

## ResearchSpace@Auckland

### Journal Article Version

This is the publisher's version. This version is defined in the NISO recommended practice RP-8-2008 <http://www.niso.org/publications/rp/>

### Suggested Reference

Jackson, G., Dalbeth, N., Te Karu, L., Winnard, D., Gow, P., Gerard, C., & Minko, N. (2014). Variation in gout care in Aotearoa New Zealand: a national analysis of quality markers. *New Zealand Medical Journal*, 127(1404), 37-47. Retrieved from <http://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2014/vol-127-no-1404/6329>

### Copyright

Items in ResearchSpace are protected by copyright, with all rights reserved, unless otherwise indicated. Previously published items are made available in accordance with the copyright policy of the publisher.

<http://www.nzma.org.nz/journal/subscribe/conditions-of-access>

<http://www.sherpa.ac.uk/romeo/issn/0028-8446/>

<https://researchspace.auckland.ac.nz/docs/uoa-docs/rights.htm>

## ORIGINAL ARTICLE

## Variation in gout care in Aotearoa New Zealand: a national analysis of quality markers

Gary Jackson, Nicola Dalbeth, Leanne Te Karu, Doone Winnard, Peter Gow, Catherine Gerard, Nikolai Minko

### Abstract

**Aim** To examine whether there was variation in markers for the quality of gout care using national linked data for the entire Aotearoa New Zealand population.

**Method** Data drawn for the New Zealand Atlas of Healthcare Variation was used to examine regularity of allopurinol dispensing, laboratory testing for serum urate, and acute hospitalisation for gout. Standardised rates by age, gender, ethnicity and District Health Board (DHB) of domicile were calculated.

**Results** For New Zealanders aged 20–79 years with gout, 57% were dispensed allopurinol in 2010/11. Of these, 69% were receiving allopurinol regularly, and only 34% of people dispensed allopurinol had serum urate testing in a 6-month period. The annual hospitalisation rate was 1% of people with gout. Māori and Pacific people with gout were less likely to be on regular allopurinol treatment, despite having more than twice the chance of being hospitalised with acute gout.

**Conclusion** We have demonstrated that routinely collected health data can be used to monitor the quality of care for people with gout at a high level. Primary care initiatives that focus on ensuring a continuous supply of urate-lowering therapy to achieve therapeutic serum urate targets are required to improve the impact of gout in Aotearoa New Zealand.

Gout is the commonest form of inflammatory arthritis, caused by deposition of monosodium urate crystals in and around joints, tendons and ligaments. Recent enumerations suggest over 4% of the Aotearoa New Zealand population suffer from gout, with rates particularly high for Māori and Pacific males.<sup>1 2</sup>

An acute attack of gout is extremely painful. While attacks are usually self-limiting, untreated gout or inadequate treatment can lead to tophi, chronic gouty arthritis and joint destruction. Treatment to achieve serum urate levels of <0.36 mmol/L is associated with improved clinical outcomes for people who have more than one attack a year of gout.<sup>3–6</sup> Treatment goals are then to keep serum urate at <0.36 mmol/L.

Gout is predominately managed in primary care. Despite clear guidelines and pathways<sup>3–6</sup> marked variation in gout management exists internationally<sup>7,8</sup> and in Aotearoa New Zealand as shown by the Health Quality and Safety Commission's Atlas of Healthcare variation ([www.hqsc.govt.nz/atlas](http://www.hqsc.govt.nz/atlas)). The Atlas shows that on average 41% of people with gout across New Zealand are regularly prescribed allopurinol, but this ranges from 33% in people residing in the Auckland District Health Board (DHB) area to 47% in Nelson-Marlborough. The question then arises whether this is reasonable variation, or whether it might reflect differing quality of care.

The aim of this study is to examine markers for the quality of gout care in Aotearoa New Zealand primary care that can be assessed using national linked data for the entire Aotearoa New Zealand population. We examined data by gender, ethnicity, and DHB of domicile, looking at potential inter-relationships.

## Methods

The Aotearoa New Zealand national data collections were assessed for their utility to measure the quality of gout care. Three indicators were selected as shown in Table 1.

The Aotearoa New Zealand Health Tracker (ANZHT) provided the denominator gout population, as described in Winnard et al.<sup>1</sup> The ANZHT links the Aotearoa New Zealand national health datasets to cover the entire Aotearoa New Zealand population who have had some contact with the health system. The gout population were identified as people aged 20 to 79 who had a discharge diagnosis of gout [International Classification of Disease (ICD)-9 274, ICD-10 M10] from a public hospital admission from 1988 to June 2011, or who had been dispensed allopurinol or colchicine at least once from a community pharmacy between 2006 and June 2011. Diagnosis of leukaemia or lymphoma was an exclusion criterion for dispensing of allopurinol, and the use of probenecid was not included in the algorithm as it is little used for gout care in Aotearoa New Zealand and gout care not easily distinguished from its other prescribed uses.

