

Supplement 3 – Key Articles about Risks & Supports to Competence

This appendix includes a selection of key articles pertaining to each of the risks and supports to competence categories that were identified in our literature review. Key articles were generally selected based on perceived relevance, impact and rigour. We preferentially selected articles that were:

- primary research studies, wherever available, rather than commentaries, editorials, or historical articles;
- more recently published, where available; and
- articles where larger participant sample sizes were used.

If readers are interested in the complete inventory of articles on each risk and support to competence, please contact the corresponding author.

Overall Highly Recommended Articles on Risks & Supports to Competence

a. **Grace 2014 [1]**

This study examined a sample of 683 physicians referred for assessment at the Center for Personalized Education for Physicians (CPEP) from 2000 to 2010, who were evaluated as either safe or unsafe to return to practice. Older physicians were more likely to have unsafe assessment outcomes. Board-certified individuals were less likely to have poor assessment outcomes than uncertified individuals. Physicians in solo practice were more likely to be deemed unsafe than physicians in other settings. Physicians with a practice scope that matched their training were less likely to have unsafe assessment outcomes than those whose were working within a different practice scope. Physicians with current or previous board action (suspension, revocation, limitation, or stipulation) were more likely to be deemed unsafe than those without any board action. Those not currently in practice were more likely unsafe than those currently working. Overall, a relatively small percentage (12.6%) of the 683 physicians in this study performed poorly.

b. **Handfield-Jones 2002 [2]**

Physician performance varies over time, both among and within patient conditions. Doctors differ in how they monitor and detect variations in their performance, and in how they respond to these variations. Different assessment methods may capture different aspects of practice and assessment of performance and learning must be linked effectively to improve practice. Individual, professional and system-wide changes are needed to incorporate a quality assurance approach to linking learning and assessment. Practice-based assessment can assist in motivating learning & change. Assessment is fundamental to change

c. **Hays 2002 [3]**

Hays et al. reflected on the combined experiences of a group of experienced education researchers, and the results of literature searches, on performance assessment methods. The paper discusses that maintaining competence requires a capacity to change. This capacity requires the individual to possess insight into his/her performance, as well as have motivation to change. Some individuals have low levels of insight and are not aware of how their performance compares to accepted practice.

Low insight may be related to the lack of direct immediate feedback so the practitioners do not become skilled in analyzing their own capacities. The paper goes on to discuss different methods of assessing competence and expands on the pros and cons of the various methods.

d. Papadakis 2004 [4]

A case-control study was conducted of all University of California, San Francisco, School of Medicine graduates disciplined by the Medical Board of California from 1990–2000 (N=68), compared against a control group (N=196). Almost all (95%) of the disciplinary actions were for deficiencies in professionalism. The prevalence of negative comments in the Dean's letters in the cases of those disciplined was 38% and 19% in controls. Logistic regression analysis showed that disciplined physicians were more likely to have Concern/Problem/Extreme excerpts in their medical school file.

e. Tamblyn 1998, 2002, 2007 [5-7]

A series of studies examined the relationship of licensure exam scores with future practice. In 1998 the study looked at the results of 617 family physicians that passed the family medicine licensing examination in Quebec between 1991 and 1993. Physicians with higher exam scores referred more patients for consultations, prescribed fewer inappropriate medications to elderly patients, prescribed more disease specific medications to decrease symptoms, and referred more women 50+ for mammograms. The same findings were demonstrated in a larger cohort that was followed for 4-7 years.

f. Tamblyn 2007 [6]

In 2007 a cohort study of all 3424 physicians taking the Medical Council of Canada clinical skills examination between 1993 and 1996, and who were licensed to practice in Ontario and/or Quebec, were the study group. Depending on the year of taking the exam the participants were followed for 2 to 12 years. The study looked at the complaints registered and upheld by the regulators. There were 696 complaints upheld. The patient-physician communication scores from the licensure exam was recorded and compared across the sample. A 2-standard deviation decrease in communication score was associated with 1.17 more upheld complaints per 100 physicians per year and 1.20 more communication complaints per 100 practice years. Those with patient-physician scores in the bottom quartile explained an additional 9.2% of complaints

Key Articles about Risks to Competence

1 | Adequacy of practice or education

a. **Asch 2009** [8]

This study assessed whether obstetrics and gynecology residency programs can be evaluated by the quality of care their alumni deliver. This was a retrospective analysis of all Florida and New York obstetrical hospital discharges between 1992 and 2007, representing almost five million deliveries performed by 4,124 obstetricians from 107 US residency programs. Nine measures of complications from both vaginal and caesarean births were recorded. The obstetricians' residency program was associated with substantial variation in maternal complication rates. Graduates of those programs in the bottom quintile for risk-standardized major maternal complication rates had complication rates approximately one-third higher than those treated by graduates in the top quintile. The rankings of residency programs based on each of the nine measures were similar. Adjustment for medical licensure examination scores did not substantially alter the program ranking.

b. **Clarridge 2005** [9]

This study explored physicians' knowledge of cultural care. A large percentage of respondents believed they were not prepared to provide specific components of cross-cultural care, including caring for new immigrants (25%), patients with health beliefs at odds with Western medicine (25%) and patients whose religious beliefs affect treatment (20%). Almost one-quarter (24%) indicated that they lacked the skills to identify relevant cultural customs that impact medical care. Approximately a third to half of the respondents reported receiving little or no instruction in specific areas of cross-cultural care in residency. Forty-one percent (family medicine) to 83% (surgery and obstetrics/gynecology) of respondents reported receiving little or no evaluation in cross-cultural care during their residencies.

c. **Hofman 1993** [10]

The aim of this study was to evaluate physicians' knowledge of medical genetics and to determine the predictors of this knowledge. The main predictor of knowledge was length of time since graduation and practising in a specialty where exposure to genetic problems was likely. Another predictor was taking a mandatory genetics course during medical education. Paediatricians scored higher than other specialties on their knowledge of cystic fibrosis; physicians in obstetrics and gynecology and family medicine scored higher on birth defects; and psychiatrists scored higher on depression.

d. **Ryan 2013** [11]

The aim of the study was to explore and compare junior doctors' perceived self-efficacy in prescribing, their prescribing errors and the possible causes of those errors. Over 500 first- and second- year residents in Scotland completed a survey. First-year residents were more likely to report insufficient knowledge as causing an error than second-year residents. Second-year residents were more confident. The main causes of errors were reported to be a failure of attention (44%) (e.g. writing once daily vs once weekly), a failure of memory (6%) (e.g. not indicating timing of medication administration), a lack of expertise (22%) (e.g. prescribing contraindicated drugs together), and a deliberate rule break (5%) (e.g. prescribing an allergic medication).

e. **Tasker 2014** [12]

Over 2700 trainees in the UK were emailed a survey and 871 completed it. The demands on providing service have eroded training opportunities, particularly with out-patients and formal teaching sessions. The majority of trainees (90%) indicate that service takes up 80% or more of

their time, often in menial tasks. Trainees report they get little feedback from supervisors. Core medical training has not prepared them to be a medical registrar. By the end of PGY2 one-quarter of them had never led a code. Many procedures were observed but not performed.

