

Implementation of an intervention to reduce population-based screening for vitamin D deficiency: a cross-sectional study

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Abstract

Background: We describe the implementation of an intervention in Alberta in support of the Choosing Wisely Canada recommendation against population screening for vitamin D deficiency (as determined by serum total 25-hydroxyvitamin D testing). We hypothesized that the introduction of a specialized requisition for vitamin D testing would reduce the annual number of vitamin D tests performed.

Methods: We performed a cross-sectional observational study that included all vitamin D tests ordered in Alberta between Apr. 1, 2015, and Mar. 31, 2016. There were no exclusion criteria. A special requisition for ordering vitamin D tests in Alberta was introduced on Apr. 1, 2015. Using an interrupted time series model, we compared predicted versus observed vitamin D test volumes for the 12-month period following the introduction of the new requisition. The sole outcome measure was the monthly change in volume of vitamin D testing. In addition, we calculated any cost savings as a result of reduced testing.

Results: Over the first 12 months of the intervention, there was a reduction in the number of tests ordered from a predicted 342 477 tests to 29 525 tests (91.4% reduction). This decrease represented a direct spending decrease of Can\$938 856–\$1 564 760 per year in Alberta.

Interpretation: A provincially led implementation of a Choosing Wisely Canada recommendation resulted in a large and sustained reduction in serum total 25-hydroxyvitamin D testing in Alberta. This study shows that provincially led interventions based on Choosing Wisely Canada recommendations can result in substantial reductions in laboratory tests.

Choosing Wisely^{1,2} and Choosing Wisely Canada³ are national initiatives in the United States and Canada, respectively, with the goal of helping physicians and patients engage in conversations about unnecessary tests, treatments and procedures. Although Choosing Wisely Canada recommendations are released nationally, health care delivery is a provincial responsibility; therefore, implementation of specific recommendations is carried out provincially. Studies on the effectiveness of interventions to manage the use of laboratory testing are often lacking or of limited scope and quality.^{4,5}

Choosing Wisely Alberta,⁶ a physician-led committee of the Alberta Medical Association, is responsible for the coordination and promulgation of Choosing Wisely Canada recommendations. This group identified 5 priority recommendations for implementation in Alberta, one of which was the recom-

mendation against population-based screening for serum total 25-hydroxyvitamin D (vitamin D) deficiency. This recommendation was jointly put forward by The Canadian Association of Pathologists⁵ and by the Canadian Medical Association's Forum on General and Family Practice Issues and the College of Family Physicians of Canada^{7,8} as part of the Choosing Wisely Canada Wave II recommendations on Oct. 29, 2014.

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Vitamin D screening has been particularly problematic for the health system in Alberta because there has been a massive increase in test volumes over the past 10 years,⁹ with evidence that testing has been preferentially directed toward low-risk patients.¹⁰

We describe the implementation of an intervention in Alberta in support of the Choosing Wisely Canada recommendation against population screening for vitamin D deficiency.

Methods

Intervention

In March 2014, a working group was formed in Alberta to address the massive increases in requests for vitamin D testing despite provincial recommendations against population screening for vitamin D deficiency.¹¹ This working group consisted of representatives from Alberta Health Services (the operational arm of the provincial Department of Health), clinical laboratories, the Alberta Medical Association and the Alberta Obesity, Diabetes and Nutrition Strategic Clinical Network. After the release of the Choosing Wisely Canada Vitamin D recommendations in October 2014, this working group joined with Choosing Wisely Alberta to design and implement a province-wide use management strategy for vitamin D testing.

The working group considered a number of strategies including education, audit and feedback of ordering practices to individual physicians and administrative restrictions on test ordering. An administrative strategy consisting of restriction of testing to specific clinical situations combined with a new provincial requisition¹² for all vitamin D test requests was chosen by the working group because of relative ease of implementation and because administrative interventions tend to be more effective than other types of intervention.⁴ Under this use management strategy, starting Apr. 1, 2015, vitamin D tests were only available for the following clinical indications: metabolic bone disease, abnormal blood calcium, malabsorption syndromes, chronic renal disease and chronic liver disease. Requests were only accepted if accompanied by the new provincial requisition with 1 of the listed indications checked off.

This initiative was accompanied by a province-wide communication strategy that included an update of the provincial clinical practice guidelines to align them with the new requisition, development of an information sheet that was provided to physicians to give to patients who requested vitamin D testing that was not clinically indicated, and the appending of a comment describing the intervention to all reported vitamin D results for the month before the intervention.

Setting

This work was performed in Alberta and includes all vitamin D tests ordered in the province from Apr. 1, 2015, to Mar. 31, 2016. This is an observational study using publicly available secondary data on laboratory test volumes. The intervention exposure was equal for all physicians (a specialized requisition)

and there were not treatment and control groups. There was no specific follow-up of either patients or physicians in this study. Test volumes for both inpatient and outpatient samples were used in the analysis, and the unit of analysis was the number of tests rather than the number of patients.

