State of the Science on Risk and Support Factors to Physician Performance: A Report from the Pan-Canadian Physician Factors Collaboration

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The following organizations are involved in the Canadian Physician Factors Collaboration:

- College of Physicians and Surgeons of Alberta (CPSA)
- College of Physicians and Surgeons of British Columbia (CPSBC)
- College of Physicians and Surgeons of Manitoba (CPSM)
- College of Physicians and Surgeons of Nova Scotia (CPNS)
- College of Physicians and Surgeons of Ontario (CPSO)
- College des Medecins du Quebec (CMQ)
- College of Family Physicians Canada (CFPC)
- Canadian Medical Protective Association (CMPA)
- Federation of Medical Regulatory Authorities of Canada (FMRAC)
- Medical Council of Canada (MCC)
- Royal College of Physicians and Surgeons of Canada (RCPSC)

Background

The Pan-Canadian Physician Factors Collaboration is a research and development consortium that seeks to identify the specific risk and support factors that affect physician performance across a variety of contexts. A risk factor is defined as a factor that negatively impacts any facet of performance, while a support factor helps to foster, develop or improve performance (Glover Takahashi, Nayer, & St Amant, 2017). Risk factors for poor performance have been studied in the published literature, generating evidence about the individual, organizational and systems-level factors that may hinder performance. Studies have also examined support factors that may promote high-quality practices. Since the beginning of the collaboration in 2015, there has been a concerted effort to develop a strong evidence base to support the evolution of regulatory assessment programs and safe medical practices.

Risk-based principles have recently become a central tenet of regulation (OECD, 2012). Risk-based approaches are being applied to proactive medical regulation in several Canadian jurisdictions and a strong evidence base is needed to support this work. For example, there is interest among Canadian regulators to assess more physicians, more frequently to ensure that physicians engage in lifelong learning and maintenance of competence throughout their careers. Given limited resources and the imperative to develop assessments that foster learning, there is a growing need to ensure that physicians are routed to tailored interactions with the regulator proportionate to risk and learning needs. One strategy to accomplish this is to route physicians to appropriate assessments based on a profile that summarizes the combination of risk and support factors in a physician’s practice. This approach is in line with the tenets of Right Touch Regulation, which has been the cornerstone of medical regulation in the United...
This is an important endeavor as the literature base is vast and it is often difficult to reach conclusions about the extent to which the evidence supports the relationship between factors and practice performance.

The current paper strives to:

- Summarize what is known about select risk and support factors to physician performance
- Summarize what remains unknown
- Provide recommendations for future research

Data Sources

The data sources included in this document and the associated methodologies are described below. Systematic reviews aim to comprehensively search for all relevant articles in an area of study. A quality screen is developed to determine which articles should be included or excluded based on explicit criteria and a standardized tool is used by multiple coders to evaluate articles (Grant & Booth, 2009). Systematic reviews are the gold standard for literature reviews but they are not always feasible due to resource constraints. It is important to note that the methodologies for each of the data sources described in this synthesis do not meet the requirements of a full systematic review although systematic review methods were used to critically appraise studies.

A scoping review was commissioned to ascertain the extent to which risk and support factors were being studied in the published literature (Glover Takahashi, et al., 2017). Scoping reviews are conducted to broadly identify key concepts, theories and sources of evidence, but do not synthesize findings from individual studies (Arksey & O’Malley, 2005). Moving beyond the scoping review to evidence synthesis, the McMaster Health Forum was commissioned to conduct a rapid synthesis of factors associated with competence. They examined 17 primary studies looking at risk and support factors for quality clinical practices across three performance outcomes: complaints, disciplinary action and prescribing and testing errors (Wilson & JN, 2015). Moving beyond the rapid review to evidence synthesis, the McMaster Health Forum was commissioned to conduct a rapid synthesis of factors associated with competence. They examined 17 primary studies looking at risk and support factors for quality clinical practices across three performance outcomes: complaints, disciplinary action and prescribing and testing errors (Wilson & JN, 2015). Building off of the McMaster work, a more comprehensive systematized review of factors related to complaints was conducted because the rapid review did not capture all relevant articles due to time constraints. Systematized reviews were also conducted for the following factors: being an internationally trained medical graduate, age, and exam scores (note: these were not systematic reviews).
The large body of evidence that exists in this area. The individual reviews included in this report were conducted sequentially between 2015–2018. The order of the reviews was designed purposefully so that earlier reviews could inform subsequent reviews in an iterative way. For example, the scoping review served as a seminal document to understand the extent to which factors were being studied in the published literature. From this, a rapid synthesis provided early insight into the key factors that are related to different performance outcomes. Rapid syntheses are limited by time constraints so additional systematized reviews were conducted for frequently studied factors in order to consolidate the evidence base. Articles uncovered in the scoping review served as starting point for each of the systematized reviews conducted by MRA researchers and commissioned associates.