2 | Age

a. **McAuley 1990 [13]**

This study explored five years of data from the CPSO peer assessment program. Age was a significant predictor of performance, with 16% of those aged 50-74 and 35% of those aged 75 or older having deficient records or unsatisfactory care (as compared to only 9% of those under 50 years of age).

b. **Meskauskas 1975 [14]**

This study explored data from 3396 diplomates of the ABIM on the recertification examination. Mean scores showed an inverse relationship with age by each 5-year age period and each 5-year graduation period. As standard deviation (SD) was larger as age increased the best of the oldest group (65+) were just as good as the best of the youngest group (40-44). Based on mean and SD of each age group the failure rate in the 60+ is higher than the younger ages.

c. **O'Neill 2000 [15]**

A greater number of years since the surgeon was licensed was associated with greater mortality, but not with morbidity or bad outcome rates. After the adjustment for patient risk, "years since licensure" was found to be a predictor of surgical mortality.

d. **Grace 2011 [16]**

Sixty-two physicians who left practice voluntarily, and without discipline or sanction, who were returning to practice in the same discipline as their previous practice, participated in the Center for Personalized Education for Physicians (CPEP) re-entry program. Physicians completed an objective clinical skills assessment, including clinical interviews by specialty-matched board-certified physicians, simulated patient encounters, a documentation exercise, and a cognitive function screen. Approximately one-quarter (24.2%) of participants achieved a performance rating of 1 (best-performing group); 35.5% achieved a rating of 2; 33% achieved a rating of 3; 6.5% achieved a rating of 4 (global, pervasive deficits). Years out of practice and increasing physician age predicted poorer performance ($P = 0.0403$, $P = 0.0440$).

e. **Xierali 2011 [17]**

This study explores over 60,000 family physicians' geographic, demographic, and practice characteristics associated with the variations in MOC. While 91% of all active board-certified family physicians eligible for MOC are participating increasing age is significantly associated with decreasing likelihood to engage in MOC.

3 | Area of specialty

a. **Bismark 2013** [18]

This large study looked at all complaints (over 18,900) nationally across Australia over an 11-year period. These complaints were against 11,148 physicians. The top groups for complaints were family practice (47%) and surgery (14%).

b. **Khaliq 2005** [19]

A large study examined disciplinary actions among over 14,000 physicians in Oklahoma. Fewer than 400 physicians were disciplined. Specialties at greater risk of disciplinary action included family medicine, psychiatry, general practice, obstetrics-gynecology and emergency medicine.

c. **McAuley 1990** [13]

In exploring five years of data from the CPSO peer assessment program it was observed that only 3% of the workforce accounted for 49% of the complaints. General Practitioners and Family Medicine Practitioners were far more likely to have issues with performance (15%) than specialists (2%).

4 | Gender

a. **Clay 2003, Ross 2004, Alam 2012, Bismark 2013, Donaldson 2014** [18,20-23]

Multiple studies examined regulatory disciplinary activities and demonstrated that men have higher rates of referral for discipline than women.

Examples of this are:

- Ross (2004) who reviewed disciplinary hearings of 890 physicians in California with 2981 case controlled physicians. Being male was significantly associated with an elevated risk for disciplinary action that included licence revocation, practice suspension, probation, and public reprimand.
- Alam (2012) examined 606 physicians disciplined in Canada over a 10-year period. Of these physicians, 92% were male.
- Clay (2003) examined 308 physicians disciplined in Ohio over a 30-month period, matched against two groups of controls, one controlled for location and the second for location, gender, practice type, and self-designated specialty. Those disciplined were 90% male.
- Bismark (2013) looked at all complaints (over 18,900) nationally across Australia over an 11-year period, against 11,148 physicians. Of those facing complaints, 79% were male.
- Donaldson (2014) looked at predictors of competence in a large database in the UK. Male doctors were more than twice as likely to be referred to regulators for competence concerns as women doctors.

b. **Chauvel 2013, Cook 2001** [24,25]

Some studies explored adherence to guidelines.

- Chauvel (2013) explored adherence to guidelines on hbA1c testing. Doctors who were female, young, working in a group practice, participating in quality-control groups, and who had a lower patient load prescribed the recommended tests more often.
- Cook (2001) sought to determine which physician characteristics were associated with adherence to the recommended screening of teenage women for chlamydia. Female physicians were significantly ($p < .05$) more likely to screen for chlamydia than male physicians (43% vs. 24%).

c. **Xierali 2011**[17]

This study examined the associations between over 60,000 family physicians' characteristics (geographic, demographic, and practice) and their level of participation in variations of MOC. When age was held constant, female physicians were found to be less likely to miss initial MOC requirements.

5 | International graduate

a. **Khaliq 2005, Elkin 2012** [19,26]

These studies examined the complaints and disciplinary actions among over 14,000 physicians in Oklahoma and over 39,000 physicians in Australia. Foreign medical graduates had a higher risk of disciplinary action compared to US or Australian medical graduates respectively.

b. **MacLellan 2012** [27]

A study was designed to identify factors that help predict success for IMGs who train in Canadian residency programs and pass the Canadian certification examinations. The researchers conducted a retrospective analysis of 58 variables in over 800 files of IMGs. Those who chose the "clerkship pathway" had greater success on certification examinations than those who started at the residency level. Some of the factors that influence IMGs' success on certification examinations, including integration issues, the acquisition of clinical decision making skills, and varied educational backgrounds, can be better addressed by a regular clerkship pathway, in which IMGs benefit from learner-centred teaching and have more time for reflection on, and understanding of, the North American approach to medical education.

c. **Rao 2012** [28]

Researchers investigated the value of a Clinical Skills Verification process and then the education needs of first-year psychiatry residents who were foreign-country educated IMGs as compared to US citizens educated abroad. Foreign-trained IMGs were less comfortable conducting an observed interview than US-citizen IMGs.

d. **Glover Takahashi 2012**, [29,30]

These two studies investigated the performance of IMGs against Canadian third-year clerks and first-year residents, using a 12-station OSCE. The IMGs achieved lower scores than the residents and higher scores than the clerks.

e. **Watmough 2011** [31]

The study summarizes the performance of graduates, by country of primary medical qualification, in part one of the UK Royal College of Anaesthetists examination taken between 1999 and 2008. IMGs from certain countries performed better than those from other countries. Candidates from Australia, New Zealand, South Africa, and Zimbabwe performed significantly better than the mean for the group. Candidates from Egypt, Iraq, Ireland and Pakistan performed significantly worse.

6 | Lack of clinical exposure/experience

a. **Friedell 2014 [32]**

A survey was distributed to Chief Residents from all the General Surgery programs in the US. Of the 297 surveys returned, residents who had completed over 950 procedures were more likely to say they were prepared for practice than those with fewer procedures.

b. **Hobus 1987, Velhamos 2001, Verner 2003, Balslev 2012, Glance 2014 [33-37]**

This group of studies compared novice with expert physicians, observing differences in their abilities.

- Hobus (1987) compared the diagnostic accuracy of physicians, new grads, and medical students. The experts produced 50% more correct hypotheses than the novices and were able to reproduce a larger amount of relevant contextual information. In addition, a high correlation between problem-solving and recall measures was found only for the expert group.
- Velhamos (2001) investigated errors in residents reading imaging studies. Residents made mistakes that were picked up the next day by staff. The more junior residents made more mistakes and the mistakes had an impact on patient care
- Verner (2003) evaluated a robotic simulation to assess surgical skills. Differences between novices and experts were noted. Novices spent more time overall as well as longer in transition states (e.g. changing grip position).
- Baslev (2012) investigated visual attention and the concomitant cognitive processes of clinicians diagnosing authentic paediatric video cases. The more experienced clinicians were more accurate in visual diagnosis and spent more of their time looking at relevant areas. They explored the data less, yet they built and evaluated more diagnostic hypotheses. The authors concluded that clinicians of varying expertise analyze patient video cases differently.
- Glance 2014 compared transfusion rates post-surgery when residents involved with the procedure or without resident involvement. When residents were involved there was a far greater chance of the patient needing a blood transfusion and a slightly higher risk of complications, though there was no difference in 30-day mortality.

c. **Wenghofer 2009 [38]**

This study followed 208 physicians who passed the LMCC and had also been randomly selected for the peer review in Ontario. The physicians were followed for 7-10 years. The main outcome measures included quality of care (acceptable/unacceptable) as assessed by peer assessors using a structured chart review and interview. While only 7.2% of the study sample were assessed as providing unacceptable quality of care, doctors who scored in the bottom quartile of the written licensure exam had a greater than threefold increase in the risk of an unacceptable quality-of-care assessment outcome. Doctors in the bottom quartile of the clinical licensure exam were also at higher risk of being assessed as providing unacceptable quality of care.

