RESEARCH

Costs and stewardship of laboratory tests in the Capital Health District

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Abstract

Responsible use of diagnostic resources benefits the Canadian healthcare system. Educating clinicians about the costs of laboratory tests can reduce corresponding resource use, both by encouraging substitutions with appropriate and less-expensive alternatives, and by reducing overall diagnostic workup loads where warranted. To that end, this paper presents the costs of commonly used laboratory tests, and of some less-expensive alternatives, for the Capital District Health Authority of Nova Scotia, Canada. It then compares the aggregate costs of representative brief and elaborate workups for six common patient presentations. When used appropriately, initial workups composed of fewer test alternatives can save between $11.27 (abdominal pain) and $103.63 (shortness of breath) per workup without affecting patient care. Making judicious test substitutions can also provide savings. Clinicians are encouraged to consider these costs and alternatives when providing future patient care.

Healthcare spending in Canada has risen steadily in the past 15 years (7.4% per year, 1998 to 2008), with physician and diagnostic resource use contributing an important component of this rise (20.2%).[1] A Canadian Institute for Health Information (CIHI) estimate of 2013 spending shows a recent, encouraging decline in this rate of growth (2.4%), but an expenditure nonetheless of just under $6,000 per Canadian per year.[2]

Stewardship of healthcare resources is an important physician role, especially in a publicly funded system. The issue is also recognized internationally, with the American Board of Internal Medicine's Choosing Wisely Campaign (www.choosingwisely.org)[3] developing lists of low-yield and overused diagnostic tests to encourage more judicious diagnosis and treatment decisions.

When used appropriately, a restrained approach to diagnostic testing has patient benefits. For instance, fewer tests leads to fewer false-positive results and fewer incidentalomas.[4] Running fewer tests also intrinsically risks fewer patient harms, for instance by reducing iatrogenic blood loss, and reducing procedural risks such as ionizing radiation.[5]

Successful "top-down" approaches to curb unnecessary testing include restricting the availability or frequency of certain tests, and by giving regular electronic reminders, audits, and/or forcing timeouts when tests are scheduled serially.[6,7]Unbundling of standard workup panels also limits overuse.[8]

Recognizing the wide inter-individual and inter-institutional variation in test-ordering—with no indication of improved clinical outcomes (critical care studies[9,10])—there are also important opportunities to change decision-making at the individual level (i.e. "bottom-up" approaches), for instance, by providing estimated costs of tests and their alternatives to the clinician. Compared to several top-down strategies, educational approaches may achieve greater reductions in testing volume.[11]

Previous research has shown cost savings among clinicians exposed to diagnostic pricing data compared to control groups,[11-14] and in all clinical cases studied with data available, this did not affect patient outcomes or satisfaction.[13] However, the availability of outcome data remains quite limited overall.[11] Interestingly, in three of six clinical and simulated studies involving pricing education, the observed cost savings did not necessarily arise from reduced testing overall, but rather from substitutions.[13] Physicians have also shown enthusiasm for learning more about the costs of their orders.[12]

With this information in mind, the goal of this study is to contribute to greater bottom-up resource control among Capital Health clinicians. To accomplish this, I present and synthesize some locally-specific pricing data.

The Capital Health context

The majority of clinicians are presumably motivated to reduce institutional and provincial costs. Unfortunately, in the Capital Health system, the costs of our decisions are not routinely obvious, so the opportunities for cost reduction are not always clear. Until recently, a price list was available electronically, but as of September 2014, it had been taken offline for updating.

Capital Health already provides some top-down approaches to curb resource use, for instance by limiting the frequency with which certain tests can be ordered (e.g., thyroid stimulating hormone). In January 2015, the electrolytes panel was also unbundled, delivering only

Test name	Test bundle	Cost per test
Transferrin	Anemia	$3.19
Vitamin B12	Anemia	$13.45
ZPP[a]	Anemia	$3.24
Folate[b]	Anemia	$4.38
Ferritin[a]	Anemia (alternate)	$4.32
RBC folate[b]	Anemia (alternate)	$8.68
INR	Coag	$3.85
Prothrombin time	Coag	$3.85
Blood culture	Cultures	$12.86
Urine culture	Cultures	$10.66
Calcium[c]	Extended lytes	$1.12
Albumin[c]	Extended lytes	$1.12
Magnesium	Extended lytes	$1.12
PO_4	Extended lytes	$1.12
Ionized calcium	Extended lytes	$10.94
AST	LFT	$1.12
ALT	LFT	$1.12
ALP	LFT	$1.12
GGT	LFT	$1.12
Bilirubin total	LFT	$1.12
Bilirubin direct	LFT	$1.12
Lipase[d]	LFT	$1.12
Amylase[d]	LFT	$1.12
CBC	Routine	$2.77
Lytes (Na^+, K^+,Cl^-,CO_2)	Routine	$4.48
Blood urea nitrogen	Routine	$1.12
Creatinine	Routine	$1.12
Glucose	Routine	$1.12
TSH	Thyroid studies	$4.32
T4	Thyroid studies (alternate)	$4.42
T3 ‡	Thyroid studies (alternate)	$5.32
Acetaminophen	Toxins	$1.23
Alcohol	Toxins	$1.23
Salicylates	Toxins	$1.23
Troponin		$5.61
D-dimer		$34.91
Arterial blood gas		$10.94
Venous blood gas		$10.94
C-reactive protein		$3.56
Vasculitis panel ‡		$14.96
ABORh ‡		$8.12
Crossmatch ‡		$9.28
Urinalysis	Urine	$11.08
Dipstick	Urine	$1.99
Anemia	Aggregated	$24.26
Coag	Aggregated	$7.71
Extended lytes	Aggregated	$4.48
LFT	Aggregated	$7.48
Routine	Aggregated	$10.61
Urine	Aggregated	$13.07