Benzbromarone has been available under Section 29 on a named patient basis for several years but use has been limited. Newer agents such as febuxostat and pegloticase were not licensed for use in Aotearoa New Zealand in the period of the study. Only Aotearoa New Zealand residents enrolled in a Primary Health Organisation (PHO) or having had a health event in 2010/2011 and still alive at the end of June 2011 were included (i.e. presumed resident in Aotearoa New Zealand in the period of the study). Allopurinol and colchicine are prescription-only medicines in Aotearoa New Zealand, so near-100% capture in the pharmaceutical collection is expected.

People were assigned to their DHB of domicile; where more than one domicile was recorded, the most recent value was selected. Ethnicity data for this population were taken from the 2011 second-quarter primary care enrolment database and the National Health Index extract for the 2011 second quarter. In keeping with other ethnicity reporting in Aotearoa New Zealand health data, ethnicity was prioritised from multiple ethnic codes in the following order: Māori, Pacific peoples, Asian, European/'Other' New Zealanders.

For people reporting different ethnic groups over the time period the most recent value was used for prioritisation. Rates for the Asian population were similar to the European/other group, and in some DHBs the Asian population was small, so these groups were combined into a group termed 'nonMāori/nonPacific'. Ages were examined in 5-year increments from 20 to 79 years, then grouped into three age ranges: 20–39, 40–59, and 60–79 years.

All collected data were linked together by DHB, age, ethnicity and gender. Means and standard deviations were determined for each variable. Crude rates, standardised ratios (SRs) with 95% confidence intervals, and linear regression between predictor and dependent variables of interest were performed in Statistical Analysis System (SAS) v9.3 software.

**Table 1. Assessed quality markers**

Marker	Rationale	Aim
1. Of those with gout dispensed at least one allopurinol script, proportion getting at least 3 out of last 4 quarters	Prescribed allopurinol at least once so assume meet the criteria for use of urate-lowering therapy; allopurinol is only effective if regularly taken	As close to 100% as possible
2. Of those with gout, getting allopurinol, proportion getting a serum urate test in the 6 months following dispensing	The key goal of effective gout management is serum urate at <0.36 mmol/l. Cannot do this if not measuring it. Guidelines suggest 6 monthly <sup>4,5</sup>	As close to 100% as possible
3. Hospital admissions for gout—gout as principal diagnosis	Gout flares severe enough to necessitate hospital admission are potentially related to inadequate preventive care	As low as possible

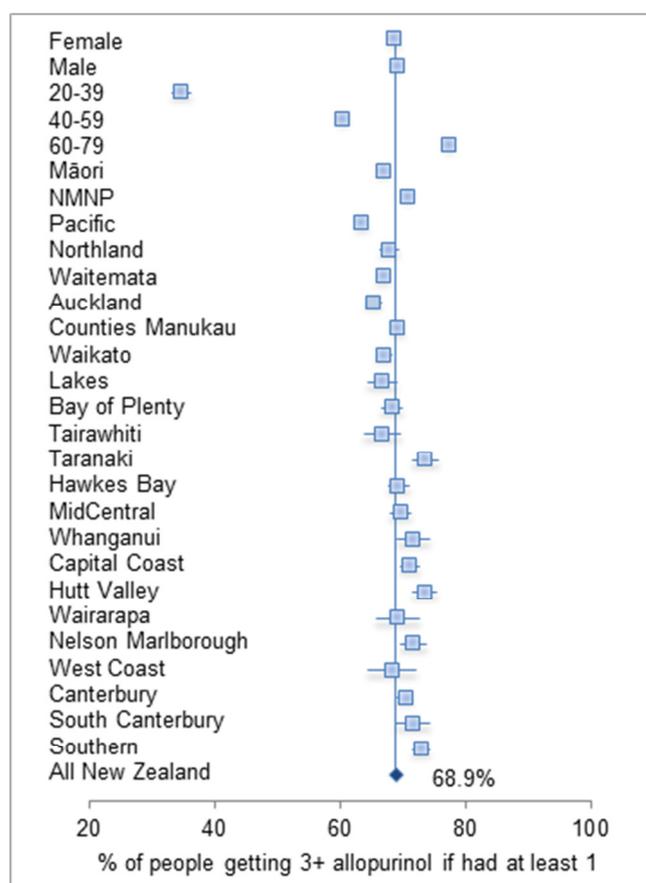
**Note:** The exact data definitions used for each indicator are noted in Appendix 1. Note that while the fact of a laboratory test being taken is collected, the results are not captured in the national collections. Thus one cannot directly capture those with a serum urate lower than 0.36 mmol/l.