For the state of the science summary, no additional searches were conducted as the data sources listed above served as inputs to this document. To consolidate the evidence from all data sources, two researchers (WY & NT) tabulated studies that found a relationship between a particular factor and a specific performance outcome (e.g. complaints, discipline, assessment). Combing across multiple syntheses and consolidating findings by factor

### Table 1
Data Sources Commissioned or Developed by MRAs

<table>
<thead>
<tr>
<th>Scoping Review</th>
<th>Rapid Review</th>
<th>Systematized Reviews</th>
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<tbody>
<tr>
<td>• External researcher commissioned to conduct scoping review on factors that affect competence(^1)</td>
<td>• McMaster University was commissioned to conduct a rapid review of key factors that affect clinical practice (n=17)(^2)</td>
<td>• Systematized reviews attempt to include elements of the systematic review process while stopping short of systematic review</td>
</tr>
<tr>
<td>• Scoping reviews shed light on the extent to which factors associated with competence is being studied but does not summarize the evidence</td>
<td>• Rapid reviews consolidate evidence and use systematized approaches but the process of searching for articles is not comprehensive due to time constraints</td>
<td>• MRA researchers and academic collaborators synthesized evidence exploring the following factors to performance:</td>
</tr>
<tr>
<td>• The scoping review yielded 943 articles, of which 754 were related to factors associated with physician competence</td>
<td>• Risk factors for complaints, disciplinary action and prescribing and testing errors were included in this study</td>
<td>• Internationally trained medical graduates (IMG) (n=18)</td>
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<tr>
<td></td>
<td></td>
<td>• Exam scores (n=9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Building off of the rapid review by McMaster, a more comprehensive systematized review of risk factors for complaints was conducted (n=14)</td>
</tr>
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</table>

\(^1\) Glover Takahashi, S., Nayer, M., & St Amant, L. M. M. (2017). Epidemiology of competence: A scoping review to understand the risks and supports to competence of four health professions. *BMJ Open*, 7(9), 1–12.


See Table 1 for an overview of evidence syntheses developed or commissioned by MRAs and definitions for different types of review methodologies.

In addition to the above, two additional data sources contributed valuable knowledge to this report. MRA research staff led a qualitative study examining risk and supports to physician performance based on the experiential knowledge of 23 physician assessors (Kain, et al., 2018). Additionally, a systematic review exploring the relationship between clinical experience and quality of health care was uncovered as part of this work (this review was not commissioned or developed by MRAs) (Choudhry, Fletcher, & Soumerai, 2005).

All of these activities represent the current “state of the science” as it pertains to consolidated knowledge of risk and support factors to physician performance. In total, over 900 published articles were coded by MRA researchers and commissioned associates to summarize what is known about risk and support factors and reveal gaps in the evidence base.

### Methods

The purpose of this report is to consolidate evidence on risk and support factors to physician performance. This is an ambitious task due to the large body of evidence that exists in this area. The individual reviews included in this report were conducted sequentially between 2015–2018. The order of the reviews was designed purposefully so that earlier reviews could inform subsequent reviews in an iterative way. For example, the scoping review served as a seminal document to understand the extent to which factors were being studied in the published literature. From this, a rapid synthesis provided early insight into the key factors that are related to different performance outcomes. Rapid syntheses are limited by time constraints so additional systematized reviews were conducted for frequently studied factors in order to consolidate the evidence base. Articles uncovered in the scoping review served as starting point for each of the systematized reviews conducted by MRA researchers and commissioned associates.