7 | No certification

- a. **Epstein 2001 [39]**
A national sample of 278 physicians from the US was used to examine the relationship between the characteristics of psychiatrists and their responses to vignettes about depression. Correct diagnosis was significantly correlated with board certification in psychiatry.
- b. **Grace 2014 [1]**
A sample of 683 physicians referred for assessment at the Center for Personalized Education for Physicians (CPEP) from 2000 to 2010 were evaluated as either safe or unsafe to return to practice. Board-certified individuals were less likely to have poor assessment outcomes than uncertified individuals.
- c. **Khaliq 2005 [19]**
This study examined the risk of disciplinary action among over 14,000 physicians in Oklahoma. Just under 400 (2.8%) were disciplined. Non-board-certified physicians were found to be at greater risk of being disciplined ($P < 0.001$).
- d. **McAuley 1990 [13]; Caulford 1994 [40]; Davis 1993 [41]**
This series of studies explored data from the CPSO peer assessment program. Those with certification in Family Medicine were far less likely to have significant competence issues (3%) than those that were certified (18%).
- e. **Norcini 2002 [42]**
Data on all patients admitted with an acute myocardial infarction for the calendar year of 1993 were collected and analyzed by the Pennsylvania Health Care Cost Containment Council. Certified and self-designated family practitioners, internists, and cardiologists ($n = 4,546$) treated these patients. Treatment by a certified physician in Internal Medicine or Cardiology was associated with a 19% reduction in mortality among these patients.

8 | Practice features

- a. **Chauvel 2013 [24]**
Physicians working in a group practice and who had a lower patient load prescribed the three or four recommended diabetes mellitus monitoring tests more often than those practicing in solo practice.
- b. **Grace 2014 [1]**
This sample consisted of 683 physicians referred for assessment to the Center for Personalized Education for Physicians (CPEP) from 2000 to 2010 and who were evaluated as either safe or unsafe to return to practice. Physicians in solo practice were more likely to be deemed unsafe than physicians in other settings.
- c. **McAuley 1990 [13]**
This study explored five years of data from the CPSO peer assessment program. In observing the office practices of 918 physicians it was observed that those in solo practice were more likely to have significant performance issues (17%) than those in group practices (9%).
- d. **Norcini 1985 [43]**
This large-scale study examined ABIM recertification examination data from 5,000-7,600 candidates a year for a 10-year period. The results demonstrated that physicians working in solo practice, rural areas or smaller practices had lower scores on the recertification exam.

e. **Xierali 2011 [17]**

This was a study of over 70,000 family physicians who participated in MOC requirements. Physicians who worked in poorer neighborhoods or who were solo practitioners were more likely to have missed initial MOC requirements than those from a large, undifferentiated reference group of certified family physicians.

9 | Previous disciplinary activity

a. **Papadakis 2004 [4]**

A case-control study was conducted of all University of California, San Francisco, School of Medicine graduates disciplined by the Medical Board of California from 1990–2000 (N=68), compared against a control group (N=196). Almost all (95%) of the disciplinary actions were for deficiencies in professionalism. The prevalence of negative comments in the Dean's letters in the cases was 38% as compared to 19% in the control group. Logistic regression analysis showed that disciplined physicians were more likely to have Concern/Problem/Extreme excerpts in their medical school file.

b. **Bismark 2013 [18]**

Bismark et al. looked at all complaints (over 18,900) nationally across Australia over an 11-year period. These complaints were made against 11,148 physicians. Doctors named in a third complaint had a 38% chance of being the subject of a further complaint within a year, and a 57% probability of another complaint within 2 years; doctors named in a fifth complaint had a 59% chance of being the subject of a further complaint within a year and a 79% probability of a complaint within two years. The average number of complaints per doctor was 1.98.

c. **Grace 2014 [1]**

This sample consisted of 683 physicians referred for assessment at the Center for Personalized Education for Physicians (CPEP) from 2000 to 2010 who were evaluated as either safe or unsafe to return to practice. Physicians with current or previous board action (suspension, revocation, limitation, or stipulation) were more likely to be deemed unsafe than those without a previous board action.

10 | Resources

a. **Augustine 2010 [44]**

This study examined the advantages of a Pay-4-Performance (P4P) system. The study consisted of a survey of 97 internal medicine residents. Disadvantages of P4P included negative impacts on clinical care (e.g., by fostering abuse/gaming and compromising focus, care, and safety), on resources and efficiency, and on providers in that it may undermine morale.

b. **Clarridge 2005 [9]**

A survey was sent to 3435 resident physicians in their final year of training in emergency medicine, family practice, internal medicine, obstetrics/gynecology, pediatrics, psychiatry, or general surgery, at US academic health centres, to explore their knowledge of cultural care. The response rate was 60%. Barriers to delivering cross-cultural care included lack of time (58%) and lack of role models (31%).

c. **Cook 2014 [45]**

The study explored barriers and facilitators for a specific ICU medication treatment. The survey was sent to four individuals per ICU in 27 ICUs across Canada and the USA. The five most common barriers, in descending order, were drug acquisition cost, fear of bleeding, lack of resident education, concern about bioaccumulation in renal failure, and habit.

d. **Dean 2002, Rosser 2005 [46,47]**

These two articles discussed medical errors and identified resource issues that may result in errors.

- Dean (2002) had pharmacists identify 88 physicians at one UK hospital who had made prescription errors, and then 44 of these physicians were interviewed. Doctors identified many risk factors related to prescription errors—work environment, workload, whether or not they were prescribing for their own patient, communication within their team, physical and mental well-being, and lack of knowledge.
- Rosser (2005) investigated medical errors across six countries and identified that the main factors contributing to medical error were process factors (e.g. office administration, filing systems, chart problems), investigation errors (e.g. lab, diagnostic imaging), treatment errors (e.g. medication), provider factors (communication with patients or other providers), environmental factors (financial accounting charging for services not provided), clinical knowledge (not following recommended practice) and patient factors. It was noted that most of these are system issues that impact on individual practice.

e. **Sorrentino 2003, Bush-Knapp 2007, Ertem 2009, [48-50]**

These articles touch on the resource-based issues of lack of time and institutional support and their effects on competence.