## Results

In 2010/11 we identified 114,703 people aged 20–79 years with gout from the national data collections. With 3,032,000 people in the 20–79 year old New Zealand population (Statistics New Zealand estimated resident population), this is a prevalence of 3.8%–1.6% for females and 6.2% for males. Pacific peoples had a prevalence of 9.3% and Māori 7.9%, both significantly higher than the prevalence for nonMāori-nonPacific people at 2.9%. Prevalence rose sharply with age: 0.9% of 20–39 year olds, 3.6% of 40–59 year olds and 10.1% of 60–79 year olds were estimated to have gout.

**Allopurinol regularity**—Of all people identified as having gout, 65,151 had at least one dispensing of allopurinol in 2010/11, or 57%. Of these, 44,908 were dispensed allopurinol in at least 3 out of 4 quarters in the year—which is 39% of all those with gout, or 69% of those dispensed allopurinol at least once (see Figure 1).

**Figure 1. Standardised\* rate of those receiving allopurinol regularly as proportion of those getting at least one dispensing per year, 2010/11**



\*'NMNP' = nonMāori/nonPacific; \* Each variable standardised for the others – DHB of domicile standardised for gender, age and ethnicity; ethnicity standardised for gender, age and DHB, gender standardised for ethnicity and DHB.

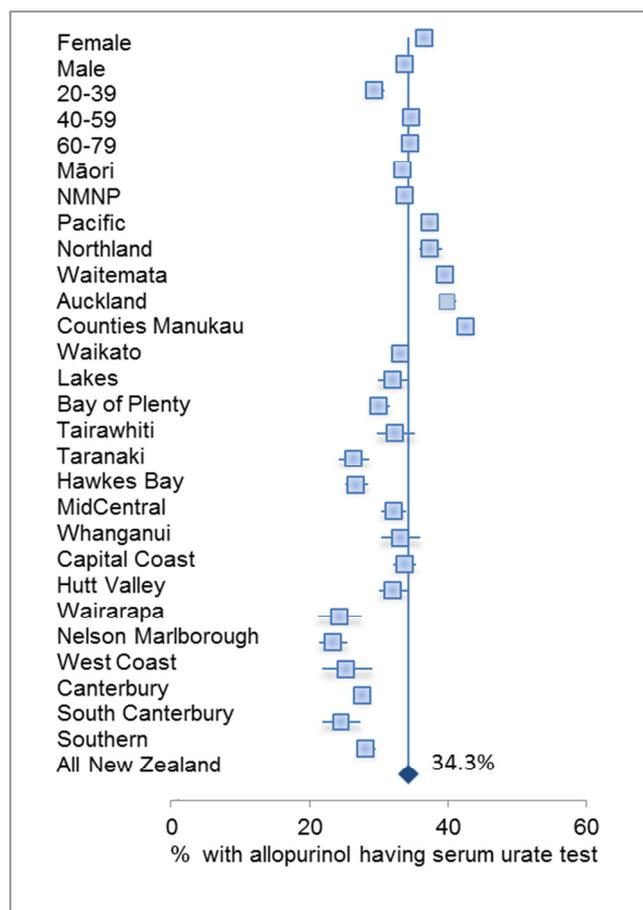
Older people with gout were more likely to receive regular allopurinol than younger (77% for 60–79 compared with 34% for 20–39 year olds), and Māori and Pacific less likely than nonMāori/nonPacific (67% and 63% compared with 71%), but there was little difference by gender (all proportions quoted here are standardised rates). Variation by DHB ranged from 65.2% for people living in Auckland DHB to 73.4% for Hutt Valley DHB.

People living in Waitemata, Auckland and Waikato DHB areas had lower rates of regular use of allopurinol; gout patients in Taranaki, Capital and Coast, Hutt Valley, Nelson Marlborough and Southern had higher rates. A somewhat North–South gradient was observed with rates *higher* in southern regions.

**Laboratory testing for serum urate**—Of all people with at least one dispensing of allopurinol in 2010/11 only 34% had at least one laboratory test for serum urate levels in the 6 months following dispensing (see Figure 2). Females (37%) were slightly more likely than males (34%) to be tested, and older people (35% for 40–59 and 60–79 year olds) more likely than younger (20–39 year olds 29%). Pacific people dispensed allopurinol were more likely to get a laboratory test (37%) than Māori (33%) or nonMāori/nonPacific (34%). Testing rates varied almost two-fold by DHB, ranging from 43% in people living in Counties Manukau DHB to 23% for those living in Nelson Marlborough.