Data sources

Vitamin D tests are only performed at 3 laboratories in the province (Edmonton, Calgary and Medicine Hat). Total test volume data on vitamin D tests for each of these laboratories is reported monthly to Alberta Health Services as part of routine quality improvement metrics. We used this data from the period Jan. 1, 2013, to Mar. 31, 2015, to establish the pattern of seasonal variation and year-over-year changes to be used in the time series model, and volumes from Apr. 1, 2015, to Mar. 31, 2016, to test the effect of the intervention. The sample size was the total number of vitamin D tests ordered. Because the reporting of data on monthly test volumes is mandated for all laboratories in the province, we expect that there was no bias in reporting.

In addition, we calculated potential cost savings based on an estimated marginal cost per test of Can\$3.00–\$5.00. Because the exact values are proprietary, we chose to illustrate a reasonable range of estimated costs based on our knowledge of reagent costs in a number of Canadian laboratories.

Statistical analysis

Preliminary analyses showed considerable seasonal variation in the number of vitamin D tests ordered. To account for this background monthly variation, we used historic test volumes at each of the 3 testing laboratories and all sites combined to create interrupted time series¹³ in IBM SPSS Statistics (version 22). Preliminary analyses showed that Winter's additive models gave the best model fit, therefore these were used for subsequent analyses. Comparing the predicted monthly vitamin D test volumes at each of the testing sites with the observed values allowed us to assess the effectiveness of the intervention on a monthly basis. This information was reported back to Choosing Wisely Alberta on a monthly basis.

Ethics approval

This study used only publicly available test volume data and therefore did not require formal ethics approval by our organization. Formal waiver by our institutional ethics review board is not granted in such instances, and determination of the need for formal ethics review is left to individual researchers.

Results

The use management initiative resulted in an immediate and dramatic reduction in vitamin D test requests. Prior to the intervention, the average number of tests per month was about 28 000. After the intervention, it was 2290 per month. The interrupted time series analysis for all testing sites combined is shown in Figure 1. The stationary R^2 for this model was 0.86 with a mean absolute percent error of 2.42, with a p

value of 0.138 for the Ljung–Box Q test,¹⁴ which suggests that the model does not exhibit autocorrelation and had a good fit to the data. In the 12 months after the introduction of the intervention, the predicted provincial volume of vitamin D testing was 342 477, whereas the observed volume was 29 525, equating to an overall reduction of 312 952 tests or 91.4%. This reduction was sustained over the first 12 months of the intervention. Similar reductions were seen at all 3 testing sites. Because we used deidentified administrative data, we were not able to test whether reductions varied with patient demographics. This intervention is projected to result in a direct spending decrease of Can\$938 856–\$1 564 760 per year in Alberta.

Interpretation

We describe the successful implementation of an intervention to manage the use of laboratory testing based on a Choosing Wisely Canada recommendation to reduce Vitamin D screening. This intervention involved broad engagement of key stakeholders, including clinical laboratories, Alberta Health Services and the Alberta Medical Association, along with analytics support to accurately measure the effect of the intervention. We report direct (marginal) cost savings of about 1 million dollars per year in Alberta, depending on the actual reagent costs in individual laboratories. Considering only marginal (reagent) costs is the most conservative way of calculating cost savings from use management interventions,^{15,16}

however the actual savings (or at least cost avoidance) are greater in this intervention because in at least 1 of the testing laboratories, the large reduction in volume allowed reallocation of technical staff to other testing areas. As previously mentioned, the literature on laboratory use management interventions is limited. However, the size of the reduction in test volume seen in this study was far greater than that generally reported.^{4,5}

We anticipated that there may have been more questions or concerns given that a recent survey of Alberta primary care physicians showed that specialized test requisitions for certain tests were felt to be acceptable to only 45% of survey respondents.¹⁷

In the current era of unsustainable increases in laboratory test volumes in Canada,^{18,19} the managed exit of low-value tests is needed to ensure resources are available for medically necessary tests. To our knowledge, Alberta is the only jurisdiction to have implemented a policy such as this. The primary difference is that other provinces have allowed for a “patient pay” option for testing that was not clinically indicated. For example, on Dec. 1, 2010, the Ontario Health Insurance Plan discontinued coverage for vitamin D testing except for patients with certain medical conditions,²⁰ although patients could still pay privately for the test. Restrictions on vitamin D test coverage by the Medical Services Plan of British Columbia began on June 1, 2013,²¹ but again, patients could pay for their own test if desired. The Choosing Wisely Alberta group, however, felt strongly that allowing patients to pay for something that



Figure 1: Time series analysis showing the effect of the intervention to reduce serum 25-hydroxyvitamin D (vitamin D) testing in Alberta. There was a sustained 91.4% reduction in vitamin D test requests during the first year after the introduction of the intervention.

was not clinically useful was inappropriate and contrary to the ideals of the Choosing Wisely Canada initiative.