- Sorrentino (2003) explored the use of PALS (paediatrics advanced life support) training in the state of Alabama. PALS has been shown to be useful and is an integral part of paediatric training, and is available to RNs, RTs, MDs, or other professions. It is not mandatory to do refreshers. About half of each of the four classes during the study year were first-time attendees and the balance were retaking the course. The number one barrier to training/retraining was time, with other reasons being the cost, the location, and not seeing the need.
- Bush-Knapp (2007) worked with The Society of Hospital Medicine and the Centers for Disease Control and Prevention and developed and conducted a quality improvement workshop based on the Centers for Disease Control and Prevention's Campaign to Prevent Antimicrobial Resistance in Healthcare Settings. Barriers to involvement in quality improvement efforts and the prevention of antimicrobial resistance included perceived lack of time, other institutional priorities, and lack of administrative and institutional support.
- Ertem (2009) evaluated the efficacy of a national training program in Turkey in improving primary health providers' knowledge and competence about paediatrics and barriers to implementation and sustainability of skills gained. Patient load, insufficient time allocated to primary care, lack of reimbursement, and ineffective referrals to pediatricians who had knowledge gaps regarding child development were identified as important barriers to implementation and sustainability of skills gained.

11 | Transitions

- a. **Benstead 2006, Brown 2007, Cave 2009, Hesketh 2003 [51-54]**

These articles explored the transition from student to resident. Generally, residents felt poorly prepared and reported a lack of support and/or supervision from their supervisors. Communication skills, teamwork skills and professionalism (coping with responsibility) were the areas deemed to be in greatest need of development.
- b. **Edwards 2007 [55]**

A six-month full-time "refresher" for nine physicians who were eligible to work as GPs, yet had been out of practice for up to 20 years, was carried out. Participants had very little self-confidence, though professionalism gave them a veneer of competence, which could hide gaps in competence. Educational needs were as great as traditional residents but with a different focus; traditional residents have content knowledge but returners may be out of date with respect to content.
- c. **Kilminster 2010 & 2011 [56,57]**

These discussion pieces pointed out that transitions are not systematically monitored. Actual practice was determined much more by situational and contextual factors than by the formal (regulatory and management) systems. Doctors cannot be fully prepared for their work and support systems are of benefit. The authors suggest that it is better that new doctors do not feel entirely prepared because they may then better recognize the complexities of clinical practice and the limits to what they can do. An important aspect of supervision is being able to ask for assistance when it is needed.
- d. **Ryan 2013 [11]**

First-year residents reported insufficient knowledge as causing errors, as well as interruptions and pressure from other staff. Second-year residents were more confident and errors were caused by failure of attention, failure of memory, lack of expertise, and deliberate rule break. Work issues for both years included low staffing levels, high workload, poor handover, pressure from other staff, shift pattern, and difficult physical environment. Team issues for both years included poor written or verbal communication with team (handover), inadequate supervision, unclear roles and responsibilities, complex patient factors, and poor communication. Task factors for both years included unavailable guidelines, test results unavailable or inaccurate, lack of familiarity with medication, individual factors, fatigue, lack of knowledge, poor motivation, and insufficient skills in prescribing.
- e. **Westerman 2010 [58]**

Westerman et al. explored the transition from residency to becoming an attending through interviews with 14 new attendings. The three themes identified were: 1) Disruptive novel elements (e.g. non-clinical tasks, new role of leadership, organizational structure and culture), 2) Perception and coping; (e.g. medically well-prepared, non-clinical tasks not well-prepared, leadership role is stressful, peer support is helpful), and 3) Personal development and outcome (e.g. task mastery develops over time, expectations are discerned over time, structure and culture of organization develop over time).

12 | Wellness

a. **Chen 2008 [59]**

This survey of 401 attending physicians was completed by 180 respondents. The survey collected information on work hours, sleep schedule, daytime sleepiness, and the perceived relation of these factors to patient safety, quality of care, and personal well-being. The Epworth Sleepiness Scale was used to measure subjective sleepiness. Of the respondents, 23% manifested abnormal Epworth Sleepiness Scale scores. Private Practice and surgically based subspecialties had higher scores (indicating more sleepiness) and reduced sleep. The sleepy physicians were more likely to associate sleep loss with medical errors and driving impairment.

b. **De Oliveira 2013 [60]**

A survey was sent to 2773 anesthesiology residents in the US. The questionnaire was divided into five parts: 1) demographic factors, 2) burnout (Maslach Burnout Inventory), 3) depression (Harvard depression scale), 4) questions evaluating best practice of anesthesiology, and 5) questions evaluating self-reported errors. Over half of the residents (N=1508, 54%) responded. High burnout risk was found in 41% of the respondents. Burnout was more likely in those working over 70 hours per week, having over 5 drinks per week, and being female. One third of those with high burnout and depression risk reported multiple medication errors as compared to the lower-risk responders, who reported few or none.

c. **Harms 2005 [61]**

The objective of this study was to analyze nearly three decades of surgical residents from a single training program. The goal was to define individual outcomes on personal and professional health and practice satisfaction. Almost all (110/114) former residents were contacted. There had been a 21% divorce rate post-residency. Major health issues occurred in 32% of the group and in 50% of those over 50. Alcohol dependency occurred in up to 7.3% of surgeons.

d. **Lemaire 2010 [62]**

Physicians are often unable to eat appropriately during their work day and nutrition has been linked to cognition. Twenty volunteer physicians were recruited for this study. On baseline and intervention day data was collected on function, blood glucose, "hypoglycemic" nutrition-related symptoms, fluid and nutrient intake, level of physical activity, weight, and urinary output. On the intervention day all nutrition was provided by the study. The outcomes demonstrated that cognitive scores were better on intervention days, blood glucose levels were more level, and there was improved hydration. The difference in intake was 935 Kcalories on control days and 1345 Kcalories on intervention days. This provides evidence that adequate nutrition improves physician wellness and this may ultimately benefit their patients.

e. **Turnbull 2000 [63]**

During a one-year period all 27 physicians who were participants in a Physician Review Program in Ontario undertook a detailed neuropsychological screening assessment. Nearly all physicians who were assessed as competent also performed well on the neuropsychological testing. A significant number (about one-third) of the physicians who performed poorly on the competency assessment had neuropsychological impairments sufficient to explain their poor performances. The difficulties were more marked in elderly physicians. This demonstrated that a minority of incompetent physicians have cognitive deficits.

Key Articles about Supports to Competence

1 | Assessment and feedback through tools

a. **Buntinx 1993 [64]**

In a randomized controlled trial three methods of providing feedback was directed at 183 doctors taking cervical smears. There was a control group with no feedback and then three groups with feedback: 1) a comment based on the results was added to lab report; 2) the comment went on the lab report, and in addition an overview of the monthly quality of their smears with the mean for the entire group; 3) in addition to the comment and monthly report, specific advice concerning the deficiencies in their technique with information on relevant post graduate educational opportunities. A significantly larger decrease in inadequate smears was found in the groups receiving monthly reviews (2 and 3) of their results compared to peers than in the control or comment groups.

b. **Ehrenfeld 2014 [65]**

The authors utilized a perioperative information management system to develop an automated, near-real-time performance capture and feedback tool to provide objective data on clinical performance to anaesthesiology residents. Of the 60 residents in the program, 80% completed a survey on the use of this tool. Prior to deployment of the new tool, they “disagreed” that they were receiving feedback in a timely manner. Resident performance on 24,154 completed cases was incorporated into the automated dashboard and trainees were given access to their own performance data. Residents “agreed or strongly agreed” that they desire frequent updates on their clinical performance on defined quality metrics. This system provided the residents with objective, detailed feedback about routine personal clinical performance.

c. **Eva 2012 [66]**

This article reports on a subset of data from a study that took place across five countries using focus groups aimed at determining participants’ perceptions of a variety of formal reflective activities. Using purposive sampling the authors recruited learners at various levels of practice from eight health professional training programs (within medicine and midwifery) known to use portfolios, personal learning plans, multi-source feedback, defined outcome competencies, and/or audit and feedback strategies. A total of 134 participants took part in 17 focus groups. Multiple factors impact on the use of feedback. These include confidence, experience, and fear of not appearing knowledgeable. Depending on the individual and situation these can either enhance or decrease receptivity to the feedback provided. The authors discuss mechanisms through which cognitive reasoning processes might impede learning and change from formative feedback. A conclusion is that there is no simple recipe for the delivery of effective feedback.