Table 1. Approximate laboratory costs (November 2014) in the Capital Health District for selected diagnostic tests, bundled according to their typical concurrent uses. Alternative tests not featured in Figure 1 are italicized. Suggested substitutions are highlighted in the footnotes.

‡Provided for interest;

[a]Zinc protoporphyrin ("ZPP"; $3.24) is less costly than serum ferritin ($4.32), and provides comparable screening efficiency for adults, including hemodialysis patients.[15-17] Savings: $1.08.

[b]Rbc-folate ($8.68) is a more expensive and more error-prone laboratory test which is not more accurate than serum folate alone ($4.38), except immediately post-hemodialysis.[18] Savings: $4.30.

[c]Direct measures of ionized calcium ($10.94) are more accurate than estimates derived from total calcium ($1.12) and serum albumin ($1.12). This more expensive test is most appropriate for inpatients with multifactorial illness and critical care patients, as well as for outpatients with late chronic kidney disease, hyperparathyroidism, and MEN1.[19] Savings: $8.70.

[d]Lipase is a more sensitive and more specific test for acute pancreatitis, although testing both simultaneously can improve diagnostic accuracy in ambiguous cases.[20] Savings with a single test: $1.12.

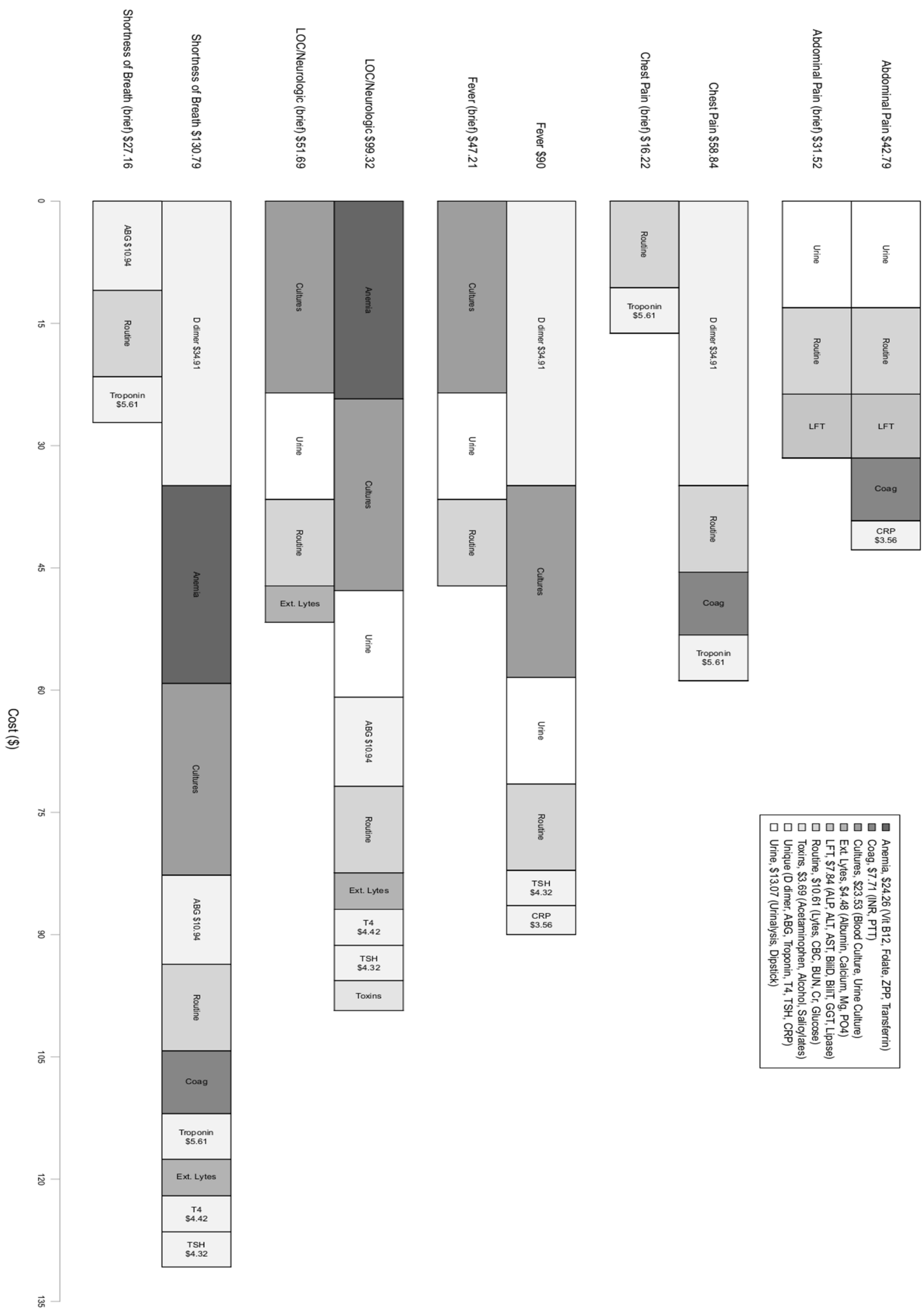

Figure 1. Costs associated with brief and elaborate workups for each of 6 standard patient presentations, grouped by diagnostic bundle in most cases. Specific tests within a bundle are described in the legend. Costs of bundled tests are in the legend; costs for unique tests are listed on the figure. Within a presentation, bundles are ordered from most expensive to least expensive; see Table 1 for specifics. Values are approximate (November 2014).

Na+ and K+ values when ordered. Internal estimates project that more than 500,000 unnecessary Cl^- and CO_2 tests will be avoided per year with this change (Dr. M. Elnenaei, personal communication).

To complement this top-down initiative, this paper acts as a bottom-up approach to improving clinicians' ordering patterns. Using current (November 2014) pricing data obtained offline (C. Mills and C. Andrews, personal communication), I summarize the approximate costs of commonly-used tests and bundles of tests (e.g., liver function tests [LFTs]), both alone and in the context of brief and elaborate workups for common presentations. These bundles and workups were developed by consensus with physician-colleagues. They include most of the high-volume tests highlighted in Horn et al. as candidates for institutional reduction or substitution (Massachusetts, USA), and they closely mirror existing bundles found in the Capital Health adult emergency department order sets.[12]

