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How can we close the loop on test results to reduce risks associated with diagnostic error in Emergency Departments?

Briefing Document

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Table of Contents

Executive summary

Diagnosing illness and injury involves not just establishing an explanation of a presenting health problem, but communicating this to patients and other clinicians. Concerted efforts to measure, understand and reduce diagnostic error, including in EDs, have increased in recent years. In addition to gaining a better understanding of system-related factors, this has also led to an emerging understanding that breakdowns in doctor-doctor and doctor-patient communication are prominent factors contributing to diagnostic error. Communication errors in diagnosis can and do result in serious consequences. The challenge of communicating diagnostic information is magnified in the Emergency Department (ED) due to time pressures, distractions, information inaccessibility and unfamiliarity with patients.

The aim of this project is to develop and test strategies to improving the communication of diagnostic information to doctors and patients in the Emergency Department setting.

A rapid review of literature identified 11 relevant systematic reviews of reasonable quality as well as four narrative reviews. Collectively, these studies found:

- technological advancements are increasingly bringing testing straight to the bedside, rather than requiring patients to be moved to other locations. This reduces risk of communication errors from clinicians to other clinicians. However, point-of-care tests do not encompass the issue of communicating diagnoses to patients, or communicating results of tests and further actions to other clinicians.
- there are a number of IT areas with potential to address diagnostic communication challenges such as telemedicine systems, novel information presentation and display and electronic communication of results to patients. However, substantial barriers to successful implementation exist, and the empirical evidence of clinical impact is weak
- establishing who is responsible for following up test results, and acting on findings, are complex issues requiring a range of policy, health IT and patient solutions.

We consulted with a panel of 15 Victorian community members to better understand their perspectives on communication of diagnostic information in the ED. Citizens highlighted technology as critical to improving the communication of test results to both health professionals and patients. They also emphasised the importance of having different ways of accessing test results, which is particularly pertinent when ensuring suitability for vulnerable populations.

Practice interviews were conducted with a radiologist, ED director, paramedic, Clinical Director of Safety and Quality and an ICU director and representative of the Clinical Excellence Commission. Participants underlined transparency and clarifying the lines of responsibility as central to improving test result communication. A range of intervention options were canvassed including inclusive handover, a single test result inbox, a discharge checklist, rostering staff to follow up on test results, automation strategies, standardisation of test result reports and providing patients with test results.

Collectively, the review and consultation activities provide basis for deliberations on how research evidence and practice insights can identify feasible and testable behaviour change strategies.

Aims

The aim of this project is to develop and test strategies to improving the communication of diagnostic information to doctors and patients in the Emergency Department setting. This research project is being developed based upon

- BehaviourWorks Australia's established three-phase method of applying behaviour change through *exploration (problem focus), deep dive (behaviour focus) and application (impact focus);*
- A structured approach to evidence review and stakeholder dialogue, the Forum method (Lavis, Boyko et al. 2014, Bragge, Piccenna et al. 2015, Bragge, Piccenna et al. 2015, Middleton, Piccenna et al. 2015).

Table 1 outlines this approach. This briefing document contains findings from the exploration phase. The Briefing Document is directed towards stakeholder groups with expertise in or experience in Victorian health service emergency departments including clinicians, consumers and consumer representatives, researchers, the Victorian Department of Health and Human Services (DHHS) and the Victorian Managed Insurance Authority (VMIA). Details of all research methods employed in producing this briefing document can be found in Appendix 1.

Table 1: *Research Project Overview*

EXPLORATION: Problem focus
Rapid review of evidence into the effectiveness of strategies to improve the communication of diagnostic information to doctors and patients that are feasible and sustainable in emergency departments Examine current practice and key issues in communication of diagnostic information in the emergency department setting in Victoria through: • A day-long citizen panel in which members of the Victorian community discuss key challenges in communication of diagnostic information; and • One-on-one interviews with clinicians, researchers and other experts in the field
DEEP DIVE: Behaviour focus
Convene a representative stakeholder group to: • Gain a shared understanding of key issues in communication of diagnostic information in the emergency department (ED) setting, including specific conditions that present diagnostic challenges; • Identify an intervention to optimize communication of diagnostic information in the ED that could be trialed and scaled across Victoria; • Determine broad trial characteristics for further development following the dialogue. A day-long structured stakeholder dialogue will be held on June 19, 2018. The dialogue aims to connect the information from this briefing document with the people who can make change happen and deliberate upon this shared challenge. Collective problem solving through multi-stakeholder dialogue has been used around the world to address healthcare policy and practice challenges. Participants consistently demonstrate high satisfaction and high intention to act upon evidence presented in this dialogue. Specific questions for deliberation at this stakeholder dialogue are presented at the end of this briefing document.
APPLICATION: Impact focus
Design, develop, implement and evaluate a pilot trial of the identified intervention in a Victorian Emergency Department setting. The pilot trial is anticipated to be implemented in the second half of 2018.

