

## Choosing Wisely Canada—Top five list in medical microbiology: An official position statement of the Association of Medical Microbiology and Infectious Disease (AMMI) Canada

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**BACKGROUND:** *Choosing Wisely Canada* is a forum for health care professional societies to lead system change through identification and reduction of low-value practices. Microbiologic investigations are frequently overused and may contribute to unnecessary health care expenditures as well as patient harm. **METHODS:** A *Choosing Wisely Canada* top five list in medical microbiology was developed by the Association of Medical Microbiology and Infectious Disease (AMMI) Canada through broad consultation of its members. Following an electronic survey of members, recommendations were developed and ranked by a working group, then further narrowed during a national open forum using the modified Delphi method. Feedback was solicited through an online forum prior to dissemination. **RESULTS:** The top five declarative statements in medical microbiology are: (1) Don't collect urine specimens for culture from adults who lack symptoms localizing to the urinary tract or fever, (2) Don't routinely collect or process specimens for *Clostridium difficile* testing when stool is non-liquid or if the patient has had a prior nucleic acid amplification test result within the past 7 days, (3) Don't obtain swabs from superficial ulcers for culture, (4) Don't routinely order nucleic acid amplification testing on cerebrospinal fluid in patients without a compatible clinical syndrome, and (5) Don't routinely obtain swabs during surgical procedures when fluid and/or tissue samples can be collected. **CONCLUSIONS:** This *Choosing Wisely* list represents a launching point to reduce low-value practices in microbiology. Strong implementation science around these statements will be needed to improve the value of microbiology testing in Canada.

**KEY WORDS:** *Choosing Wisely*, microbiology, resource stewardship

**HISTORIQUE:** *Choisir avec soin Canada* est un forum pour que les sociétés de professions de la santé ouvrent la voie à des changements systémiques par la détermination et la diminution des pratiques peu pertinentes. Les explorations microbiologiques sont souvent surutilisées, peuvent contribuer à des dépenses inutiles dans le domaine de la santé et peuvent nuire aux patients. **MÉTHODOLOGIE:** L'Association pour la microbiologie médicale et l'infectiologie (AMMI) Canada a dressé la liste de cinq principales interventions à remettre en question en microbiologie médicale pour la campagne *Choisir avec soin Canada*, après une vaste consultation menée auprès de ses membres. À la suite d'un sondage électronique auprès de ses membres, un groupe de travail a rédigé et classé des recommandations, puis les a restreintes à l'aide de la méthode Delphi modifiée à l'occasion d'un forum national ouvert. Des commentaires ont été sollicités dans le cadre d'un forum public avant la diffusion. **RÉSULTATS:** Les cinq principaux énoncés en microbiologie médicale s'établissent comme suit: 1) Ne demandez pas de cultures urinaires chez des adultes qui ne présentent ni symptôme urinaire ni fièvre. 2) Ne procédez pas d'emblée à un prélèvement ou à une analyse pour recherche de *Clostridium difficile* dans les selles lorsqu'elles ne sont pas liquides ou lorsque le patient a déjà obtenu les résultats d'un test d'amplification des acides nucléiques au cours des sept derniers jours. 3) Ne demandez pas de frottis pour culture des ulcères superficiels. 4) Ne demandez pas d'emblée un test d'amplification des acides nucléiques sur le liquide céphalorachidien chez les patients qui ne présentent pas un syndrome clinique compatible. 5) Ne demandez pas d'emblée de spécimens sur écouvillon lors d'interventions chirurgicales si des échantillons liquidiens



et(ou) tissulaires sont prélevés. **CONCLUSIONS:** Cette liste de *Choisir avec soin* représente un tremplin pour réduire les pratiques peu pertinentes en microbiologie. Il faudra de solides ressources de mise en œuvre pour améliorer la valeur des tests de microbiologie au Canada.

**MOTS-CLÉS:** Choisir avec soin, gestion des ressources, microbiologie

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## BACKGROUND

The overuse of investigations and treatments in medical care without proven benefit may result in increased health care costs and unnecessary harms to patients (1). Over the last 5 years, there have been significant national and international efforts aimed at improving value in health care. The *Choosing Wisely* campaign is one forum that has encouraged health care providers to lead system change through the identification of low-value practices (2). Since 2014, over 175 recommendations have been disseminated by more than 30 Canadian professional societies and several tool kits have been identified to assist in leading change (3).