Recognizing the value of substitution over test elimination in many cases, in accompanying footnotes, I also describe a few specific opportunities for cost reduction in the form of diagnostic alternatives.

Because the costs of individual tests are constantly updated alongside technological and institutional improvements, and because listed costs assume a certain fixed labour overhead (Dr. M. Elnenaei, personal communication) the values listed here are estimates. However, the relative differences in cost among tests are still roughly consistent, and so these data are still quite relevant to stewardship decision-making and the examples given here remain instructive.

Workup costs

With the above consensus input, I divided common tests into 8 workup bundles ("anemia", "coagulation", "cultures", "extended lytes", "LFTs", "routine", "toxins" and "urine"). I also report the costs of some unbundled, but frequently used tests (e.g., troponin); these are all summarized in Table 1.

Pairs of "brief" and "elaborate" workups for five common patient presentations were created: abdominal pain, chest pain, fever, loss of consciousness-neurologic, and shortness of breath (Figure 1). The brief workups should be seen as initial approaches, giving way to more elaborate testing only if important uncertainties remain. Suggested test substitutions are also incorporated into both types of workups (footnotes of Table 1).

Total costs of workups range from $16.22 (chest pain, brief) to $130.79 (shortness of breath, elaborate). Savings achieved through test reduction by choosing the brief initial workups over the elaborate options include $11.27 (abdominal pain), $42.62 (chest pain), $42.79 (fever), $47.63 (neurologic), and $103.63 (shortness of breath). The D-dimer ($34.91) has an enormous relative impact on workup costs. Potential savings are even greater when appropriate test substitutions are also considered (e.g., $8.70 is already saved by measuring total calcium plus serum albumin in place of ionized calcium; see footnotes).

Discussion

Cost savings opportunities, in the form of proposed briefer, initial workups are presented in Figure 1. These are complemented by cost-saving substitutions (Table 1) that are useful in specific, appropriate contexts. Clinicians should always consider these alternatives on a case-by-case basis, balancing the societal need for resource stewardship against the individual patient's needs. At a minimum, this information may lead to more judicious decision-making at the order sheet.