Introduction

A major report published by the National Academy of Medicine (2015), *Improving diagnosis in health care*, developed a definition of misdiagnosis that represents two aspects of diagnostic error:

1. Failure to establish an accurate and timely explanation of the patient's health problem(s) and:
2. Failure to communicate that explanation to the patient, as well as other clinicians

Observational data on diagnostic error statistics is sparse due to the lack of reliable measures and the often-retrospective nature of diagnostic error identification. Both the National Academy of Medicine report (Medicine 2015) and an Australian report by the NSW Clinical Excellence Commission (2015) state that 10% of diagnoses involve error. Although many diagnostic errors do not result in adverse patient events, diagnostic error is in the top ten causes of death in first-world health systems. An important source of diagnostic error data is medical liability claims. A review of over 350,000 malpractice claims from 1986 – 2010 in the USA found that diagnostic errors represented the biggest single category of claims, representing 28.6% (100, 249) of all claims – in excess of surgical (24.2%) and medication errors (5.3%). (Tehrani, Lee et al. 2013).

Data from the Victorian Managed Insurance Authority (VMIA) on Medical Indemnity claims that closed between 2012 – 2017 (relating to incidents between 1963 – 2016) reveals similar insights into diagnostic error in Victoria, Australia.

A trial focusing on strategies to identify and reduce cognitive biases to improve making a diagnosis, funded through the VMIA Research and Innovation Program, is currently underway. The aim of this project is to develop and test strategies to improving the communication of diagnostic information to doctors and patients. Figure 1 is a representation of the diagnostic process from patient presentation to patient and system outcomes, with the scope of this project highlighted.

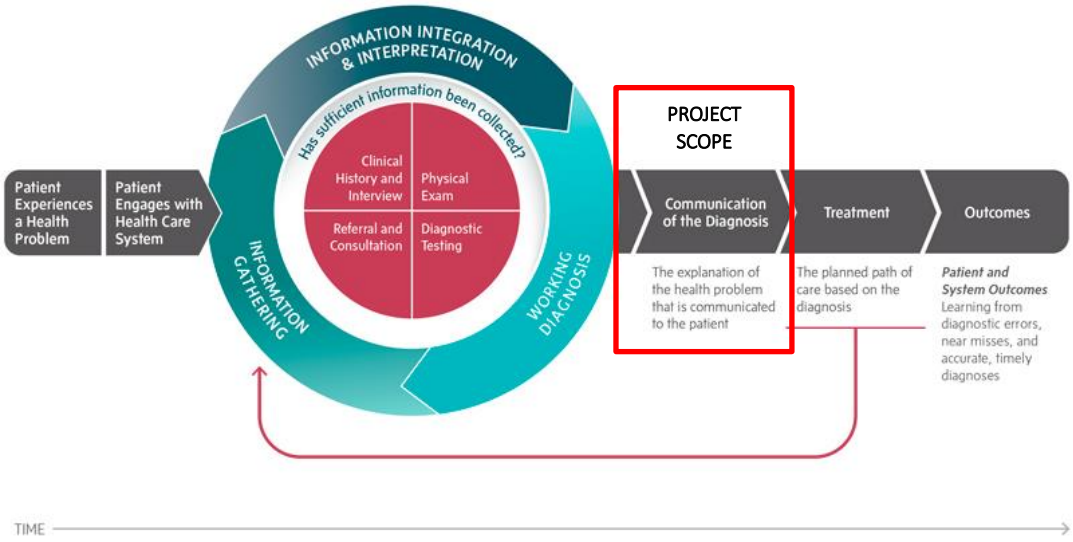

Figure 1: The Diagnostic Process (National Academy of Medicine 2015)

Breakdowns in the diagnostic process reflect 'missed opportunities' to have made the diagnosis more accurately or efficiently (Bornstein and Emler 2001). Within the scope of communication of the diagnosis, breakdowns include:

These communication breakdowns underline that even when a diagnosis is correct, communication breakdowns can have serious consequences (Fig 2).