While medical microbiologists and infectious diseases physicians already contribute significantly to improving the value of Canadian health care through their roles in directing clinical laboratories, antimicrobial stewardship, and infection prevention and control, further opportunities for resource stewardship exist within these disciplines. Recently, the Association of Medical Microbiology and Infectious Disease (AMMI) Canada released its top five *Choosing Wisely* statements in infectious diseases, which identified common practices within the purview of infectious diseases practice that are of limited benefit and may be potentially harmful to patients (4).

Similarly, common practices related to microbiologic testing may be overutilized and lead to adverse patient events (5,6). While ordering practices have generally been left to the discretion of individual care providers, as content experts, microbiologists are ideally suited to lead system change and to improve the value of diagnostic testing (6–9). To this end, a voluntary working group of

medical microbiologists from across Canada was convened by AMMI Canada to lead discussions around low-value practices in microbiology. The following position statement describes the process used and the final *Choosing Wisely Canada* top five list in medical microbiology.

## METHODS

AMMI Canada created its *Choosing Wisely Canada* top five list of recommendations in medical microbiology using a broad consultative process led by a working group of 14 members from seven provinces. The following sections describe the process used to create the top five list in medical microbiology.

### Initial survey of membership

The *Choosing Wisely Canada* framework was introduced to the AMMI Canada membership through an email communication that provided an overview of the *Choosing Wisely* campaign, as well as a request to members to submit microbiologic testing practices that they believed should be questioned based on members' opinions that they represent low-value care. A survey sent on October 29, 2015 was accessed by 225 of 537 members (42%) with 5 members (2%) providing suggestions. In total, 24 unique statement ideas were submitted.

### AMMI Canada *Choosing Wisely* working group

In December 2015, a working group of 14 AMMI Canada members was convened, representing a diverse group of microbiologists and infectious diseases specialists with an interest in laboratory resource stewardship including one

pediatric microbiologist and nine members who were dually certified in medical microbiology and infectious diseases. The group comprised early and late career physicians from community ( $n = 1$ ) and academic centres ( $n = 12$ ), in addition to a resident trainee representative.

Between December 15, 2015 and March 16, 2016, the working group held four teleconferences to develop a draft list of recommendations. The working group began by reviewing the suggestions submitted through the survey of AMMI Canada membership and added additional statements to the list based on members' opinions of low-value practices in microbiology. Statements were written using a live online document accessible by all 14 members (Zoho One, a suite of integrated online applications, available at <https://www.zoho.com>). In total, there were 6 statements incorporated from the membership survey and 20 new statements added by the working group members for a total of 26 statement ideas that were developed into formal statements and ranked by the working group. We used the following criteria to rank the statement ideas. Statements should:

- (1) be within the purview of medical microbiology practice
- (2) be frequently encountered in the laboratory
- (3) have significant potential for rapid uptake by laboratories
- (4) have the potential to change patient management
- (5) have the potential to improve patient safety
- (6) have the potential to reduce costs
- (7) have high-quality evidence to support the recommendation.

Each working group member independently scored all 26 statements against these criteria (total score out of 7) and an average score for each statement was calculated to assist in the development of a rank list. Scoring results were reviewed and all members of the working group agreed on a preliminary top 10 list for further discussion by the AMMI Canada membership.

### Vetting and endorsement of list by AMMI Canada membership

The top 10 statements and their rationales were presented on April 2, 2016 during an open forum at the 2016 Annual AMMI Canada Conference held in Vancouver, British Columbia. There were 51 AMMI Canada members in attendance, including 25 (49%) microbiologists, 17 (33%), infectious diseases physicians, 3 (6%) members from the public health sector, and 6 (12%) members from other disciplines associated with infectious diseases and medical microbiology (members were asked to identify how they spent the majority of their time). Real-time polling software was used to allow members to anonymously rank

the top 10 statements. Using a modified Delphi method (10), discussions were held and polling was conducted through five rounds, until consensus on a top five list was reached.

