Gastrointestinal disease</td>
<td>3</td>
<td>1 (33)</td>
<td>$2833520</td>
<td>$679652 (24)</td>
</tr>
<tr>
<td>Genetics</td>
<td>4</td>
<td>(0)</td>
<td>$6874278</td>
<td>(0)</td>
</tr>
<tr>
<td>Gerontology</td>
<td>6</td>
<td>1 (17)</td>
<td>$12201793</td>
<td>$1191255 (10)</td>
</tr>
<tr>
<td>Health services research</td>
<td>18</td>
<td>1 (6)</td>
<td>$18497050</td>
<td>$666038 (4)</td>
</tr>
<tr>
<td>Immunology</td>
<td>23</td>
<td>(0)</td>
<td>$37572450</td>
<td>(0)</td>
</tr>
<tr>
<td>Infectious disease</td>
<td>8</td>
<td>(0)</td>
<td>$9965120</td>
<td>(0)</td>
</tr>
<tr>
<td>Intensive care</td>
<td>7</td>
<td>(0)</td>
<td>$4970242</td>
<td>(0)</td>
</tr>
<tr>
<td>Māori health</td>
<td>32</td>
<td>7 (22)</td>
<td>$27717532</td>
<td>$2174704 (8)</td>
</tr>
<tr>
<td>Mental health</td>
<td>10</td>
<td>4 (40)</td>
<td>$10815450</td>
<td>$4989086 (46)</td>
</tr>
<tr>
<td>Neurology</td>
<td>26</td>
<td>6 (23)</td>
<td>$37541479</td>
<td>$6371284 (17)</td>
</tr>
<tr>
<td>Nutrition</td>
<td>5</td>
<td>(0)</td>
<td>$9555347</td>
<td>(0)</td>
</tr>
<tr>
<td>Oncology</td>
<td>20</td>
<td>(0)</td>
<td>$27422837</td>
<td>(0)</td>
</tr>
<tr>
<td>Pacifica health</td>
<td>4</td>
<td>(0)</td>
<td>$3345736</td>
<td>(0)</td>
</tr>
<tr>
<td>Public health</td>
<td>65</td>
<td>12 (18)</td>
<td>$89176957</td>
<td>$8812435 (10)</td>
</tr>
<tr>
<td>Rehabilitation medicine</td>
<td>13</td>
<td>1 (8)</td>
<td>$12564871</td>
<td>$1015022 (8)</td>
</tr>
<tr>
<td>Renal disease and urology</td>
<td>4</td>
<td>(0)</td>
<td>$4215568</td>
<td>(0)</td>
</tr>
<tr>
<td>Respiratory disease</td>
<td>10</td>
<td>(0)</td>
<td>$8862672</td>
<td>(0)</td>
</tr>
<tr>
<td>Rheumatology</td>
<td>5</td>
<td>(0)</td>
<td>$9195170</td>
<td>(0)</td>
</tr>
<tr>
<td>Surgery</td>
<td>3</td>
<td>(0)</td>
<td>$2367020</td>
<td>(0)</td>
</tr>
<tr>
<td>Vision</td>
<td>3</td>
<td>(0)</td>
<td>$3668184</td>
<td>(0)</td>
</tr>
<tr>
<td>Women’s health</td>
<td>18</td>
<td>4 (22)</td>
<td>$23501167</td>
<td>$4762116 (20)</td>
</tr>
<tr>
<td>Total</td>
<td>374</td>
<td>48</td>
<td>$471663336</td>
<td>$47095727 (10)</td>
</tr>
</tbody>
</table>
we must also question any non-available study results in terms of public money being lost and look at ways to improve this.

A report on the poor reporting of trial results by TranspariMED,39 a non-profit advocate for trial transparency, reveals that the problem remains large in Europe, with a conservative estimate of missing data from at least 5488 trials. They call for strong engagement from national medicine regulators to improve this situation.

Various initiatives are being used in research funding organisations to improve the reporting of trial results. These initiatives fall into two categories: those that are punitive and those that encourage publication. Punitive measures include the withholding of any new funds to investigators who have failed to register and report trial results within 12 months of the last visit by the last participant. Both Canada and the US funders have strong mandatory policies in this regard, these funders include the Canadian Institutes of Health Research (CIHR),33 the US Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD)34 and the US NIH,35 all of whom monitor the timely reporting of results and withhold any new funding to those who do not comply.

After instigating these policies, the NICHD found a 27.3% improvement in the proportion of complete publication over time. There was also a decrease in the time to the publication of abstracts from 3.5 years 1990–2002 to 1.1 years in the 2010–2013 studies.34 In addition, the NIH requires the submission of a manuscript at the point of publication acceptance to the NIH manuscript portal and a failure to do so will lead to a delay or withholding of funds.35

In terms of encouraging dissemination, the REWARD Alliance,36 an international working group established following the Lancet series on research waste,37 shares ideas and experiences, and in 2017, it held a collaborative funders forum meeting to discuss funders’ role in the dissemination and implementation of research.38 The ZonMw from the Netherlands, a convenor of the group, has created an overarching organisation that aims to identify decision points and actions required throughout all stages of the study life cycle, that is, from the grant application, experiment, analysis and reporting to policy and application; working in an international collaborative relationship to ‘introduce evidence-based improvements’.

It is acknowledged that both techniques, mandatory and supportive encouragement, require resources for their development and implementation. Qualitative studies by Tetroe et al.,39 McEllish et al.,40 and Wilson et al.41 reveal that most funding agencies both showed a lack of clarity in how to promote dissemination of study results and also a lack of resources and tools to enable them to do this adequately. Kernan et al.42 have described the resources provided to funding agencies for disseminating results, as ‘decimal dust’ the amount being so minute. While adequate resources are one part of the solution, Tetroe et al.43 go a step further to propose an overarching collaboration among the multiple trial agencies, including ethics committees, trials registries, funders and journals, stating that collaboration and sharing between agencies can only be a ‘win-win situation’, with the expectation that this would lead to clearer pathways and guidance for researchers regarding expectations for dissemination.

With adequate resources and a discrete budget for dissemination, funding agencies like the HRC could play a more active, targeted role in monitoring the reporting of study results and increasing their capacity to encourage study investigators to disseminate results. There might also be the opportunity to develop links and collaborative relationships between the study stakeholder agencies to provide a unified front in decreasing publication bias.

CONCLUSIONS
Our study found that 87% of HRC-funded studies from 2006 to 2014 were disseminated in online reports, conference abstracts or journal publications, with an average time to publication of 4.73 years. New initiatives to decrease publication bias will lead to future healthcare and policy that is both based on all available evidence and on all evidence.

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Contributors Conceptualisation, methodology and writing—review and editing: VMBJ, MS, GG and CF. Data curation, software and validation: MS and GG. Formal analysis and visualisation: MS and VMBJ. Investigation, project administration and resources: MS, GG and VMBJ. Supervision: CF and VMBJ. Writing: MS. Content guarantor: MS.

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Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

Patient consent for publication Not required.

Ethics Approval Statement An ethics approval was not provided. This study did not require ethics approval as the data were publicly available. The data were provided by The Health Research Council of New Zealand.

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REFERENCES

8. Ioannidis JP. Effect of the statistical significance of results on the time to completion and publication of randomized efficacy trials. JAMA 1998;279:281–6.
33. Canadian Institutes of Health R, GHFHR policy guide – requirements for registration and disclosure of results from clinical trials. 2022.