News / National

Fax failure criticised in Vic cancer death

12:36pm May 10, 2018

A coroner has urged the medical profession to ditch "antiquated technology" after linking a misdirected fax to the death of a Victorian cancer patient.

Hodgkin's lymphoma patient, 58-year-old Mettaloka Halwala, died alone in a hotel room near Shepparton in November 2015 from chemotherapy complications.

Days earlier a scan at a Melbourne hospital showed signs of potentially-fatal lung toxicity linked to Mr Halwala's treatment.

But the scan results were faxed to the wrong number.

Combined with other communication failures, it meant neither Mr Halwala nor his hematologist - who ordered the scan - were made aware before further treatment was administered at the Goulburn Valley Hospital.

On Thursday Coroner Rosemary Carlin found Mr Halwala had been "let down by the medical profession".

Figure 2: From the Bendigo Advertiser, May 10 2018

Closing the loop on diagnostic tests in the Emergency Department

"Closing the loop" on test results includes transfer of information from sender to recipient, but also acknowledgment of receipt by the recipient, and recorded follow-up actions on the test result (Kwan and Singh 2017). The Australasian College of Emergency Medicine (ACEM)'s policy on the follow-up of results of investigations ordered from EDs is that *"Clinicians in emergency departments must ensure that the results of investigations ordered from that department are followed up within a clinically appropriate time frame."* Six procedures and actions are outlined in relation to this policy:

1. *"Systems need to be in place to ensure that the results of investigations ordered from an emergency department are reported to the responsible clinician, documented by them and followed up within a clinically appropriate time frame.*
2. *The results of all investigations from the emergency department should be reviewed by the ordering clinician, unless the responsibility for care of that patient has been handed over to another clinician (refer to S18 ACEM Statement on Responsibility for Care in Emergency Departments).*
3. *A system must be in place for review of results that return after a patient has been discharged from the emergency department.*

4. *When outpatient investigations are ordered from the emergency department, clear follow up arrangements for review of results must be in place.*
5. *Investigation results review processes should be periodically reviewed to ensure that they are functioning effectively.*
6. *Patients should be informed of investigations performed in the ED, and the follow-up arrangements required for the results."*

Successfully operationalising these is challenging in the ED setting, which is characterised by "time pressure, distractions, incomplete access to information, and the fact that the physician typically has never seen the patient before." [(Clinical Excellence Commission 2015) p. 10]. Breakdown in communication has been identified as a common problem with test result follow-up. In the emergency department (ED), up to 75% of test results are missed and the potential impact on patient outcomes includes missed cancer diagnoses (Callen, Giardina et al. 2015). In a US study analysing medical malpractice claims, communication failures were noted in 23% of the radiology cases (Siegal, Stratchko et al. 2017). Of those claims, communication to the ordering provider accounted for 13% of the cases while communication to the patient was noted as a contributing factor in 10%.

A number of barriers can interfere with optimal communication of test results to clinicians. Misinterpretation or delayed communication of imaging findings can certainly lead to a breakdown in the progression towards clarity of diagnosis and appropriate patient care (Siegal, Stratchko et al. 2017). Incomplete, unclear, or non-standardized communication in radiology or pathology reports may lead to misinterpretation of the results by referring clinicians. This can result in either inappropriate treatment or lack of treatment (Allen, Chatfield et al. 2017). When unexpected findings are encountered by the radiologist, amended reports may not reach the treating clinicians which means that diagnoses are not subsequently updated as required (Parkash, Domfeh et al. 2014). These discrepancies in reported imaging findings can pose a challenge if treatment has been implemented based upon an initial radiologic interpretation that is later revised (Siegal, Stratchko et al. 2017). In cases where the ordering physician may not provide long-term patient care, particularly in the Emergency Department setting, this underlines the importance of follow-up of discordant imaging findings (Siegal, Stratchko et al. 2017). An example illustrating this is:

> *"Failure to communicate critical over-read of a neck radiograph, first read (by a resident) as mild swelling, but follow-up read found significant potential for airway obstruction. While the over-read was documented, its urgency was not verbally reported per the "critical result" process. The patient returned to the ED in full respiratory arrest and died of a vascular rupture before the updated report was communicated to the patient" (p.128)*