For the state of the science summary, no additional searches were conducted as the data sources listed above served as inputs to this document. To consolidate the evidence from all data sources, two researchers (WY & NT) tabulated studies that found a relationship between a particular factor and a specific performance outcome (e.g. complaints, discipline, assessment). Combing across multiple syntheses and consolidating findings by factor

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allowed the research team to ascertain the degree to which the evidence supported a particular factor being associated with different performance outcomes. The research team focused on risk factors frequently studied in the published literature (age, gender, exam scores, specialty, workload, solo practice, international training and experience). Each risk factor was assigned a rating: factor, probable factor, and possible factor, based on the strength of the evidence supporting each factor. This was based on the quantity and consistency of the findings throughout the literature. The quality of article was not directly considered in the rating, as the researchers were consolidating syntheses which did not have uniform quality screens.

A system was created so that factors under investigation could be rated by the strength of the evidence (Table 2).

### Results

Using the rating system described, age, gender, exam scores and specialty were coded as risk factors due to the strength of the evidence. Practice experience, workload and solo practice were coded as probable risk factors given that there were fewer studies on these factors but they were still trending in a consistent direction. IMG and lack of engagement were coded as possible risk factor given that findings are conflicted for the former and only one study exists for the latter.

Table 3 provides a high-level summary of findings. Tables 4, 5 and 6 provide detailed findings as well as implications of the results. References for the detailed findings can be found in Appendix 2.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Rating System</th>
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<tbody>
<tr>
<td>☑️☑️</td>
<td>Risk Factor</td>
</tr>
<tr>
<td>☑️</td>
<td>Probable Risk Factor</td>
</tr>
<tr>
<td>☑️</td>
<td>Possible Risk Factor</td>
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</table>

<table>
<thead>
<tr>
<th>Table 3</th>
<th>High-Level Summary of Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk Factors ☑️☑️</strong></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Most studies found positive associations between age and complaints Nearly all 62 articles found age to be a risk factor for competence</td>
</tr>
<tr>
<td>Gender</td>
<td>Most studies found associations between multiple measures of performance and being male</td>
</tr>
<tr>
<td>Exam scores</td>
<td>All studies found exam scores to be predictive of multiple measures of performance</td>
</tr>
<tr>
<td>Specialty</td>
<td>Nearly all studies found that some specialties are associated with more complaints and disciplinary action</td>
</tr>
</tbody>
</table>

| **Probable Risk Factors ☑️** | |
| Practice experience | Many studies found associations between increased years in practice and poor performance |
| Workload | All five studies found associations between increased workload and poor performance |
| Solo practice | All six studies found associations between solo practice and poor performance |