### Online discussion forum

To offer additional opportunity for input from AMMI Canada members who could not attend the national forum, the top five statements were posted on an AMMI Canada online discussion forum for members to review and provide additional commentary. Between August 9 and September 6, 2016, 11 AMMI Canada members posted comments for discussion. The working group held a follow-up teleconference where feedback on the top five list was reviewed and revisions were made. A response to members' comments was posted along with the revised top five list on the AMMI Canada website on October 3, 2016.

### Approval and dissemination by AMMI Canada and Choosing Wisely Canada

The final top five list was reviewed by the AMMI Canada Executive Council and Guidelines Committee, as well as *Choosing Wisely Canada*. Following minor refinements, full endorsement of the final list was received, which was disseminated online on January 10, 2017.

## RESULTS

The final top five *Choosing Wisely* statements in medical microbiology are listed in Table 1. Each statement is supported by a brief paragraph that provides its rationale. In this section, we expand on the rationales for the selection of each of the recommendations and how the statement might ultimately be incorporated into microbiology practice to improve the value of care through changes to the pre-analytical, analytical, and post-analytical phases of testing (see Table 2).

**Statement #1:** DON'T collect urine specimens for culture from adults who lack symptoms localizing to the urinary tract or fever unless they are pregnant or undergoing genitourinary instrumentation where mucosal bleeding is expected.

This statement was ranked in the top five by 88% of participants during the national forum with no participants voting against its endorsement. It also received strong support in the online forum. The majority of those surveyed felt that unnecessary urine cultures contribute significantly to the overutilization of both human and material laboratory resources owing to the large volume

**Table 1:** Association of Medical Microbiology and Infectious Disease (AMMI) Canada *Choosing Wisely Canada* physician recommendations for medical microbiology**1. DON'T collect urine specimens for culture from adults who lack symptoms localizing to the urinary tract or fever unless they are pregnant or undergoing genitourinary instrumentation where mucosal bleeding is expected.**

Urine cultures are the most frequently ordered microbiologic test, with 50%–90% of specimens submitted from asymptomatic patients (5). Urine cultures should only be ordered if patients have symptoms localizing to the urinary tract, such as acute dysuria, urgency, frequency, suprapubic or flank pain, or fever without an obvious alternate source. Outside of these specific symptoms, positive cultures indicate asymptomatic bacteriuria and frequently result in antimicrobial therapy that is of no benefit and is potentially harmful. Cloudy or malodorous urine are not specific findings of urinary tract infection and should not prompt culture unless acute urinary tract symptoms are present (11). Delirium is not considered a symptom of cystitis in non-catheterized patients (12). In catheterized patients with fever or delirium, a positive urine culture may still represent asymptomatic bacteriuria unless alternate sources have been excluded (11). Laboratories should consider supplementing educational efforts to reduce collection of urine cultures from asymptomatic patients with analytical or post-analytical interventions that reduce processing of low-value specimens (7,8).

**2. DON'T routinely collect or process specimens for *Clostridium difficile* testing when stool is non-liquid (i.e., does not take the shape of the specimen container) or if the patient has had a prior nucleic acid amplification test result (positive or negative) within the past 7 days.**

Only liquid stool specimens should be collected or processed for *C. difficile* detection, as a positive test in the absence of diarrhea likely represents *C. difficile* colonization (6). Diagnostic gains are minimal with repeat *C. difficile* nucleic acid amplification testing within 7 days of a negative test (13,14). Repeat *C. difficile* toxin testing by enzyme immunoassay within 7 days of a prior negative test is also of little incremental diagnostic yield but may be warranted in select cases. Test of cure in patients with recent *C. difficile* infection is also not recommended. Prior investigations have shown that the use of hospital information systems to restrict ordering of repeat tests for these reasons resulted in a 91% reduction in repeat testing (14).

**3. DON'T obtain swabs from superficial ulcers for culture, as these represent poor quality specimens which are prone to both false positive and false negative results with respect to the cause of the infection.**

All wounds are colonized with microorganisms. Cultures should not be obtained from wounds that are not clinically infected (i.e., absence of classical signs of inflammation or purulence or increasing pain (15–17). For wounds that are clinically infected, the ideal specimens for culture are deep specimens that are obtained through biopsy or deep curettage following cleansing/debridement of the wound (15). Laboratories should consider use of screening criteria to reject such swabs without proceeding to culture (18). For superficial swab specimens that are processed/cultured, interpretation of the results should be correlated with the Gram stain (18).