d. **Sargeant 2007 [67]**

The purpose of this qualitative study was to increase understanding of the consequential validity of MSF by exploring how doctors used their feedback and the conditions influencing this use. Interviews were conducted with volunteers from two groups of family doctors who participated in a pilot assessment of MSF: those who received high (n = 25) and those who received average/lower (n = 44) scores. Changes were more likely if the MD received specific feedback consistent with other sources of feedback from credible reviewers who were able to observe the subjects. These reviewers were most frequently patients.

e. **Shubrook 2011 [68]**

The American Osteopathic Association developed a Clinical Assessment Program (AOA-CAP) for residencies to provide a mechanism for programs to measure and improve their quality of patient care. This program is a form of feedback seeking behaviour as the results point out how

much/little the patient care conforms to current guidelines. The study analyzed data from 52 osteopathic family medicine residency programs consisting of 2568 patient cases from 2005-2007. Programs who had used the tool previously (repeat programs) had statistically significant better performance than first-time programs in the composite measure of processes of care related to diabetes care.

2 | Clinical Exposure/Experience

a. **Balslev 2012 [36]**

These researchers investigated visual attention and the cognitive processes of clinicians making a diagnosis while watching authentic paediatric video cases. The more experienced clinicians were more accurate in visual diagnosis and spent more of their time looking at relevant areas. They explored the data less, yet they built and evaluated more diagnostic hypotheses. The authors concluded that clinicians of varying expertise analyze patient video cases differently.

b. **Bayrak 2012 [69]**

This study was designed to evaluate the pediatric percutaneous nephrolithomy (PCNL). A single surgeon, who had performed over 120 procedures in adults, then completed this procedure on 70 paediatric patients. The first 35 were compared with the second 35 with respect to outcomes. Most patients in the first group (82%) were stone-free after the procedure, and 100% of the second group were stone-free after the procedure. Five patients in the first group received transfusions and only two patients in the second group. The only major complication occurred in group one. These results indicate that competence in this procedure can be attained after 35 children.

c. **Friedell 2014 [32]**

An online survey was sent to every general surgery program director in the United States for dissemination to each graduating chief resident. The survey study was designed to evaluate the readiness for practice in chief residents from surgery programs. Almost 300 surveys were returned. The 77% who had completed over 950 procedures were far more likely to say they were prepared for practice than those with fewer procedures ($p < .0001$).

d. **Marcus 2006 [70]**

To determine whether the auscultation of a clinically useful S3 improved with experience, 100 patients undergoing left-sided heart catheterization underwent blinded auscultation by four physicians (one from each of 4 different levels of experience). Residents' and interns' auscultatory findings demonstrated no significant agreement with phonocardiographic findings, however an S3 auscultated by cardiology fellows ($P = .001$) and cardiology attendings ($P = .003$) did agree with phonocardiographic findings. Additionally, the S3 detected by attendings and fellows was superior in distinguishing additional objective findings (e.g. an elevated B-type natriuretic peptide level, a depressed left ventricular ejection fraction, or an elevated left ventricular end-diastolic pressure). The conclusion was that those with more experience were more likely to identify a clinically useful S3.

e. **Morris 2014 [71]**

The authors aimed to determine if and how PID diagnoses vary between clinicians with different experience levels. The study sample included 3804 women assessed by 36 clinicians. Of those diagnosed with PID, 64% of the diagnoses made by experienced practitioners met the CDC key clinical criteria, vs. 41% by inexperienced. The diagnoses of chlamydia-positive PID increased with experience from 6% to 32%. The authors concluded that correct clinical diagnosis improves with experience.

3 | Continuing education participation

a. **Bundy 2014 [72]**

This study was to evaluate the Education in Quality Improvement for Pediatric Practice (EQIPP) online program. It consisted of a study of over 3500 participants in one of three modules over a five-year period. Significant quality gaps were observed across many of the quality measures at baseline and sizable improvements were observed across most quality measures at follow-up. The most influential module elements were collecting and analyzing data, creating and implementing aim statements and improvement plans, and completing “QI Basics.” Participants spanned all age ranges. Even the group of physicians over 60 years old, where there had initially been concerns they wouldn’t fare well with online learning program, improved their knowledge of QI.

b. **Buriak 2014 [73]**

The purpose of this study was to design, develop, and evaluate a fully accredited, evidence-based CME intervention to address the established knowledge gap for specific cancer survivorship education (4 cancers). Delivery of the content was through a web-based program. The program was administered to over 1500 participants, including physicians, nurse practitioners, nurses, physician assistants and doctors of osteopathy. The results of this educational intervention demonstrated the effectiveness of internet-based CME/CE for cancer survivorship. Effect size suggested extremely high practical significance. Significant knowledge gains were observed for each survivorship knowledge question across all clinical specialties studied. Nearly 100% of participants agreed that the course contributed to survivorship care and was organized effectively. The greatest gains occurred in the Other Medical Specialties group (as compared to oncology/hematology, primary care, psychiatry, and surgical).

c. **Evans 2010 [74]**

This study was designed to investigate the effect of a printed information package on the low back pain (LBP)-related beliefs and reported behavior of musculoskeletal practitioners (chiropractors, osteopaths, and musculoskeletal physiotherapists) across the United Kingdom. Over 1700 professionals participated in this study. The intervention was providing a printed information package containing guideline recommendations for the management of low back pain (LBP). LBP-related beliefs were significantly improved in those who were sent the information package ($P=0.002$), but only to a small degree (mean difference, 0.884 scale points; 95% confidence interval, 0.319–1.448). Behaviour was also changed with more guideline-consistent management in the three areas of recommendations (work, activity, bed rest). The study demonstrated that sending a CPG to practitioners can change behaviour.

d. **Markeret 2003 [75]**

This study evaluated learning from nine different CME programs with an overall sample of over 700 participants. While the programs varied in length from a few hours to a week, there was a significant increase in knowledge found for six of the nine programs. When all groups were combined the intervention group was significantly better than the control group in terms of an increase in knowledge.

e. **Wenghofer 2014 [76]**

This study looked at CPD participation and performance in the Ontario regulatory peer review process for 617 physicians. CPD was considered to be participation in RCPSC or CFPC MOC programs. Analysis revealed that physicians who reported participating in any CPD activities were significantly more likely to have satisfactory peer assessments than those who had not participated in CPD. In addition, physicians participating in group-based CPD activities were more likely to have satisfactory assessments than those whose activities were not group-based. Of those with no CPD credits 10% were rated as unsatisfactory on the peer assessment, as compared to 4% of those who had participated in CPD. Physicians

who participated in a single type of CPD were more likely to be unsatisfactory (10%) than those who participated in multiple types of CPD 4%. Similarly, those who participated in group-based CPD were less likely (4%) to be unsatisfactory than those participating in CPD that not include group (11%).