Rates were higher in the 4 northern region DHBs—Northland, Waitemata, Auckland, and Counties Manukau, and lower in 10, including all the South Island DHBs. An opposite north–south gradient to that of allopurinol regularity was observed with rates lower in southern regions. Of note, if the period was changed to a full 12 months after dispensing then the proportion tested rises from 34% to 50.7% of those with at least one dispensing of allopurinol (DHB range from 33% to 61%—data not shown).

**Figure 2. Standardised\* rate of those receiving allopurinol getting at least one serum urate laboratory test in the 6 months following dispensing, 2010/11**

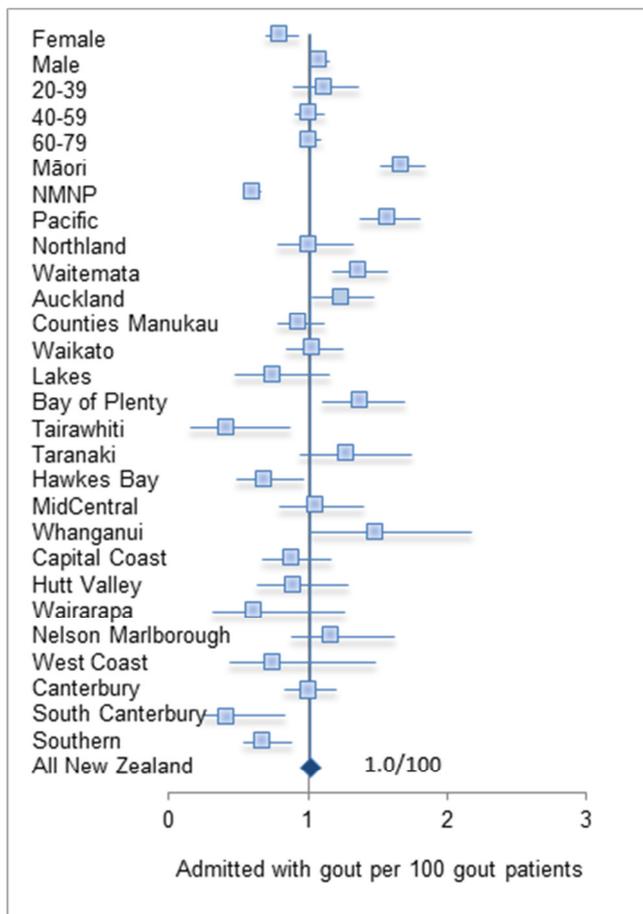


\*'NMNP' = nonMāori/nonPacific; \*Each variable standardised for the others—DHB of domicile standardised for gender, age and ethnicity; ethnicity standardised for gender, age and DHB, gender standardised for ethnicity and DHB.

**Hospital admission for gout**—In 2010/11 there were 1168 acute hospitalisations with a primary diagnosis of gout, or 1.0% of the estimated population with gout (See Figure 3). Females (0.8%) were slightly less likely to be hospitalised than males (1.1%), while age had little effect.

Māori and Pacific people were more likely to be hospitalised (1.7% and 1.6%) than nonMāori/nonPacific (0.6%). Hospitalisation rates by DHB of domicile varied nearly three-fold, ranging from 1.5% in Whanganui to 0.4% for South Canterbury. Rates were high in Waitemata and Bay of Plenty DHBs, and lower in Tairāwhiti, South Canterbury and Southern DHBs.

**Figure 3. Standardised\* rate of hospitalisation for gout as proportion of all with gout, 2010/11**



\*'NMNP' = nonMāori/nonPacific; \*Each variable standardised for the others - DHB of domicile standardised for gender, age and ethnicity; ethnicity standardised for gender, age and DHB, gender standardised for ethnicity and DHB. Acute or arranged admissions with a principal diagnosis of gout, ages 20–79 years.

**Correlations between quality indicators**—Only weak correlations appeared to exist between the quality indicators tested at the DHB level – indeed some were negatively correlated—for example DHBs with higher rates of people regularly receiving allopurinol had lower rates of serum urate testing ( $r^2=-0.24$ ).

For Māori and Pacific people their relatively low rate of allopurinol regularity fitted with their relatively high rate of hospital admission ( $r^2=-0.70$ ), but not with their higher rate of serum urate testing ( $r^2=-0.64$ ). It is in the age group analyses that we see the most consistency across the indicators, with those in older age groups being more likely to receive allopurinol regularly and to have serum urate tests, while being relatively less likely to be admitted to hospital for gout.