**4. DON'T routinely order nucleic acid amplification testing on cerebrospinal fluid (e.g., herpes simplex virus, varicella zoster virus, enteroviruses) in patients without a compatible clinical syndrome.**

Although nucleic acid amplification testing is the modality of choice for determining the viral etiology of meningitis/encephalitis, it should not be requested routinely on all cerebrospinal fluid specimens (19). The routine use of these tests in patients without compatible clinical syndromes can result in unnecessary empiric antiviral treatment, additional care, and prolonged length of hospitalization for patients awaiting testing results. In addition, routine testing may result in depletion of cerebrospinal fluid needed for other diagnostic purposes. In cases where nucleic acid testing is requested for adults, laboratories should create policies for when testing will be performed if the cerebrospinal fluid cell count and protein are normal (19,20).

**5. DON'T routinely obtain swabs during surgical procedures when fluid and/or tissue samples can be collected.**

Fluids and tissue specimens can usually be obtained in the controlled setting of the operating room and represent higher quality specimens than swabs (21). Culture of swab specimens is associated with increased false negative results, as they are inferior in recovering anaerobic bacteria, mycobacteria, and fungi, and provide inadequate volumes to perform all necessary diagnostic tests (22). To encourage collection of fluid and/or tissue samples, consideration should be given to making swabs unavailable in the operating room without specific request.

of specimens submitted. International guidelines based on multiple randomized controlled trials suggest that urine culture screening in asymptomatic patients and treatment is only recommended during pregnancy or before urologic procedures from which mucosal bleeding is expected (11). Despite this strong evidence, over 50% of urine cultures

are submitted to the microbiology laboratory in the absence of symptoms of urinary infection and positive results from these specimens prompt antibiotic therapy in 30%–50% of cases (5,11). This practice not only lacks benefit, but may carry significant patient harm including

**Table 2:** Potentially actionable interventions related to the Association of Medical Microbiology and Infectious Disease (AMMI) Canada *Choosing Wisely Canada* top five declarative statements in medical microbiology

<i>Choosing Wisely Canada</i> declarative statement	Pre-analytical actions	Analytical actions	Post-analytical actions
DON'T collect urine specimens for culture from adults who lack symptoms localizing to the urinary tract or fever unless they are pregnant or undergoing genitourinary instrumentation where mucosal bleeding is expected.	Clinician education regarding indications for urine culture testing; diagnostic algorithms for urine culture ordering (23).	Not routinely culturing urine specimens demonstrated to be of low-value, such as pre-operative specimens from asymptomatic patients not undergoing genitourinary procedures, unless a specific request is made to the microbiology laboratory (8).	Not routinely reporting culture and susceptibility results of urine specimens demonstrated to be of low-value, with comments instructing to call the laboratory if symptoms of urinary tract infection are present (7).
DON'T routinely collect or process specimens for <i>Clostridium difficile</i> testing when stool is non-liquid (i.e., does not take the shape of the specimen container) or if the patient has had a prior nucleic acid amplification test result (positive or negative) within the past 7 days.	Clinician education regarding testing indications; diagnostic algorithms for <i>C. difficile</i> testing; restricted electronic order entry if another sample has been analyzed in the preceding 7 days, with an option of making specific requests to the microbiology laboratory (14).	Laboratory rejection of non-liquid stool specimens with notification to the ordering clinician; laboratory rejection of repeat <i>C. difficile</i> tests within 7 days of a negative test, with a comment requesting clinicians to contact the microbiology laboratory in cases of high clinical pre-test probability; laboratory rejection of repeat <i>C. difficile</i> tests within 7 days of a positive test, with a comment to the ordering clinician.	Addition of comment to <i>C. difficile</i> results regarding the high sensitivity and specificity of testing.
DON'T obtain swabs from superficial ulcers for culture, as these represent poor quality specimens which are prone to both false positive and false negative results with respect to the cause of the infection.	Clinician education regarding the lack of value of swabs obtained from superficial ulcers, even when infection is suspected (15–17).	Development, validation and implementation of Gram stain screening criteria to reject low-value swabs without proceeding to culture (18).	Addition of comments to culture results regarding the limitations of cultures of superficial ulcers; Addition of comments to the results of cultures recommending clinicians correlate the culture results to the results of the Gram stain.
DON'T routinely order nucleic acid amplification testing on cerebrospinal fluid (e.g., herpes simplex virus, varicella zoster virus, enteroviruses) in patients without a compatible clinical syndrome.	Education regarding compatible clinical presentations of viral central nervous system infections; development of diagnostic algorithms to guide requests for nucleic acid amplification testing.	Processing of nucleic acid amplification testing by diagnostic cascade; establishing standard operating procedures for when and how to test specimens if cerebrospinal fluid cell count and protein concentration are normal. (19,20)	Audit and feedback regarding clinician ordering practices.
DON'T routinely obtain swabs during surgical procedures when fluid and/or tissue samples can be collected.	Education and training of operating room staff and surgeons regarding superiority of tissue/fluid specimens over swabs for the diagnosis of infection (21,22); making swabs unavailable in the operating room.	Not applicable (swabs should always be processed for testing when these are the only specimens received from the operating room).	Addition of comments to the culture report regarding the limitations of the results of cultures obtained by swab and the superiority of cultures of fluid or tissue specimens;