Further challenges are presented in conveying diagnostic information to patients. A recent review found that internationally, the average primary care visit averaged just 5 minutes (Irving, Neves et al. 2017), implying that even less time may be available in ED settings. Besides time, several other factors can detract from effective communication (Graham and Smith 2016). The use of jargon, specialist terms and abbreviations when communicating with patients often impedes the patient's ability to understand the diagnosis or the associated instructions. For example, one study found that patients who presented with chest pain in the ED were often unable to remember diagnoses or advice post-discharge and were given very limited chances to discuss the diagnoses or concerns or ask questions (Ackermann, Heierle et al. 2016). For these reasons, authors have recommended structured reports that ensure patients and referring physicians understand findings and recommendations (Allen, Chatfield et al. 2017).

What does the evidence say? Rapid review findings

A rapid literature review was undertaken to identify, evaluate and synthesise published literature investigating interventions to improve timeliness or inclusion of test results in diagnostic decisions. Whilst a focus on Emergency Departments was prioritised, evidence from other areas of hospitals was also considered.

Rapid reviews are an emerging method of efficiently synthesising research evidence in health policy and other settings where a broad overview of research evidence is required in a short timeframe. Unlike traditional systematic literature reviews (which take 12- 18 months), rapid reviews focus on synthesised research evidence and / or high-quality or recent primary studies. *Caution needs to be applied interpreting rapid review findings, as more comprehensive review approaches may elucidate further information and insights, which would influence review interpretation and conclusions (Khangura, Polisena et al. 2014). Therefore, systematic reviews remain the definitive method of literature review, and we recommend systematic reviews be undertaken whenever possible. Further details of the review and other methods employed in producing this briefing document can be found in Appendix 1.*

The literature search yielded a total of 4352 citations, after the removal of duplicates. Following screening, eleven systematic reviews were eligible for inclusion in the rapid review ((Meyer, Atherton et al. 2012, Joshi, Lira et al. 2013, Rubano, Mehta et al. 2013, Al Deeb, Barbic et al. 2014, Hasselberg, Beer et al. 2014, Asha and Miers 2015, Vrablik, Snead et al. 2015, Benabbas, Hanna et al. 2017, Chartier, Bosco et al. 2017, Fields, Davis et al. 2017, McCaughey, Li et al. 2017)). Quality appraisal of these reviews using the recognised AMSTAR tool showed that 9 out of the 11 reviews were of reasonable to high quality, satisfying a majority of applicable quality criteria. This means that reasonable confidence can be placed in the findings of these reviews. Appendix 2 presents full details of AMSTAR review and summaries of all included reviews.

Collectively, the systematic and narrative reviews cover the following areas:

- Point-of-care testing: 8 systematic reviews (Joshi, Lira et al. 2013, Rubano, Mehta et al. 2013, Al Deeb, Barbic et al. 2014, Asha and Miers 2015, Vrablik, Snead et al. 2015, Benabbas, Hanna et al. 2017, Chartier, Bosco et al. 2017, Fields, Davis et al. 2017); 1 narrative review (Bainbridge, McConnell et al. 2018)
- Use of information technology, including telemedicine: 2 systematic reviews (Meyer, Atherton et al. 2012, Hasselberg, Beer et al. 2014); 2 narrative reviews (El-Kareh, Hasan et al. 2013, Meyer and Pare 2015)
- Following up on results: 1 systematic review (McCaughey, Li et al. 2017); and one narrative review (Kwan and Singh 2017)

A synthesis of these reviews is presented below.

Point-of-care testing

Point-of-care testing offers the opportunity for clinicians to instantly perform a diagnostic test, therefore reducing the potential for communication errors.

Generally, bedside ultrasounds have been found to have adequate diagnostic accuracy or strengthen the working diagnosis for many conditions. Two systematic reviews focused on the use of point-of-care ultrasound in the diagnosis of acute appendicitis. Benabbas, Hanna et al. (2017) and Fields, Davis et al. (2017) both reported that when performed by an experienced operator, ED point-of-care ultrasound is an appropriate tool for diagnosing appendicitis. Benabbas, Hanna et al. (2017) stated