Limitations

This intervention concerned only the commonly ordered serum total 25-hydroxyvitamin D test, and not the less commonly ordered 1,25-dihydroxyvitamin D₃ test. Furthermore, there is considerable ongoing research concerning the possible association of vitamin D levels with various diseases. As the science surrounding vitamin D progresses, the recommendations of the Choosing Wisely Canada program may require re-evaluation.

Conclusion

A specialized requisition for vitamin D test requests in Alberta reduced test use by more than 90%. Interventions such as that described in this paper will become increasingly important in effectively managing laboratory testing resources. Choosing Wisely Canada, provincial health departments, provincial medical associations and clinical laboratories all have a cooperative role to play in this process. It is our intention to monitor vitamin D test requests on an ongoing basis to evaluate the long-term effectiveness of this intervention.

References

- Hilborne LH. When less is more for patients in laboratory testing. *Am J Clin Pathol* 2013;139:271-2.
- Hilborne LH. Choosing wisely: selecting the right test for the right patient at the right time. *MLO Med Lab Obs* 2014;46:40.
- Leon-Carlyle M, Srivastava R, Levinson W. Choosing Wisely Canada: integrating stewardship in medical education. *Acad Med* 2015;90:1430.
- Thomas RE, Vaska M, Naugler C, et al. Interventions at the laboratory level to reduce laboratory test ordering by family physicians: systematic review. *Clin Biochem* 2015;48:1358-65.
- Thomas RE, Vaska M, Naugler C, et al. Interventions to educate family physicians to change test ordering: systematic review of randomized controlled trials. *Academic Pathol* 2016;3:1-23.
- Choosing Wisely Alberta [homepage]. Edmonton: Alberta Medical Association. Available: www.albertadoctors.org/leaders-partners/choosing-wisely-alberta (accessed 2016 June 2).
- Pathology: five things physicians and patients should question. Toronto: Canadian Association of Pathologists, and Ottawa: Canadian Medical Association; 2014. Available: www.choosingwiselycanada.org/recommendations/pathology/ (accessed 2016 June 2).
- Family medicine: eleven things physicians and patients should question. Toronto: The College of Family Physicians of Canada, and Ottawa: Canadian Medical Association; 2014. Available: www.choosingwiselycanada.org/recommendations/family-medicine/ (accessed 2016 June 2).
- Naugler C, Zhang J, Henne D, et al. Association of vitamin D status with socio-demographic factors in Calgary, Alberta: an ecological study using Census Canada data. *BMC Public Health* 2013;13:316.
- de Koning L, Henne D, Woods P, et al. Sociodemographic correlates of 25-hydroxyvitamin D test utilization in Calgary, Alberta. *BMC Health Serv Res* 2014;14:339.
- Vitamin D testing and supplementation: clinical practice guideline*. Edmonton: Toward optimized practice; 2014. Available: www.topalbertadoctors.org/download/1304/Vitamin%20D%20Testing%20and%20Supplementation.pdf (accessed 2016 June 2).
- Laboratory Services Vitamin D (25-Hydroxy) Requisition form. Edmonton: Alberta Health Services. Available: www.albertahealthservices.ca/frm-19500.pdf (accessed 2016 June 2).
- Mohammed AA, Naugler C, Far BH. Emerging business intelligence framework for a clinical laboratory through big data analytics. In: Tran QN, Arabnia H, editors. *Emerging trends in computational biology, bioinformatics, and systems biology: algorithms and software tools*. New York: Elsevier/Morgan Kaufmann; 2015:577-602.
- Ljung GM, Box GEP. On a measure of a lack of fit in time series models. *Biometrika* 1978;65:297-303.
- Morgen EK, Naugler C. Inappropriate repeats of six common tests in a Canadian city: a population cohort study within a laboratory informatics framework. *Am J Clin Pathol* 2015;144:704-12.
- MacMillan D. Calculating cost savings in utilization management. *Clin Chim Acta* 2014;427:123-6.
- Thommasen A, Clement F, Kinniburgh DW, et al. Canadian family physician knowledge and attitudes toward laboratory utilization management. *Clin Biochem* 2016;49:4-7.
- Rockey MJ, Naugler C, Sidhu D. Laboratory test utilization trends: past and future. *Can J Pathol* 2013;5:65-71.
- Naugler C. A perspective on utilization management from Canada. *Clin Chim Acta* 2014;427:142-4.
- Ontario changing OHIP coverage for vitamin D testing. Toronto: Ontario Ministry of Health and Long Term Care; 2010. Available: www.health.gov.on.ca/en/news/bulletin/2010/20101130.aspx (accessed 2017 Jan. 9).
- Restricted 25-hydroxy-vitamin-D testing as of June 1st. Vancouver: BC Biomedical Laboratories; 2013. Available: www.bcbio.com/news/324-restricted-25-hydroxy-vitamin-d-testing-as-of-june-1st (accessed 2017 Jan. 9).

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