| **Possible Risk Factors ☑️** | |
| IMG | Findings are mixed: Most studies found IMGs perform less well on certification exams Most studies found IMGs more likely to receive disciplinary action Findings on studies of complaints is mixed All studies found IMGs to be comparable to non-IMGs on other performance outcomes |
| Lack of engagement / patient centeredness | Identified to be a risk factor in qualitative study by nearly all interviewees |
### Table 4
**Detailed Findings for Risk Factors**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Data Sources</th>
<th>Key Findings</th>
<th>Summary and Implications</th>
</tr>
</thead>
</table>
| **Age** | • Evidence synthesis on aging (83)  
• Literature synthesis on complaints (14)  
• McMaster rapid synthesis (14) | General findings from aging evidence synthesis:  
• Physical and cognitive performance declines with age  
• Problems with psychological wellness increases with age  
• Aging negatively impacts patient outcomes  
• Younger doctors perform better on knowledge tests/practice assessments  
• Younger physicians better adhere to guidelines  
Complaints:  
• (5/8) studies found positive associations between age and complaints  
• All studies on complaints in the McMaster document were included in the MRA complaints synthesis | Summary:  
• Well-studied factor  
• Strong predictor of performance  
• Future studies to determine risk factors for early, middle and late career  
• Future studies to examine “how old is old”?  
Mitigating strategies:  
• Take less complex cases  
• Reduce caseload (if appropriate)  
• Utilize support staff  
• Promote health and wellness  
• Promote continuing competence programs  
• Mandatory physical/cognitive reporting  
• Guided self-assessment  
• Develop programs specifically for older physicians |
| **Gender** | • Literature synthesis on complaints (14)  
• McMaster rapid synthesis (17) | Complaints:  
• (9/11) studies found that being male is associated with increased complaints  
Discipline:  
• (4/4) studies in the McMaster rapid synthesis found that being male was predictive of disciplinary action  
Prescribing and ordering tests:  
• 1 study in McMaster rapid synthesis found females had better prescribing practices  
• 1 study in McMaster rapid synthesis found females more often ordered recommended tests  
Assessment:  
• MRA data show that males do less well on practice assessments (pending publication) | Summary:  
• Well-studied factor  
• Strong predictor of performance  
• Future studies to stratify by gender to examine risk factors for males  
• Qualitative studies needed to determine why gender is a risk factor |
| **Exam scores** | • Literature synthesis on exam scores (9) | Various performance outcomes:  
• (9/9) studies found exams scores predictive of practice performance  
• Associations found for prescribing, screening, consultation rates, complaints and assessment | Findings support the need to develop educational interventions for those with low exam scores earlier along the competence continuum |
| **Specialty** | • Literature synthesis on complaints (14)  
• McMaster rapid synthesis (17) | Complaints:  
• (8/9) studies found that some specialties associated with more complaints  
• Surgery, plastic surgery, dermatology, psychiatry, OB/GYN and family doctors found to have more complaints  
Discipline:  
• (3/3) studies in the McMaster rapid synthesis found that certain specialties are associated with discipline cases (family medicine, psychiatry, surgery) | • Practice is nuanced and future analyses should look at factors related to specific specialties  
• Some specialties are more prone to complaints/discipline due to their nature (e.g. plastic surgery) |