Taking all people with gout in Aotearoa New Zealand aged 20–79 only 39% were being regularly treated with allopurinol. This varied by DHB from 33% to 47%. We compared the variation by DHB to the variation for each of the indicators. There was the expected correlation with allopurinol regularity ( $r^2=0.63$ ) but a negative correlation with serum urate testing ( $r^2=-0.54$ ), and no correlation with hospital admission. No measure was particularly correlated with gout prevalence.

## Discussion

With an estimated 3.8% of New Zealanders aged 20–79 years having gout, it is important that quality of gout care can be quantified. Maintaining serum urate levels below 0.36 mmol/L is associated with improved clinical outcomes for people who have more than one attack a year of gout. In this analysis, we were particularly interested in exploring system-level effects, where larger population groups vary in care quality indicators. Three indicators have been explored here.

Of all people dispensed allopurinol 69% were receiving it regularly and yet without regular use its benefits on gout would be limited. Only 34% of people dispensed allopurinol had serum urate testing in the guideline-recommended 6-monthly period.<sup>4,5</sup> Combined, only 23% of gout patients considered to require allopurinol treatment were being treated according to best practice. However we are unable to ascertain if dose titration of urate lowering therapy occurred alongside these two important steps.

The third indicator was for acute hospitalisation for gout—1% of gout patients were admitted in 2010/11. At a DHB level the three indicators varied significantly, but seemed to be relatively independent of each other. Each would seem to be measuring a different aspect of care. No measure was correlated with gout prevalence, despite an initial supposition that clinicians working in areas where they saw more gout might be more systematic in their care and demonstrate better quality outcomes.

The higher burden of morbidity related to gout for Māori and Pacific peoples compared to other New Zealanders is highlighted by rates of hospitalisation more than 2½ times that of the nonMāori/nonPacific population (1.7% and 1.6% compared with 0.6%). Despite this higher rate they are no more likely to receive any allopurinol preventive treatment, and are less likely to be receiving regular allopurinol.

This paper suggests that acute flares of gout severe enough to necessitate hospital admission are potentially related to inadequate preventive care, and the higher admissions rates in Māori and Pacific peoples correlate with their being less likely than those identified as nonMāori/nonPacific to be receiving regular allopurinol.

Most people with gout and also the wider public believe that gout is present when there is an acute attack rather than understanding that gout is in fact a long-term (chronic) illness. This misperception makes it hard for people of any ethnicity to understand the need for long-term medication.<sup>9,10</sup> Additionally a New Zealand review of health education resources on gout medication by health literacy professionals, Workbase, found that messages most relevant to Māori and Pacific peoples, are not provided in a manner that is understandable to them.<sup>11,12</sup> An inherited tendency to develop gout<sup>13</sup> for these people is coupled with a lack of prioritisation of resources.<sup>14</sup> They found that the health literacy demands of managing gout are high; that:

Initially, the medication and management process for gout and gout attacks is complex, with a lot of new information, experiences and decisions for people with gout. It is during this initial phase that managing medication is most complicated and people form incorrect medication habits and beliefs. Poor medication management can lead to a refusal to use preventive medication (p vi, Ministry of Health 2012).<sup>14</sup>

The Workbase review suggested that successful management of gout requires the provision of clear instructions about medication and support for those with gout and their families and whānau to ensure the instructions are understood and followed as part of regular monitoring. This approach will be key

to reducing the current inequities for Māori and Pacific peoples in the quality of gout care demonstrated by this study.

**Comparisons**—The overall proportion of people with gout regularly receiving allopurinol at 39% was similar to that found in an earlier New Zealand study at 39–42.7%,<sup>15</sup> but higher than the 30% seen in the UK in 2006,<sup>16</sup> 17% over 2 years seen in Israel in 2002 to 2009<sup>17</sup> or 18% over 2 years in the US in 1997/8.<sup>18</sup> In relation to people dispensed allopurinol, general practitioners in the UK saw a ‘persistence’ of patients on allopurinol at 61% after one year in 2000–2005, while a similar measure for German patients was 31%.<sup>19</sup> Harrold et al found an adherence rate of only 44% in the Northeast US, and noted poorer adherence for younger patients.<sup>20</sup> The equivalent figure reported here at 69%, while compiled from a different metric, compares well.

Proportions of patients on allopurinol getting appropriate laboratory tests for serum urate are not well described in the literature. A practice audit in the UK found 34% had had a test done in the previous year,<sup>21</sup> lower than found here where 50.7% had a test over a 12-month period. Only 32% of general practitioners in Ireland stated that they routinely monitored serum urate levels in patients on allopurinol.<sup>22</sup> Without knowing the level of uric acid in the blood the achievement of the treatment goal of 0.36 mmol/L or below cannot be monitored.