Three important weaknesses of this research worth considering are as follows. First, the data presented here are specific to the Capital Health District, and may not be applicable in other jurisdictions. Second, these data are also time-sensitive. Improvements in diagnostic automation have the potential to change the relative costs of many tests, thus changing the relative magnitudes of the results. Nonetheless, the benefits of reducing unnecessary testing remain. Third, I have assumed that any changes to clinical practice arising from this research will persist in the long term. Unfortunately, there is very limited research in this regard.[11] Nonetheless, in the opinion of the author, the potential short-term benefits of these data still make this research worthwhile.

While less appropriate for emergent and critical cases—where parallel tracks of diagnosis are more important than serial decision-making—the spirit of wise resource use, recommended substitutions, and briefer workups presented here will hopefully guide future diagnostic choices, contributing to a more-efficient healthcare system, and in turn, to better patient care.

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References

1. Canadian Institute for Health Information. “Health Care Cost Drivers: The Facts.” 2011. <https://secure.cihi.ca/free_products/health_care_cost_drivers_the_facts_en.pdf> (5 Oct 2015).
2. Canadian Institute for Health Information. “National Health Expenditure Trends, 1975 to 2013.” 2013. <https://secure.cihi.ca/free_products/NHEXTrendsReport_EN.pdf> (5 Oct 2015).
3. Cassel CK, Guest JA. Choosing wisely: helping physicians and patients make smart decisions about their care. JAMA 2012;307(17):1801-2.
4. Hoffman JR, Cooper RJ. Overdiagnosis of disease: a modern epidemic. Arch Intern Med 2012;172(15):1123-4.
5. Smith-Bindman R, Miglioretti DL, Johnson E, Lee C, Feigelson HS, Flynn M, et al. Use of diagnostic imaging studies and associated radiation exposure for patients enrolled in large integrated health care systems, 1996-2010. JAMA 2012;307(22):2400-9.
6. Calderon-Margalit R, Mor-Yosef S, Mayer M, Adler B, Shapira SC. An administrative intervention to improve the utilization of laboratory tests within a university hospital. Int J Qual Health Care 2005;17(3):243-8.
7. Neilson EG, Johnson KB, Rosenbloom ST, Dupont WD, Talbert D, Giuse DA, et al. The impact of peer management on test-ordering behavior. Ann Intern Med 2004 Aug;141(3):196-204.
8. Attali M, Barel Y, Somin M, Beilinson N, Shankman M, Ackerman A, et al. A cost-effective method for reducing the volume of laboratory tests in a university-associated teaching hospital. Mt Sinai J Med 2006;73(5):787-94.
9. Garland A, Shaman Z, Baron J, Connors AF. Physician-attributable differences in intensive care unit costs: a single-center study. Am J Respir Crit Care Med 2006;174(11):1206-10.
10. Zimmerman JE, Seneff MG, Sun X, Wagner DP, Knaus WA. Evaluating laboratory usage in the intensive care unit: patient and institutional characteristics that influence frequency of blood sampling. Crit Care Med 1997;25(5):737-48.
11. Kobewka DM, Ronksley PE, McKay JA, Forster AJ, van Walraven C. Influence of educational, audit and feedback, system based, and incentive and penalty interventions to reduce laboratory test utilization: a systematic review. Clin Chem Lab Med 2015;53(2):157-83.
12. Horn DM, Koplan KE, Senese MD, Orav EJ, Sequist TD. The impact of cost displays on primary care physician laboratory test ordering. J Gen Intern Med 2014;29(5):708-14.
13. Goetz C, Rotman SR, Hartoularos G, Bishop TF. The effect of charge display on cost of care and physician practice behaviors: a systematic review. J Gen Intern Med 2015;30(6):835-42.
14. Feldman LS, Shihab HM, Thiemann D, Yeh HC, Ardolino M, Mandell S, et al. Impact of providing fee data on laboratory test ordering: a controlled clinical trial. JAMA Intern Med 2013;173(10):903-8.
15. Cook JD. Diagnosis and management of iron-deficiency anaemia. Best Pract Res Clin Haematol 2005;18(2):319-32.
16. Fishbane S, Lynn R. The utility of zinc protoporphyrin for predicting the need for intravenous iron therapy in hemodialysis-patients. Am J Kidney Dis 1995;25(3):426-32.
17. Labbé RF, Dewanji A. Iron assessment tests: transferrin receptor vis-à-vis zinc protoporphyrin. Clin Biochem 2004;37(3):165-74.
18. Farrell CJ, Kirsch SH, Herrmann M. Red cell or serum folate: what to do in clinical practice? Clin Chem Lab Med 2013;51(3):555-69.
19. Calvi LM, Bushinsky DA. When is it appropriate to order an ionized calcium? J Am Soc Nephrol 2008;19(7):1257-60.
20. Keim V, Teich N, Fiedler F, Hartig W, Thiele G, Mössner J. A comparison of lipase and amylase in the diagnosis of acute pancreatitis in patients with abdominal pain. Pancreas 1998;16(1):45-9.