Please note that for the detailed findings tables, numbers in the Data Sources column represent the total number of studies within a given source. Denominators in the key findings column represent the number of studies that included a specific factor in the analysis. Not all data sources/studies included all factors.
Table 5
Detailed Findings for Probable Risk Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Data Sources</th>
<th>Key Findings</th>
<th>Summary and Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice experience</td>
<td>• McMaster rapid synthesis (17)</td>
<td>• Discipline:</td>
<td>• Practice experience is highly correlated with age (see summary and implications in Table 4)</td>
</tr>
<tr>
<td></td>
<td>• Systematic review of practice experience (62)</td>
<td>• (3/3) studies in McMaster rapid synthesis found number of years in practice was strongly correlated with disciplinary cases</td>
<td>• Future research to study the relationship between years in practice and age (e.g., at what point does increasing years in practice lose its protective effect to aging?)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Various performance outcomes:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• (48/62) studies in systematic review reported decreasing performance with increasing years in practice</td>
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<tr>
<td></td>
<td></td>
<td>• Those with more years had less factual knowledge, were less likely to adhere to standards, and had poorer patient outcomes</td>
<td></td>
</tr>
<tr>
<td>Workload</td>
<td>• 5 published studies from other inputs that studied this factor</td>
<td>• (5/5) studies found increased workload to be associated with:</td>
<td>• Evidence limited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Complaints</td>
<td>• Higher workload associated with decreased performance across multiple outcomes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Prescribing errors</td>
<td>• May be even more risky with increasing age</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Decrease in ordering tests</td>
<td>• Different workload thresholds should be studied with different age groups and specialty areas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Poor performance on assessment</td>
<td></td>
</tr>
<tr>
<td>Solo practice</td>
<td>• 6 published studies from other inputs that studied this factor</td>
<td>• (6/6) found solo practices were more likely to:</td>
<td>• Evidence limited</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Order fewer tests</td>
<td>• Need to better understand solo practice versus professional isolation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Do less well on assessments</td>
<td>• Risk can be mitigated by engaging with colleagues and high quality CPD (e.g., practice based small group learning, creating forums for colleague interaction)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Have lower scores on recertification exams</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Miss initial MoC requirements</td>
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<tr>
<td>Lack of</td>
<td>• Qualitative study with 23 interviewees</td>
<td>• Identified as a risk factor by nearly all 23 interviewees</td>
<td>Findings provide information on factors not previously studied in this work</td>
</tr>
<tr>
<td>engagement/patient-</td>
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<tr>
<td>centered care</td>
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Table 6
Detailed Findings for Possible Risk Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Data Sources</th>
<th>Key Findings</th>
<th>Summary and Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMG</td>
<td>Literature synthesis on IMG performance (18)</td>
<td>Educational performance:</td>
<td>• Study findings across different performance outcomes are mixed</td>
</tr>
<tr>
<td></td>
<td>McMaster rapid synthesis (17)</td>
<td>• (5/6) studies found IMGs perform less well on exam scores/certification rates</td>
<td>• Definition of IMG is changing due to Canadians Studying Abroad (CSAs) and varies depending on where the research was conducted</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Exam scores found to be associated with poor performance (see Table 4)</td>
<td>• Future studies to look at IMG subgroups as IMGs are not homogenous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complaints:</td>
<td>• IMG is based on place of undergraduate medical education; place of residency will need to be considered going forward</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Studies on complaints is mixed</td>
<td>• IMG performance is a complicated area of study where alternative explanatory variables can account for differences (e.g., bias, language)</td>
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<tr>
<td></td>
<td></td>
<td>Discipline:</td>
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<tr>
<td></td>
<td></td>
<td>• (4/6) disciplinary studies found IMGs more likely to receive disciplinary action</td>
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<td></td>
<td></td>
<td><strong>Other performance outcomes:</strong></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• (4/4) studies found IMGs to be comparable to non-IMGs on patient mortality, readmission rates, surgical outcomes and cardiac procedures</td>
<td></td>
</tr>
<tr>
<td>Lack of</td>
<td>• Qualitative study with 23 interviewees</td>
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<tr>
<td>centered care</td>
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Discussion

To date, knowledge of risk and support factors that impact physician performance has never been consolidated in a comprehensive and usable way. It is envisioned that such knowledge will benefit physicians as well as physician organizations in the healthcare system. Physicians will be provided with knowledge to proactively mitigate risks in their practice before they arise. It is important to note that some risk factors are not modifiable and physicians should be encouraged to consider the information in the context of their own practices. MRAs will use knowledge of risk factors to triage physicians for...
assessments so that resources are used more efficiently to support risk-based regulation. National certifying colleges responsible for setting standards for training, certification and lifelong learning will use knowledge of factors to shape personal learning plans and develop programs that help physicians use supports to mitigate risk. Other stakeholders in the system, such as the Medical Council of Canada and the Canadian Medical Protective Association, will also use knowledge of factors to understand, support and protect physician practices. All of the above endeavors are geared towards promoting high-quality practices and an effective continuing competence system.

Several MRAs across Canada are already using consolidated knowledge of factors to inform regulatory processes and programs. British Columbia, Alberta, Ontario, Quebec and Nova Scotia are using knowledge of factors to select physicians for assessment. Quebec has been risk-prioritizing physicians for many years by using their in-house data to understand the associations between various demographic and practice factors and assessment outcomes. Other jurisdictions are beginning to use the knowledge gained through Quebec’s experience along with the evidence base to inform selection processes. Nova Scotia, Ontario and Alberta are also using knowledge of factors to develop assessment programming to inform physicians of risks and supports to practice. For example, Ontario is developing a self-directed online interactive tool that will provide physicians with an individualized practice profile of risk and support factors. A report will be made available through this process, which will provide physicians with mitigating strategies and resources available for practice improvement.

It should be highlighted that although this report consolidates evidence across markers of performance (e.g. complaints, discipline, assessment, etc.), it is always important to consider “at risk of what?”.