4 | Educational information/program features

a. Bekkers 2010 [77]

This study examined a blended learning program that included seven parts. It included online reflection on a clinicians' own practice, presentation of research evidence and guidelines, a practice-based seminar focusing on participants' own antibiotic prescribing and resistance rates in urine samples sent from their practice, communication skills training using videos of simulated patients in routine surgeries, and participation in a web forum. Participants reported greater self-confidence in reducing antibiotic prescribing and at least some change in consultation style and antibiotic prescribing behaviour. The components of the intervention that appeared to have the greatest influence on changing clinician behavior were the up-to-date research evidence resources, simple and effective communication skills presented in on-line videos, and presentation of the practice's own antibiotic prescribing levels combined with an overview of local resistance data.

b. Midmer 2006 [78]

This study evaluated a CME program for family physicians regarding opioid abuse. All participants attended a three-hour session. The intervention group participated in 10 weeks of e-mail case discussions, with designated participants responding to questions on cases. Several months after the e-mail discussion, participants took part in a mock telephone consultation; a blinded researcher posing as a medical colleague asked for advice about 2 cases involving opioid and benzodiazepine prescribing. Using a checklist, the researcher recorded the questions asked and advice given by the physician. Both groups improved in optimism about treatment outcomes and were more likely to report using a treatment contract and providing advice about sleep hygiene. During the telephone consultation, the intervention group asked significantly more questions and offered more advice than the control group. Facilitated by electronic mail and a medical expert, case discussion is an effective means of improving physician performance.

c. Meuser 2010 [79]

The American Medical Association (AMA) developed an evidence-based, multi-media curriculum to promote basic competences in assessment of screening geriatric patients related to driving. This study evaluated reported changes in practice behaviors three months post-training in 693 professionals. Training included a one-hour lecture or two-hour workshop. Physicians were split 50/50 for the two formats, though other professionals were assigned the two-hour workshop. A post-test was conducted by mail. Significant improvements in reported attitudes, confidence, and practices were found across measured items. In particular, post-test data indicated increased use of in-office screening techniques, chart documentation of driver safety concerns, and planning for transportation alternatives. Findings suggest that a well-designed, one-time multi-media continuing education intervention can enhance clinical practice concerning driver fitness evaluation.

d. Nilsson 2001 [80]

The intervention for this study consisted of providing feedback to physicians on their prescribing rates and then problem-oriented education through outreach visits. Forty family physicians participated in the study. Information on prescription rates was collected for one year before and one year after the intervention. There was a decrease in inappropriate prescribing rates following the intervention.

e. **Seghal 2014 [81]**

A three-day course brought adult learners to the bedside in an academic health centre. It was aimed at training physicians to be better hospitalists. The course included instruction in online searches as well as bedside sessions. Almost all participants (98%) indicated they would change some component of practice

f. **Shershneva 2011 [82]**

This study examined multiple outcomes of a US-based collaborative, multicomponent smoking cessation educational program for clinicians. The multi-pronged approach to CME is called CS2day (quit smoking today). The study documented changes in clinicians' competence and performance with respect to the 5 As best practice algorithm (i.e., Ask, Advise, Assess, Assist, and Arrange). The program reached more than 43,000 clinicians who participated in a variety of activities. Participants demonstrated higher scores than a comparison group on six of seven competencies. The majority of respondents to the Commitment to Change questions reported intended and implemented practice changes consistent with desired outcomes. Performance outcomes of three performance improvement activities varied from 9% to 36%. A smoking quit rate of 46.8% was observed in two other Performance improvement activities.

5 | Performance review

a. **Brinkman 2007 [83]**

A study of 36 first-year paediatric residents was performed to determine the impact of MSF assessments, as completed by nurses and patients' parents. This augmented the typical performance review feedback given to the residents. The group that received the additional MSF feedback demonstrated significant improvement in their communication skills with patients and their families and timeliness of task completion, and demonstrated increased responsibility and accountability.

b. **Fidler 1999 [84]**

The Physician Achievement Review (Alberta regulatory process) uses an MSF to provide feedback to physicians. Following results of the MSF feedback to 308 physicians a survey was conducted to determine whether the participants had made any changes and 255 physicians responded. The majority of the physicians (83%) had contemplated a change and 66% had contemplated changes for clinical practice and resource use. Changes initiated were mostly for communication. The physicians who made changes had lower MSF scores than those who did not make changes, suggesting that physicians did use the feedback. The main areas for change included: 1) collaboration with colleagues; 2) clinical skills and resources; 3) professional development and stress management; 4) communication with patients; and 5) office systems.

6 | Personal support and feedback

a. **Brinkman 2007 [83]**

The purpose of this paper was to determine whether augmenting standard feedback on resident performance with a MSF intervention would improve pediatric resident communication skills and professionalism. There were 18 residents in each group. The MSF, along with tailored coaching, was found to improve performance. Statistically significant differences were observed for communicating effectively with the patient and family; timeliness of completing tasks; and demonstrating responsibility and accountability.

b. **Connor, 2000** [85]

This article described the outcomes of a mentoring program for doctors through qualitative focus group interviews. Mentors (78 senior physicians) valued the program highly, in that it allowed them to be part of a network of senior doctors helped them to develop mentoring skills and allowed them to engage in personal and professional development. Both mentors and mentees were found to gain skills in co-mentoring.

c. **Theising 2014** [86]

The authors assessed how peer assessment impacted behaviours and self-confidence of 161 third-year pharmacy students. Students perceived feedback from instructors to be more meaningful than feedback from their peers. Nonetheless, 65% agreed that peer assessment have enhanced their learning. Only 40% of students reported that they reflected on previous assessments. Almost all students said that peer assessment gave them more confidence in their abilities and most agreed that the assessments helped them to identify areas for development.

7 | Professional organization participation / systems

a. **Chaudhry 2012** [87]

Beginning in 1971 state medical boards in the US began to require continuing medical education. In 2010 the Federation of State Medical Boards' House of Delegates voted to adopt a framework for Maintenance of Licensure (MOL). At the time of publication almost all state boards required CME credit hours or had other specific requirements. Generally, there are three components to the maintenance of licensure programs: 1) reflective self-assessment ("What improvements can I make?"), which relies heavily participation in CME 2) assessment of knowledge and skills ("What do I need to know and be able to do?"), which can be met by various activities (e.g. computer-based case simulations, performance improvement CME, procedural hospital credentialing, completion of performance improvement activities offered by the Institute for Healthcare Improvement, American Medical Institute, or American College of Physicians); and 3) performance in practice ("How am I doing?"), could be evaluated with patient and peer surveys (for example the American Board of Medical Specialties provides practice improvement activities or the Clinical Assessment Program of the American Osteopathic Association, 360-degree multisource evaluations, or, over time, submission of practice activities adhering to regional or national performance improvement benchmarks. Over 230,000 physicians are not specialty certified in the United States, and physicians "grandfathered" for specialty certification are not currently required to participate in the maintenance of certification programs. Organizations are exploring activities and tools to encourage these physicians to maintain their competence and potentially meet the MOL requirements.

b. **Finlay 2009** [88]

The aim of the study was to investigate the experiences of general practitioners (GPs) of the current appraisal process in the UK. A survey was mailed to all 385 GPs who worked in a particular region of the UK and 72% responded. The key findings obtained were that 47.5% of the respondents stated that taking part in the appraisal process had enhanced their learning, 40.2% felt that the appraisal process had improved their practice and 55.8% stated that the appraisal process had encouraged their involvement in CPD. Participants indicated that it was vital for the appraiser to be a respected peer. The downside to the appraisal process was the time commitment, as there was little to no protected time for preparation of documentation and engagement in the required CPD.