that ED point-of-care ultrasound can replace radiology department ultrasound for the diagnosis of acute appendicitis in paediatric patients. The authors concluded that in paediatric patients suspected of acute appendicitis, a positive ED point-of-care ultrasound was diagnostic and negated the need for CT or MRI. Fields, Davis et al. (2017) found that point of care ultrasound has high sensitivity and specificity for diagnosing acute appendicitis, the results are limited by the quality of included studies. Both reviews concluded that negative results could not rule out acute appendicitis and therefore may not remove the need for further tests. Two systematic reviews assessed the use of point of care ultrasound for diagnosing fractures (Joshi, Lira et al. 2013, Chartier, Bosco et al. 2017). The meta-analysis conducted by Chartier, Bosco et al. (2017) revealed that point-of-care ultrasound demonstrates good diagnostic accuracy in long bone fractures. Similarly Joshi, Lira et al. (2013) found that emergency physician ultrasound is sufficiently accurate test to rule extremity fractures in or out. Both reviews concluded that point-of-care ultrasounds could be used as an alternative diagnostic test to plain radiographs in certain settings i.e. low-resource settings.

A systematic review and meta-analysis of 7 studies conducted by Al Deeb, Barbic et al. (2014) found that point-of-care ultrasound using B-lines may assist clinicians in the diagnosis of acute cardiogenic pulmonary edema (ACPE). In patients with a moderate to high pretest probability for ACPE, ultrasound studies demonstrating B-lines can strengthen working diagnosis and can almost exclude the possibility of ACPE among patients with low pretest probability. All 7 studies included in a systematic review by Rubano, Mehta et al. (2013) demonstrated excellent diagnostic performance for emergency physician-conducted bedside ultrasound to detect abdominal aortic aneurysm (AAA) in suspected patients. The authors concluded that bedside ultrasound conducted by emergency physicians can be used to rule in or out the need for further imaging studies and vascular surgery consultation in patients with suspected abdominal aortic aneurysm (AAA).

A systematic review and meta-analysis of three small prospective studies also found that bedside ocular sonography has a high level of accuracy in the identification of retinal detachment (Vrablik, Snead et al. 2015). The authors suggested that the speed, non-invasive nature and cost-effectiveness of ocular ultrasonography make it any ideal tool for the busy ED setting. Furthermore, a meta-analysis of 5 studies conducted Asha and Miers (2015) revealed that negative D-dimer result may help to rule out acute aortic dissection in low-risk patients. However, a D-dimer result cannot provide additional certainty to diagnosis.

Bainbridge, McConnell et al. (2018) conducted a narrative review of 80 original articles (including 7 reviews and/or meta-analyses) to investigate the impact of peri-operative bedside ultrasound on diagnosis and decision making when used to assess the heart, lungs, gastric volume and airway. They found that perioperative point-of-care ultrasound is a useful tool for the diagnosis of many important perioperative conditions.

Collectively, these reviews indicate that technological advancements are increasingly bringing testing straight to the bedside, rather than requiring patients to be moved to other locations. This reduces risks associated with moving patients, and the potential for communication errors from clinicians to other clinicians. However, point-of-care tests do not encompass the issue of communicating diagnoses to patients, or communicating results of tests and further actions to other clinicians.

Use of information technology

Telemedicine or telepathology allows for additional services or reviews to be provided, where resources may limit these options in traditional settings. Thus, it can allow greater access to pathology services in difficult to service areas. A scoping review of 159 papers showed that this is particularly relevant to laboratory tests, as full-time pathologists are often not needed in low population density

areas and they are often unavailable at night and on weekends (Meyer and Pare 2015). This review also concluded that "the nature and scale of encountered implementation challenges also varies depending on the network structure. In smaller telepathology networks, organizational concerns are less prominent, and implementers are more focused on usability issues. As the network scope widens, organizational and legal issues gain prominence." (p. 1550)

A systematic review of 24 studies highlighted that image-based telemedicine systems for emergency injury care tend to support valid diagnosis and influence patient management (Hasselberg, Beer et al. 2014). However, the evidence supporting this was weak and restricted in clinical scope, and "as in the case of telemedicine in general, user and system quality aspects are poorly documented, both of which affect scale up of such programs" (p. 1)