Physician performance is a multi-dimensional construct and the quality of care delivered in one domain does not presuppose quality in another. Characteristics that are associated with physicians who have been disciplined may be different than those who have an unsuccessful assessment outcome. Both disciplinary action and assessment results are a measure of different aspects of poor performance. When applying the evidence in this summary, the context, purpose and what facet of care the program is measuring, assessing or facilitating needs to be considered.

Strengths

One of the key strengths of this work is that a comprehensive state of the science summary has never been conducted in this area to take stock of what is known. This work is valuable as evidence from multiple reviews is consolidated in a usable way to guide policy and program development. In the absence of such work, it is difficult to ascertain the strength of the evidence across multiple data sources. This work also represents a significant contribution in that considerable resources were dedicated to the individual inputs included in this report (i.e. numerous researchers and academic partners contributed to each of the individual syntheses). Through the scoping review, a comprehensive reference list of 754 studies that examined risk and support factors to physician competence was generated and will be used as a starting point to synthesize evidence about factors not covered in this report.

While the reviews included in the report do not meet the criteria for systematic review (with the exception of one), systematized methodology was used for each of the inputs to ensure rigor. Our understanding of select factors was enhanced by the ability to study their impact across a variety of performance outcomes (e.g. prescribing, assessment, complaints) as well as across various samples and settings due to the heterogenous nature of individual studies. In total, over 900 studies were coded as part of this analysis and we were able to ascertain the strength of the evidence for some well-studied risk factors as well as reveal gaps in the literature base. This consolidated work can now be shared with national and international audiences to inform risk-based approaches to regulation and continuing competence systems.

Limitations

Limitations also exist for the work described in this report. The methodology does not meet the rigor of a full systematic review, which means that some articles may have been missed, quality screens may or may not have been applied, depending on the review, and multiple coders were not always used. While this work represents a significant contribution, the research team was only able to synthesize evidence on select risk factors due to resource constraints. As such, this was not an exploratory exercise to catalogue all the possible factors, but rather, a confirmatory exercise to consolidate and summarize what is known. The impact of risk factors was considered for the performance outcomes most frequently studied in the published literature and does not represent all possible performance outcomes. As such, more work is
needed to understand risk factors above and beyond what has been included in this report. For example, while the scoping review uncovered published articles on support factors, we have not taken an in-depth look at these studies and know relatively little compared to our knowledge of risk factors.

While the evidence base on risk and support factors to performance is growing steadily, there remains a scarcity of information on why identified factors may hinder or support practice. This dearth can be largely explained by the methodological approaches used to study risk and support factors to date; most of the published literature utilizes epidemiological approaches on epidemiological data, which does not shed light on why a factor might be a factor and typically only reveal correlations, not causal relationships. Finally, it is unorthodox to conduct a state of the science summary that includes syntheses that are not yet available in the public domain. We strategically decided to prioritize the current high-level synthesized findings of multiple reviews to facilitate sharing the knowledge with administrators and program developers in a timely manner.

**Future Research Agenda**

The evidence base will continue to grow as more factors research is published. A national research agenda will be developed and formalized under the direction of the Steering Committee and MCC/FMRAC to address gaps inclusive of the following:

- Due to methodological constraints and availability of data, some factors are easier to study than others, which may contribute to why they are strong predictors of performance in the published literature (e.g., gender). There are likely risk and support factors that are strongly predictive of practice performance but are more difficult to measure and study (e.g., lack of engagement, patient centeredness). These important factors will need to be studied using different methodological approaches, such as qualitative research, which does not rely on administrative data.

- Other factors not summarized in this report but identified in the literature include: lack of board or specialty certification, practice location, previous complaints or medico-legal events, practicing in a hospital environment and engaging in certain types of continuing professional development. Future work should examine evidence for these factors as well as study how organizational and system levels factors affect performance.

- Qualitative methodologies will also help us to understand why a factor is a factor and not just whether or not it is associated with practice performance.

- For factors where there is a lot of evidence (e.g., age, gender), future studies can stratify groups to garner more nuanced understanding. For example, stratifying by gender will allow researchers to understand the specific risk factors associated with being male. Stratifying by age cohorts will contribute to understanding factors pertinent to early, middle, and late career practice.