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an eightfold increased risk of *Clostridium difficile* infection in certain patient populations (24).

The recommendation not to treat asymptomatic bacteriuria among non-pregnant adults has already been included in the top five *Choosing Wisely* statements of the Canadian Society of Hospital Medicine and the Canadian Geriatrics Society (3). The challenge in changing this practice is that once urine cultures have been submitted and positive results are reported, physician restraint on acting upon positive results is often lacking, even when the pre-test probability of urinary tract infection is low (5,7). The AMMI Canada medical microbiology statement expands on the prior statements by other societies by highlighting the importance of curtailing urine culture ordering practices in a further effort to reduce inappropriate utilization of microbiology resources and the treatment of asymptomatic patients.

The pre-analytical focus of this statement was specifically chosen to recognize the significant role of over-ordering of this test by clinicians. Implementation of diagnostic algorithms can result in improved urine culture ordering practices resulting in significant decreases in urine culture ordering and the treatment of asymptomatic bacteriuria (23). Such algorithms and education are within the purview of microbiology practice. However, to supplement pre-analytic interventions, system changes will ultimately be required.

Analytical changes that could be safely implemented include not routinely culturing urine specimens that are received from non-urologic pre-operative clinics. This approach resulted in a 99% reduction in screening urine cultures before elective joint arthroplasty at one centre (8). A post-analytical change for urine specimens at low probability of being clinically significant involves culturing but only reporting results upon telephone request to the laboratory (7).

**Statement #2:** DON'T routinely collect or process specimens for *Clostridium difficile* testing when stool is non-liquid (i.e., does not take the shape of the specimen container) or if the patient has had a prior nucleic acid amplification test result (positive or negative) within the past 7 days.

This statement was voted for by 76% of AMMI Canada members at the national forum to be included in the top five statements, with no participants voting against its endorsement. *C. difficile* infection is a major cause of health care-associated infection. However, there are circumstances where *C. difficile* testing is inappropriately ordered or processed, including testing of non-liquid stools. In these circumstances, positive tests likely represent *C. difficile*

colonization that can prompt both unnecessary treatment and isolation of patients with its potential for associated negative impact on patient outcomes (25).

Another circumstance where *C. difficile* testing is felt to represent low-value care is in the ordering and processing of tests of cure. Multiple AMMI Canada members, both at the national forum and online, commented about the pervasive practice of testing for cure following treatment of *C. difficile* infection. Nucleic acid amplification testing may remain positive after successful treatment, resulting in unnecessary prolongation of treatment and contact precautions when tests of cure are positive (6). Furthermore, there is no need for repeat testing during the same episode of diarrhea. Multiple studies have suggested that the diagnostic gains of repeat enzyme immunoassay or nucleic acid amplification testing within 7 days of a prior submission, whether the initial test is either positive or negative is very low (13,14).

This statement also highlights both pre-analytical and analytical opportunities to improve the value of *C. difficile* testing. In addition to improving ordering practices, some Canadian laboratories have already implemented policies to no longer test repeat specimens within 7 days of a prior test, but many AMMI Canada members commented that further gains could be made.