Rates of admission to hospital for gout patients in Aotearoa New Zealand were compared to England by Robinson et al.<sup>23</sup> Their rate for Aotearoa New Zealand of 1.3% of gout patients of all ages for 2008/09 is similar to the 1% shown here for 20–79 year olds, and was compared with estimates from 0.39% (2004) to 1.6% (2007) for England for depending on which gout prevalence estimate was used.

**Strengths and limitations**—This study covers the entire Aotearoa New Zealand population, and potentially 80% of all gout patients within that.<sup>2</sup> Problems of potential bias from facility-based or region-based studies are avoided. However this study is not based on a clinical diagnosis of gout, nor were we able to otherwise validate the diagnosis. Some people may have been given allopurinol for non-gout reasons.

Evidence for gout flares is imputed from the dispensing data rather than directly measured. There is a lack of direct information about whether a person had more than one attack a year or had tophi – and hence should be offered allopurinol or other urate-lowering medication. Although sustained serum urate levels below 0.36 mmol/L represents the gold standard for optimum gout management, this data is not available at a population level. However, regular use of urate lowering therapy, with monitoring of urate levels to enable adjustment of allopurinol dose to achieve this goal, are useful intermediate outcomes. Urate levels are available in clinical practice records, providing the opportunity for quality audits to explore further issues highlighted by this population study.

**Further work**—We have demonstrated that it is possible to measure some aspects of quality of care of gout with national data and found little relationship between prevalence and indicators of quality of care. Sometimes neglected in the past, there are now very clear guidelines and treatment goals for gout.<sup>3–6</sup> Practices can audit their care against these treatment goals and recommended processes.<sup>5,20,24–25</sup> A summary of potential aspects of quality of gout care one might measure are shown in Table 2. In addition there is the whole field of appropriate treatment for comorbidities that feature so prominently in gout patients.<sup>26</sup> Further work could explore dose-related measures, particularly around initiation of treatment.

**Table 2. Potential indicators for gout quality of care from routinely collected data**

Marker	Rationale	Aim
1. Of those with gout, proportion with serum urate levels <0.36 mmol/l	Flares controlled if serum urate levels <0.36 mmol/L, joint damage minimal. [often not available in routinely collected data]	As close to 100% as possible.
2. Of those with gout dispensed at least one allopurinol script, proportion getting at least 3 out of last 4 quarters.	Prescribed allopurinol at least once so assume meet criteria for starting urate-lowering therapy; allopurinol only effective if regularly taken.	As close to 100% as possible.
3. Those with gout getting colchicine dispensed 2 or more times but not allopurinol	Getting more than one attack but not being treated with allopurinol; would likely benefit from allopurinol	As low as possible – some may be getting their first double attack in a year, so prior to initiating allopurinol. Reasons for not taking allopurinol are minimal if people are dosed optimally.
4. Those initiating allopurinol also dispensed colchicine or NSAID	Good practice is to cover initiation of allopurinol treatment with prophylaxis as allopurinol doses are escalated	No target defined.
5. Those initiating allopurinol starting on a low dose (i.e. 100 mg/day or less) then up-titrating if needed	Trying to avoid gout flares on initiation. Guidelines recommend 100mg/day (or less in renal disease) as initiating dose. <sup>4</sup> If possible use eGFR to set starting doses, but this is not usually available in routinely collected data	No target defined.
6. Of those initiating allopurinol, proportion getting a serum urate test within 6 months	Key part of titrating initial treatment is knowing the urate level; guidelines suggests every 2-5 weeks <sup>4</sup>	As close to 100% as possible.
7. Of those with gout on allopurinol, proportion getting a serum urate test in last 12 months	Key marker of potential damage is to keep serum rate below 0.36 mmol/l. Cannot do this if not measuring it. Guidelines suggest 6 monthly <sup>4</sup>	As close to 100% as possible.
8. Proportion of those on allopurinol above 300mg/day	Evidence of dose titration to meet treatment goals.	Non-zero – perhaps 10% or higher
9. Hospital admissions for gout – gout as principal diagnosis	Acute attacks of gout severe enough to necessitate hospital admission are potentially related to inadequate preventive care.	As low as possible.

**Source:** A distillation from a number of sources including<sup>3-7,15,27,28</sup>

Note it is assumed most urate lowering therapy will be with allopurinol in Aotearoa New Zealand. More generally “urate-lowering therapy” could be substituted for allopurinol in the table.

## Conclusion

We have demonstrated that routinely collected health data can be used to monitor the quality of care for people with gout at a high level. Variation by ethnicity and DHB was demonstrated around Aotearoa New Zealand, with lower levels of adequate preventive treatment for Māori and Pacific peoples.