- MRAs are well positioned to make a significant contribution to the existing evidence base due to the wealth of performance data that exists in these organizations.

- Factors associated with performance outcomes not included in this review will need to be studied in future work (e.g., billing data, patient outcomes).

- Compared to knowledge of risk factors, we know relatively little about factors that support high-quality practices. This will be a key area for future work as system partners focus on preventive strategies to facilitate the development of safe practices.

- New directions for future research should focus on trends in health care inclusive of the role of context in performance, how to assess team-based care and the role of support factors in promoting high-quality practices.

**Key Takeaways**

To date, evidence of risk and supports to performance has never been consolidated in such a comprehensive way. The following represents key takeaways from this work:

- The evidence base on risk and supports to physician practice will continuously evolve as practice changes and new knowledge is added to the system. It is the intention of the national collaboration to continue to update the evidence base so it can be iteratively applied to regulatory programming to ensure relevance.

- It is always important to consider “at risk of what?” as risk factors differ across performance outcomes.

- Audiences will need to bear in mind that the methodologies used in individual studies within each review examine associations between variables. This is not the same as examining the relationship between cause and effect among variables. As such, those with high-risk profiles will not necessarily perform more poorly, although they are more likely to.
Future national work will focus on developing the necessary infrastructure to share factors knowledge across MRAs, physician organizations and academic partners. The appropriate knowledge translation infrastructure is to be built under the guidance of the collaboration and MCC/FMRAC.

The knowledge generated in this document will need to be applied to processes and programs in the system to measure the added benefit to this approach (e.g., are triage tools developed to select at-risk physicians effective? Does providing physicians with knowledge of risk and support factors help to protect practices?).

General References

Appendix 1
Detailed Information of Data Sources

<table>
<thead>
<tr>
<th>Input</th>
<th>Public Availability</th>
<th>N</th>
<th>Dates Range for Articles</th>
<th>Search Strategy</th>
<th>Inclusion Criteria</th>
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<tr>
<td>Scoping review</td>
<td>BMJ Open</td>
<td>N=754*</td>
<td>1975–2014</td>
<td>Multiple databases and search terms used for relevant articles on risk and support factors across four health professions</td>
<td>• Peer reviewed articles (reviews excluded)</td>
<td>Multiple coders abstracted and coded articles; quality checks conducted</td>
<td>Tabular and narrative synthesis</td>
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<td>McMaster rapid review</td>
<td>McMaster Health Forum</td>
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<td>1993–2014</td>
<td>• Related article search conducted using one highly relevant article</td>
<td>• Peer reviewed articles</td>
<td>Research questions, methods, sample, intervention and findings summarized for each study</td>
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Systematized Reviews

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<th>Factors associated with complaints</th>
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<td>review available upon request</td>
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<td>Additional studies identified by content experts</td>
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*943 articles were uncovered in the scoping review but only 754 articles were about risk and support factors to physician competence (other articles were about non-medical health care professionals).
## Appendix 2

**References for Detailed Findings**

### Risk Factors

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### Probable Risk Factors

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### Possible Risk Factors

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RISK FACTORS

**Age:** Complaints


**Age:** Physical Performance


**Age:** Cognitive Performance


**Age:** Psychological Wellness


Age: Clinical Knowledge or Performance


Age: Patient Safety


Gender: Discipline


Gender: Prescribing and Ordering Tests


Exam Scores


Specialty: Complaints


**Specialty: Discipline**


**PROBABLE RISK FACTORS**

**Practice Experience: Discipline**


**Practice Experience: Other Performance Outcomes**


**Workload**


**Lack Of Engagement/Patient Centeredness**


**POSSIBLE RISK FACTORS**

**IMG: Educational Performance**


McManus, I. C., & Wakeford, R. (2014). PLAB and UK graduates’ performance on MRCP (UK) and MRCGP examinations: data linkage study, 262(1April), 1–24.


IMG: Complaints


IMG: Discipline


IMG: Other Performance Outcomes


About the Authors

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