**Statement #3:** DON'T obtain swabs from superficial ulcers for culture, as these represent poor quality specimens which are prone to both false positive and false negative results with respect to the cause of the infection.

This statement was voted to be included in the top five statements by 74% of members at the national forum. Only 7% voted against its endorsement but no reason was provided. Discussion focused on the recognition of the lack of correlation between the results of cultures of superficial swabs compared with deeper tissue specimens (15–17). This may result in the prescription of broader spectrum antimicrobial therapy than is required to successfully manage these infections and in some cases may influence clinicians to treat ulcers with antimicrobial therapy when the results represent microbial colonization (17). AMMI Canada members commented on the over-reliance on the results of superficial swabs in both ambulatory and acute care settings with the potential for safe reduction in resource utilization through implementation of this recommendation.

While the statement highlights the need for pre-analytical changes in practice, AMMI Canada members agreed that there is also opportunity to improve the way laboratories screen these specimens to determine suitability for culture.

Laboratory procedures to safely reject some specimens, such as those that demonstrate the presence of squamous epithelial cells and an absence of purulence, are important analytical quality assurance measures (18). Finally, when the result of the culture of swabs are reported, working group members felt that the laboratory could play a stronger role in guiding clinicians by recommending the correlation of Gram stain with culture results in an effort to both reduce the frequency of treatment and the spectrum of antimicrobial therapy that may be prescribed for results that represent superficial colonization. Many Canadian laboratories have already added comments to culture results, but there remain opportunities for improvement.

**Statement #4:** DON'T routinely order nucleic acid amplification testing on cerebrospinal fluid (e.g., herpes simplex virus, varicella zoster virus, enteroviruses) in patients without a compatible clinical syndrome.

This statement was voted to be included in the top five statements by 72% of members at the national forum. It was not as highly ranked as the top three statements because it was judged to be of lower impact. Nevertheless, multiple AMMI Canada members attested to the over-ordering of nucleic acid amplification testing (NAAT) at their institutions where it is often routinely ordered on cerebrospinal fluid (CSF) specimens in the absence of clear signs or symptoms of meningoencephalitis. In addition to the relatively high cost of NAAT, this testing can lead to additional days of intravenous antiviral treatment and/or days in hospital while awaiting results.

This statement was framed as a pre-analytical opportunity to reduce over-ordering of tests by clinicians, but the working group felt that the ordering of these tests often falls outside of the purview of AMMI Canada members and might be difficult to improve upon for this reason. Some Canadian laboratories have implemented analytical interventions to not routinely process NAAT on CSF specimens in some patient populations when the cell count and protein concentration are normal due to evidence to suggest that this approach can safely reduce over-testing (19). Because testing may still be warranted in some patients despite a normal cell count and protein concentration (20), laboratories should develop standard operating procedures for processing of these samples, such as laboratory inclusion criteria for processing (e.g., patient with a known immunocompromised state). Education is required to ensure clinicians are aware of any changes that are made to laboratory processes, and that testing is still available through discussion with microbiologists.

This statement remained contentious among some AMMI Canada members, with 20% voting against endorsement of this practice due to safety concerns (20). Following

further online discussion and review of this statement by the Executive Council, consensus was reached that laboratories should work to develop policies regarding when to perform NAAT on CSF specimens when the cell count and protein are normal (20). Whether laboratories choose to process these specimens routinely or not, is likely to be influenced by multiple factors including the cost of local NAAT assays, the accessibility of hematology and biochemistry results to the microbiology laboratory, and the laboratory resources available to process clinician requests in a timely manner.

**Statement #5:** DON'T routinely obtain swabs during surgical procedures when fluid and/or tissue samples can be collected.

This statement was voted to be included in the top five statements by 66% of members at the national forum. During both the national forum and the online discussion, members universally agreed that intraoperative specimens obtained by swab are inferior to fluid or tissue samples. Cultures of specimens obtained by swab are associated with increased rates of false negative results, as they are inferior in recovering anaerobic bacteria, mycobacteria and fungi, and provide inadequate volumes to perform all necessary diagnostic tests that may be required (21,22). Many members commented that they frequently received swabs obtained in the operating room and felt that change was needed. Due to the limited impact of educational efforts alone, some members proposed simply not processing swabs obtained from the operating room. This idea was opposed by 20% of those in attendance at the national forum due to concerns raised that these specimens may be the only specimens obtained and available for culture. To address these concerns, the statement was modified to focus only on pre-analytical system changes to promote collection of fluid and/or tissue samples rather than swabs. At a hospital of one of the working group members, swabs were made unavailable in the operating room, resulting in a dramatic change in surgical practice, with receipt of preferred specimens (personal communication, Larissa Matukas). In the follow-up online forum, no concerns were raised regarding the revised version of this statement.