c. **Iglehart 2012 [89]**

This discussion paper considers whether MOC works. It describes the MOC requirements in the US, including re-certification via exam for some specialties. At the moment most physicians wait until the ninth or tenth year of the window to participate in any activities; the organizations are looking at changes to MOC to make it necessary to participate regularly. There are four components for MOC: 1) licensure & certification (initial); 2) lifelong learning and self-assessment 3) cognitive expertise 4) assessment of practice performance. There are over 20 American Board of Internal Medicine (ABIM) specialties that have MOC requirements. The requirements, generally, are: 1) Maintenance of medical licensure throughout the cycle; evidence of professional credentialing, and peer letters of reference may also be required; 2) CME credits, patient-safety module, self-assessment; 3) ALL specialties have a secure examination as part of their process; and 4) various activities, including peer assessment, QI activities (local or national), case discussions, simulations, modules for self-assessment and improvement, or practice logs. The American Board of Medical Specialties (ABMS) is also promoting that there should be more evidence that MOC activities result in better patient care.

d. **Silver 2008 [90]**

The authors describe self-evaluation learning activities of the RCPSC Maintenance of Certification program (MOC) and the CFPC Maintenance of Proficiency program (Mainpro®). Both programs incorporate several self-evaluation learning processes and tools are designed to encourage physicians to self-assess knowledge and performance against objective measures. The programs also provide guided self-audit learning activities that encourage physicians to gather information about their practices and reflect on the information with their colleagues. The program components that support reflection include developing personal learning plans based on an assessment of need, attending accredited self-assessment programs, practice assessment, simulations, self-learning based on web-based assessment, mini-practice audits and structured reflection. Physicians are given extra credits when they participate in these types of learning activities. The authors recognize that self-assessment skills are not good and efforts to improve self-assessment have not been successful. Reflection on actions, as described by Schon's reflection cycle, is important and can lead to maintenance of competence.

e. **Sole 2014 [91]**

This paper reviews procedures in the European Union (EU) that are designed to ensure that physicians continue to meet criteria for registration. It also discusses the implications of these procedures for labour mobility. A questionnaire was completed by key informants in 10 EU member states, supplemented by a review of peer-reviewed and grey literature on the topic. CME/CPD is one mechanism to maintain competence. Some countries have self-regulation with CME/CPD requirements, others include peer review and minimum activity levels, and others may include a review of complaints or compliments on performance, while others may use multi-source feedback (MSF) from patients. Some countries consider that self-regulation is sufficient to ensure competence and have no mandatory requirements. The paper points out that further consistency across the EU is desired.

8 | Quality assurance participation

a. **Berwick 1986 [92]**

Education at an HMO was presented to 35 internists and 30 nurse practitioners. It consisted of two departmental meetings to discuss the 12 commonly ordered blood tests and X-rays. Peer comparison feedback was provided on costs of the tests. Clinicians received individualized reports on their personal rates of ordering as compared with peers. They were also provided with peer comparison feedback on the yield of tests, i.e. the rate of abnormal test results. Providing information of rates of use (costs) as compared to peers decreased the use of 11/12 tests (lab & X-rays). Cost feedback had the most impact at 8.3%, yield feedback had some impact at 1.3% and education had some impact at 2.3%.

b. **Dietrich 1992 [93]**

This study evaluated the impact of education on early cancer detection. Physicians in 98 ambulatory care practices in the US were the subjects. The intervention consisted of a day-long physician meeting directed at improving knowledge, attitudes, and skills relevant to cancer prevention and early detection. The office intervention included assistance from a project facilitator in establishing routines for providing needed services. These routines included division of responsibilities for providing services among physicians and their staff and the use of medical record flow sheets. Based on cross-sectional patient surveys, the office system intervention was associated with an increase in mammography, the recommendation to do breast self-examination, clinical breast examination, faecal occult blood testing, advice to quit smoking, and the recommendation to decrease dietary fat. Education was associated only with an increase in mammography. Record review for a patient cohort confirmed cross-sectional survey findings regarding the office system for mammography and faecal occult blood testing. Community practices that are assisted by a facilitator in the development and implementation of an office system can substantially improve provision of cancer early detection and preventive services.

c. **Margolis 2004 [94]**

The study was to examine the effectiveness of an intervention that combined continuing medical education with process improvement methods to implement "office systems" to improve the delivery of preventive care to children. A random sample of 44 practices in North Carolina that met the inclusion criteria were selected (i.e. sufficient newborns enrolled each month to achieve sample size requirements; not part of an academic institution or a publicly funded health centre; and, in the region near the University of North Carolina, and annual Medicaid billing in excess of \$50 000). This was a practice-based continuing medical education study in which project staff coached practice staff in reviewing performance and identifying, testing, and implementing new care processes (such as chart screening) to improve delivery of preventive care. The proportion of children per practice with age-appropriate delivery of all four preventive services increased significantly in the intervention groups. Thirty months after baseline, the proportion of children who were up to date with preventive services was significantly higher in intervention than in control practices and improvements in screening for tuberculosis, lead, and anaemia were statistically significant.

d. **Mold, 2008 [95]**

This study was a six-month randomized, controlled trial comparing a multicomponent quality improvement intervention to feedback and benchmarking in 24 practices in Oklahoma. Intervention practices received performance feedback, peer-to-peer education (academic detailing), a practice facilitator, and computer (information technology) support. Implementation of the three targeted processes was determined by a blinded 3-clinician panel that reviewed transcribed clinician interviews before and after intervention using performance definitions. Rates of delivery of selected preventive services were determined by chart audit. Intervention practices implemented more of the processes than control practices. They were also more likely

to implement at least one of the processes for children and to implement standing orders for either children or adults. Mammography rates increased significantly. Neither clinician characteristics, practice characteristics nor a clinician's readiness to change predicted implementation of the quality improvement intervention. A multicomponent implementation strategy consisting of feedback, benchmarking, academic detailing, facilitation, and IT support increased implementation of evidence-based processes for delivering preventive services to a greater extent than performance feedback and benchmarking alone

9 | Reflection and self-assessment

a. **Ballon 2008 [96]**

The authors studied the use of reflection for psychiatry residents in an addiction rotation. Their goal was to determine the key factors that impact on the development of attitudes and professionalism. Activities included reflection discussion times, reflection journaling, and end-of-rotation reflection papers. Authors completed a qualitative analysis of the 28 papers. Papers demonstrated the change in knowledge, attitudes, and skills as a result of the rotation. The reflection techniques were deemed valuable by students.

b. **Baldwin 2012 [97]**

A reflective journal was instituted in 2010 for post-graduate general practitioner trainees (N=18) at one university in the UK. Before starting the course some participants did not think there would be value in the reflective journal. Strengths of the journal included providing a critical perspective of oneself, thinking about how theory impacts practice, assisting in identifying knowledge gaps and planning for future learning, and allowing one to see how they changed over time. Some of the challenges included finding the time to write, the emotional content, and the written format. Overall, the participants generally liked using the reflective journal as a formative assessment, but were not in favour of it being summative.

c. **Epstein 2011 [98]**

The author discusses the use of mindful practice as a key to patient safety. Mindful practice involves three processes: 1) Intention—one's values and purpose; 2) Attention—what one notices and considers important; and 3) Habits—what one does and how one thinks. Intention is the commitment to engage with difficult challenges or situations or conflict and not withdraw. Attention is more than seeing and hearing, but requires being alert to both expected and unexpected information. Habits associated with mindful practice include being curious about patients, having a "Beginner's mind" which allows one to look at a familiar situation with new eyes, and being present, rather than being on autopilot. This type of mindfulness can reduce the likelihood of errors. It promotes awareness of elements that may interfere with performance, including: working outside of one's usual clinical area; feeling anxious, angry, or bored; or recognition of having inadequate skill for a task and needing to ask for assistance. Clinicians who participated in workshops to teach mindful practice reported a positive impact on their practice. This included greater mindfulness, improved mood, lower burnout, increased empathy and orientation toward their patients' clinical needs.

d. **Lowe 2007 [99]**

Occupational therapists (N=41) in Ontario participated in a study of reflection and implementation of learning from a short continuing education course. Participants used reflection before, during, and after the course, and reflection was influenced by a range of factors associated with the course, practice context, and the individual. Individual factors that influenced reflection included pre-course learning, motivation, interest, awareness, and background. The course factors that influenced reflection included novelty, pace, volume of material, and content. The practice context factors that influenced reflection included management support, demands on time, being open to innovation, the learning environment,

expectations, adequate staffing levels, resources, and the type of clinical practice. The authors conclude that reflection may play multiple roles during the process of implementing short course learning into practice. Commitment to Change statements may promote practice change using reflection.