Comparisons using the Atlas of Healthcare Variation may enable DHBs to identify local problems, design interventions, and set appropriate targets. Further work is needed to draw a more comprehensive picture of gout care and development of potential composite scores for monitoring

purposes. In Aotearoa New Zealand, regularity of allopurinol dispensing was less than 70% over 1 year, and laboratory testing for serum urate was low at 34% in 6 months for those taking allopurinol.

Around 1% of all people with gout aged 20–79 years were admitted to hospital in 1 year with gout as the primary cause of admission. Collectively, these data indicate that initiatives that focus on maintaining a continuous supply of urate-lowering therapy to ensure therapeutic serum urate targets are achieved are required to improve the impact of gout in Aotearoa New Zealand.

**Competing interests:** Nil.

**Author information:** Gary Jackson, Principal Consultant Clinical Planning, Health Partners Consulting Group, Auckland; Nicola Dalbeth, Associate Professor of Rheumatology, University of Auckland; Leanne Te Karu, Pharmacist Prescriber from Turangi – Māori Pharmacists' Association; Doone Winnard, Clinical Director Population Health, Counties Manukau District Health Board, South Auckland; Peter Gow, Associate Professor, Rheumatology, Middlemore Hospital, South Auckland; Catherine Gerard, Senior Analyst, Health Quality & Safety Commission, Wellington; Nikolai Minko, Senior Analyst, Health Quality & Safety Commission, Wellington

**Correspondence:** Dr Gary Jackson, Health Partners Consulting Group, PO Box 147-209, Ponsonby, Auckland 1144, New Zealand. [gary@healthpartnersconsulting.com](mailto:gary@healthpartnersconsulting.com)

## References

1. Winnard D, Wright C, Taylor WJ, et al. National prevalence of gout derived from administrative health data in Aotearoa New Zealand. *Rheumatology (Oxford)* 2012;51(5):901–9.
2. Jackson G, Wright C, Thornley S, et al. Potential unmet need for gout diagnosis and treatment: capture-recapture analysis of a national administrative dataset. *Rheumatology (Oxford)* 2012;51(10):1820–4.
3. Sivera F, Andrés M, Carmona L, et al. Multinational evidence-based recommendations for the diagnosis and management of gout: integrating systematic literature review and expert opinion of a broad panel of rheumatologists in the 3e initiative. *Ann Rheum Dis* 2014;73:328–335.
4. Khanna D, Fitzgerald JD, Khanna PP, et al. American College of Rheumatology guidelines for management of gout. Part 1: Systematic nonpharmacologic and pharmacologic therapeutic approaches to hyperuricemia. *Arthritis Care Res* 2012;64:1431–46.
5. An update on the management of gout - BPJ Issue 51. Available at: <http://www.bpac.org.nz/BPJ/2013/March/managing-gout.aspx> Accessed 1 Apr 2014.
6. Auckland Regional Clinical Pathways for Gout Prevention. Available at: <http://www.healthpointpathways.co.nz/gout-prevention/> Accessed 1 Apr 2014.
7. Dalbeth N. Management of gout in primary care: challenges and potential solutions. *Rheumatology (Oxford)* 2013;52:1549–50.
8. Harrold LR, Mazor KM, Negron A, et al. Primary care providers' knowledge, beliefs and treatment practices for gout: results of a physician questionnaire. *Rheumatology (Oxford)* 2013;52:1623–9.
9. Harrold LR, Mazor KM, Peterson D et al. Patients' knowledge and beliefs concerning gout and its treatment: a population based study. *BMC Musculoskeletal Disorders* 2012;13:180.
10. Rees F, Jenkins W, Doherty M. Patients with gout adhere to curative treatment if informed appropriately: proof-of-concept observational study. *Ann. Rheum. Dis.* 2013;72:826–830.
11. Ministry of Health. Korero Marama: Health literacy and Māori. Results from the 2006 Adult Literacy and Life Skills Survey. Wellington: Ministry of Health, 2010.
12. Ministry of Health. Tupu Ola Moui Pacific Chart Book 2012. Wellington: Ministry of Health, 2012.
13. Merriman TR, Dalbeth N. The genetic basis of hyperuricaemia and gout. *Joint Bone Spine.* 2011;78:35–40.