## DISCUSSION

The AMMI Canada *Choosing Wisely Canada* top five list in medical microbiology is intended to stimulate discussion and a call to action among microbiologists and practising clinicians, regarding ways to improve the value of microbiology resource utilization. Each statement addresses specific investigations that are not only overused

but may contribute to patient harm, through treatment decisions that are triggered by the results of these tests.

Microbiologists have long recognized that many laboratory resources could be better used and have advocated for resource stewardship. The greatest challenge exists in the pre-analytic phase of testing where inappropriate specimens are frequently submitted or specimens are submitted for inappropriate indications (5,11). As content experts, microbiologists are ideally suited to be stewards of laboratory resources and improve the value of diagnostic testing. This role has traditionally relied on providing education to ordering clinicians. Despite these efforts, overuse and misuse of microbiologic resources has remained a pervasive problem.

We do not expect that dissemination of the *Choosing Wisely* statements alone, or education of health care providers on appropriate utilization, will be sufficient to facilitate substantial changes in practice. There remains a great need for system change around the ordering, processing and reporting of microbiologic investigations to ensure better value care. Throughout the process of developing the top five list, the AMMI Canada *Choosing Wisely* working group paid particular attention to identify opportunities to effect change through system re-design when sufficient evidence was available, and to encourage the evaluation of new microbiologic processes when evidence was lacking. The statements generated are within the mandate of microbiology laboratories spanning the pre-analytical, analytical, and post-analytical phases of testing.

There is a need for novel approaches to improve test utilization and results interpretation. The addition of microbiologist's interpretive comments to positive test results may be useful to clinicians. Requisitions that contain specific collection guidance and rejection criteria may discourage inappropriate ordering. To not routinely culture or report test results pending the receipt of further justification or clinical information may be feasible, even in high volume laboratories. Traditionally, the microbiology laboratory has been satisfied to perform tests without access to necessary clinical information, but to improve upon the value of testing, including the reporting of clinically relevant results, increased communication between ordering clinicians and the laboratory may be necessary.

There are several important strengths of the *Choosing Wisely Canada* statements in medical microbiology developed by AMMI Canada. First, this list was developed through broad consultation and engagement of AMMI Canada members throughout the process, with ample opportunity for contribution from members-at-large. Consensus was reached on the final top five list during a

national open forum and through additional online discussion to ensure inclusion of members who could not attend the national forum. Second, the process created by the working group involved the application of defined criteria to rank each declarative statement. Third, great effort was undertaken to identify practices that are not only pre-analytical but also may be actionable within the microbiology laboratory. This differs from the approach used by many other laboratory-based professional societies across North America which have largely framed their *Choosing Wisely* statements through a pre-analytical lens (3). The declarative statements in the AMMI Canada *Choosing Wisely Canada* top five list in medical microbiology should be directly actionable by its members to improve the value of microbiologic testing (see Table 2).

The creation of the top five list also carries limitations. First, it does not represent a comprehensive list of low-value practices within microbiology. Additional practices could have been included, but we limited the list to five statements to adhere to the *Choosing Wisely Canada* format. Second, the statements explicitly state that these investigations should not *routinely* be performed but leave room for exceptions where testing may be appropriate. The intent of the *Choosing Wisely Canada* campaign is not to produce rigid rules or guidelines, but rather to identify practices that should be questioned before they are performed. Reframing the conversation from testing for all, to testing when clinically indicated, is required to improve the value of health care.

The *Choosing Wisely Canada* statements in microbiology endorsed by AMMI Canada build upon those in infectious diseases released last year and encourage the engagement of AMMI Canada members to begin to have conversations related to resource stewardship. The dissemination of these statements is only a starting point and is not sufficient to ensure changes in practice. Strong implementation science around these statements will be needed to improve the value of microbiology testing in Canada.

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