10 | Support through structure or organization

a. **Bass 1986 [100]**

Thirty-four family practices in southwestern Ontario were randomly assigned to have the use of a medical assistant to oversee blood pressure screening and provide education to the patients. The practices were followed for five-years. There were 17 physicians in each group and over 15,000 patients in each group. More patients in the experimental group were screened and those who were determined to have high blood pressure had better compliance and thus lower blood pressure than the group seen by physicians alone. The physician-medical assistant team resulted in higher patient satisfaction. Providing the care takes time, and physicians are frequently pressed for time. There was no ongoing change after the study, as none of the experimental group kept the medical assistants after the end of the research, due to a lack of funding for primary care nursing.

b. **Lysaght 2001 [101]**

The purpose of this study was to examine the relationship between work environment and the competency maintenance activities of occupational therapists. A survey of 121 occupational therapists in three states and interviews with eight occupational therapists in Ohio was used for the data analysis. Analysis of survey data indicated that workplace support and the degree of competency monitoring are significant determinants of competency maintenance behaviour. State continuing education requirements had no impact on reported levels of competency maintenance. Personal motivation of the therapist emerged as a potentially important moderator of the relationship between environment and competency maintenance.

c. **Smetzer 2008 [102]**

Deadly errors can occur in the administration of medication. In the UK, a number of cases of administration of a drug through an intravenous line (IV), rather than an epidural, have resulted in patient deaths. Systems to reduce the incidence of injecting epidural medications into IVs need to be created. The author recommends that the industry make changes to the administration systems (i.e. type of tubing and connectors), so that it is impossible to hook up the incorrect medication to the IV. A number of other system changes are options that will also prevent this type of error (e.g. using barcode technology, using only authorized clinicians for administration, storing epidural medications in a separate location, or labelling bags “for epidural use only”). Multiple process changes are also suggested that would prevent this type of error from occurring in the future.

11 | Technology

a. **Downs 2006** [103]

This study compared three educational interventions for detection and management of dementia in primary care. The educational interventions were: 1) an electronic tutorial carried on a CD Rom; 2) decision-support software built into the electronic medical record; and 3) practice-based workshops. The decision-support software and practice-based workshops both significantly improved rates of detection compared with control groups.

b. **Frost 2011** [104]

First and second year family medicine residents attended a two-hour curriculum that combined didactic and simulator exposure to common valvular pathologies. Diagnostic accuracy improved in 95% of the residents. Echocardiography requests for non-pathologic murmurs decreased, which was a positive outcome. Residents were more confident in their auscultation skills.

c. **Gallagher 2004, Sherman 2005, Patel 2014, Jensen 2014, Giannotti 2013, Ang 2014** [105-109]

An increasing volume of studies are investigating the ability of simulation to teach laparoscopic surgery.

- **Gallager 2004** [105]
The performance of 100 laparoscopic novices was compared to that of 12 experienced (>50 minimally invasive procedures) and 12 inexperienced (<10 minimally invasive procedures) laparoscopic surgeons. The values of the experienced surgeons' performance were used as benchmark criterion measures. Each subject completed six tasks on the Minimally Invasive Surgical Trainer-Virtual Reality three times. After three trials with the simulation, the mean performance of the medical students approached that of the experienced surgeons. However, 7–27% of the scores of the students fell more than two SD below the mean scores of the experienced surgeons (the criterion level). Virtual reality can be used to evaluate skill, to categorize different levels of ability, and to promote learning.
- **Sherman 2005** [106]
This study compared experts (over 50 procedures), juniors (residents with fewer than 25 procedures) and naïve (third-year med students with 0 procedures) on three lap-sim tasks. All three groups improved significantly over the three tasks for both time-error and motion scores. The experts had significantly higher scores for time error performances at both baseline and final scores. A significant difference in motion scores was seen only at baseline, with the experts scoring higher.
- **Giannotti 2013** [109]
The authors investigated the influence of a four-week structured NintendoH WiiTM training on laparoscopic skills by analyzing performance metrics with a validated simulator (Lap MentorTM, SimbionixT). Participants were first- and second-year residents in General, Vascular and Endoscopic Surgery. One group had training on the Nintendo for four weeks and the control group did not. There were 21 subjects in each group. All 42 subjects in both groups improved significantly from beginning to end. The experimental group showed a significant improvement in performance for 13 of the 16 performance metrics.
- **Patel 2014** [107]
In a study that was conducted over a one-year period, more than 30 general surgeons completed various tasks for over 26,000 overall minutes of simulation practice. For general surgeons training in robotic surgery, most users would need 4-5 attempts to achieve 80% proficiency for any given metric. Those who demonstrate lower skills at the beginning need more attempts to reach this level. The simulator training was demonstrated to be effective.

- Ang 2014
This study was to validate a practical and economical method of assessing economy of movement during a simulated task. Participants included attendings, senior and junior residents, and interns. Movement was assessed through a wrist-mounted smart phone. Students took longest to complete the task and consultants took the least time. Lower-level trainees did more movements, indicating lack of precise instrument control. The number of movements decreased over the levels of training. While there are differences in skills at different levels of training, this study showed improvement only for those who were at the lowest level.

d. **Moreau 2008 Vadnais 2012 [110,111]**

Some studies looked at simulations for high-risk procedures in obstetrics and neonatology:

- Moreau 2008 [110]
A simulator was used to teach forceps delivery. Four novices (under one year of obstetrical residency) were supervised by experienced obstetricians (over 10 years). Experimental results indicated that the novices demonstrated very diverse initial abilities, which indicates that they need a personalized training scheme. This can be carried out on the BirthSIM simulator without any safety concerns for patients.
- Vadnais 2012 [111]
The objectives of this study were to examine short-term and long-term improvement in the management of uncommon but critical obstetrical events (eclampsia, shoulder dystocia, postpartum hemorrhage and vacuum-assisted vaginal delivery) and to determine whether annual exposure to the workshop would be of benefit. There was a pre-test prior to the one-day simulation workshop, then post-tests at 4 and 12 months for residents and 12 months for attending physicians. Participants attended the workshop again at 12 months and then completed another post-test. Knowledge and comfort improved after the workshop. This improvement was maintained at one year for the residents. While attending physicians remained more comfortable managing these scenarios up to one year later, their knowledge had diminished. Repeating the simulation brought additional improvements.

e. **Rubio-Gurung 2014 [112]**

This study explored team simulation for neo-natal resuscitation. The session was four hours duration. It covered theoretical knowledge, followed by the team simulation. Participants were paediatricians, midwives, nurses and anaesthesiologists. Following the training the teams were able to achieve a higher neonatal heart rate and a decrease in hazardous events was noted.

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