14. Ministry of Health. Review of Health Education Resources on Gout Medication: Summary of report to the Ministry of Health. Wellington: Ministry of Health, 2012.
15. Dalbeth N, House ME, Horne A et al. Prescription and dosing of urate-lowering therapy, rather than patient behaviours, are the key modifiable factors associated with targeting serum urate in gout. *BMC Musculoskeletal Disorders* 2012;13:174.
16. Roddy E, Zhang W, Doherty M. Concordance of the management of chronic gout in a UK primary-care population with the EULAR gout recommendations. *Ann Rheum Dis* 2007;66:1311–1315.
17. Zandman-Goddard G, Amital H, Shamrayevsky N, et al. Rates of adherence and persistence with allopurinol therapy among gout patients in Israel. *Rheumatology (Oxford)* 2013;52:1126–31.
18. Riedel AA, Nelson M, Joseph-Ridge N et al. Compliance with allopurinol therapy among managed care enrollees with gout: a retrospective analysis of administrative claims. *J Rheumatol.* 2004;31(8):1575–81.
19. Annemans L, Spaepen E, Gaskin M, et al. Gout in the UK and Germany: prevalence, comorbidities and management in general practice 2000–2005. *Ann Rheum Dis* 2008;67:960–96.
20. Harrold LR, Andrade SE, Briesacher BA, et al. Adherence with urate-lowering therapies for the treatment of gout. *Arthritis Res Ther* 2009;11:R46.
21. Cottrell E, Crabtree V, Edwards JJ, Roddy E. Improvement in the management of gout is vital and overdue: an audit from a UK primary care medical practice. *BMC Family Practice* 2013, 14:170.
22. Owens D, Whelan B, McCarthy G. A survey of the management of gout in primary care. *Ir. Med. J.* 2008;101:147–149.
23. Robinson PC, Merriman TR, Herbison P, Highton J. Hospital admissions associated with gout and their co-morbidities in New Zealand and England 1999–2009. *Rheumatology (Oxford)* 2013;52(1):118–126.
24. Reaves E, Arroll B. Management of gout in a South Auckland general practice. *J Prim Health Care* 2014;6(1):73–78.
25. Gow P, He J. How healthy are our patients with gout? A study of health status and management of patients with gout at two primary health care practices. *Ann Rheum Dis* 2014;73(Suppl2).
26. Winnard, D, Wright C, Jackson G, et al. Gout, diabetes and cardiovascular disease in the Aotearoa New Zealand adult population: co-prevalence and implications for clinical practice. *NZ Med J* 2013;126(1368):53–64.
27. Stamp LK, O'Donnell JL, Zhang M et al. Using allopurinol above the dose based on creatinine clearance is effective and safe in patients with chronic gout, including those with renal impairment. *Arthritis & Rheumatism* 2011;63(2):412–421.
28. Mikuls TR, MacLean CH, Olivieri J, et al. Quality of care indicators for gout management. *Arthritis Rheum.* 2004;50(3):937–43.

**Appendix 1**

<b>Indicator</b>	<b>Numerator</b>	<b>Denominator</b>	<b>Notes on indicators</b>
1. Of those with gout dispensed at least one allopurinol script, proportion getting at least 3 out of last 4 quarters.	Those with an indication of gout who were dispensed allopurinol for at least three of the four quarters of the year in 2010/11	Those with an indication of gout in ANZHT getting at least one allopurinol dispensing in 2010/11	Assumed that gout flares present as received at least one allopurinol dispensing.
2 Of those with gout dispensed allopurinol, proportion getting a serum urate test in the 6 months following dispensing	Those dispensed allopurinol in ANZHT and at least one recorded community laboratory serum urate lab test in the 2010/11 year in the six months following the first allopurinol dispensing of the year	Those dispensed allopurinol at least once	Could extend this to cover all people diagnosed with gout, given they should be monitored. Also could cover the whole year, not just 6 months.
3. Hospital admissions for gout – gout as principal diagnosis	All discharges from public hospitals with a principal diagnosis of gout (ICD10AM M10) in 2010/11	Health care-using population, ANZHT	Acute medical surgical discharges, casemix only; Age-gender-ethnicity standardised
Gout prevalence	Those with an indication of gout in ANZHT-hospitalisation, dispensing of colchicine or allopurinol 2006-2011	Health care-using population, ANZHT	See Winnard et al <sup>1</sup>
Proportion of gout population on allopurinol	Those with an indication of gout who were dispensed allopurinol for at least 3 of the 4 quarters of the year in 2010/11	Those with an indication of gout in ANZHT	

ANZHT = Aotearoa-New Zealand Health Tracker, a Ministry of Health dataset. All indicators include ages 20–79. 2010/11 refers to the period 1 July 2010–30 June 2011. Prescribing of chronic medication is normally in 3-month increments. Dispensing in 3 out of 4 quarters is roughly equivalent to a Medication Possession Ratio of 80%, often used as a benchmark in compliance work.