A narrative review found that IT has an important role to play in healthcare, particularly in displaying information effectively and facilitating reliable follow-up and diagnostic collaboration (El-Kareh, Hasan et al. 2013). Using graphical displays to present laboratory information can lead to reduced time spent reviewing this information. However, the most appropriate way to present information is dependent on which clinical questions need to be answered (El-Kareh, Hasan et al. 2013). Overall, improving the organisation and display of data may help to ensure that key information is not overlooked, especially given the amount of information available in EMRs (El-Kareh, Hasan et al. 2013). It should be noted that research in this area is in its early stages and there are few high-quality studies. Therefore, "Future efforts need to focus on: (1) improving methods and criteria for measurement of the diagnostic process using electronic data; (2) better usability and interfaces in electronic health records; (3) more meaningful incorporation of evidence-based diagnostic protocols within clinical workflows; and (4) systematic feedback of diagnostic performance" (p. ii40)

Meyer et al. (2012) aimed to investigate the effectiveness of email for communicating diagnostic medical investigations to patients, however no relevant studies were found. Given the rapid pace of change in this field, an update to this review is warranted.

Collectively, reviews pertaining to the use of IT highlight a number of areas with potential to address diagnostic communication challenges such as telemedicine systems, novel information presentation and display and electronic communication of results to patients. However, substantial barriers to successful implementation exist, and the empirical evidence of clinical impact is weak, or in the case of communication to patients, non-existent.

Following up on results

A systematic review by McCaughey, Li et al. (2017) found that GPs often failed to initiate appropriate treatment for patients with diabetes and cardiovascular disease based on laboratory results. The authors reported that interventions designed to assist them to manage these results should assist GPs to initiative appropriate treatment. The review also suggests that providing feedback to GPs about their test ordering patterns and including education messages on results improves patient outcomes (McCaughey, Li et al. 2017). However, the evidence underpinning this review was weak.

Kwan and Singh's 2017 narrative review focused on the issue of how to establish who is responsible for initiating follow-up actions on tests that are ordered in the context of medical imaging. The review highlighted the complex challenge of ensuring that test results are sent, received, acknowledged and acted upon. The authors concluded that a range of policy, health IT and patient solutions will be required to address this. These could include online patient portals linked to electronic health records and legislation pertaining to notification responsibilities of health services. The review concluded:

"We call upon key stakeholders to engage in the conversation, including clinicians, patient advocates, national professional societies, policymakers and malpractice insurers, in order to ensure progress in solving this complex problem." (p. 5)

Primary studies

A short synthesis of primary studies of potential interest found in the rapid review these is below. The studies have not been quality appraised, but may be of interest in developing behaviour change interventions.

Clear Communication

Effective communication is paramount to safe patient care and there are many proposed strategies to improve communication. Al-Mutairi, Meyer et al. (2015) found that patients whose abnormal imaging results contained recommendations for further imaging were less likely to be followed up in a timely manner than patients without recommendations. This finding highlights the potential need for additional safeguard development to allow for better monitoring and tracking of recommendation follow-up and communication (Al-Mutairi, Meyer et al. 2015). Although verbal communication of abnormal imaging results is significantly more likely to be associated with timely follow-up when compared to electronic communications, this mode of communication is not always possible (Al-Mutairi, Meyer et al. 2015). Electronic notifications may not be acted on for a number of reasons. For example, ambiguity surrounding who is responsible for follow-up action increases the chances that providers will not follow up, for example, when the ordering physician is not the patient's primary care provider. Furthermore, information overload when using comprehensive electronic medical record (EMR) systems can result in missed test results (Al-Mutairi, Meyer et al. 2015). Considering these barriers may be important in addressing the communication of test results. A study conducted by Bailey, Pope et al. (2013) shows that sharing electronic health information was associated with 64% lower odds of repeated diagnostic imaging in the emergency evaluation of back pain. Unfortunately, the sharing of electronic health information only occurred in 12.5% of visits. Low exchange of health information was partly due to the preferential use of independent EMR systems in each hospital to access records within the same hospital (Bailey, Pope et al. 2013).

Utilising mobile technology in diagnosis

Aside from EMRs, technology can also be utilised in other ways, including the use of mobile technology which has increased in recent years. A study by Park, Kim et al. (2016) on the effect of reviewing radiology reports on mobiles as opposed to in-house found that radiologists' results and reports were essentially equivalent between the two methods. Using off-site smartphone consultation in radiology could help to address issues with result delays and patient discharge prior to results being returned. While the smartphone reader has a small viewing screening, inferior resolution and unavailability of clinical data, results were in better agreement with in-house radiologists' reports than on-call residents' reports. Therefore, mobile consultation could be used when an on-call radiologist reports an equivocal findings, and it needs to be clarified to make decision for the next management step (Park, Kim et al. 2016). Furthermore, smartphones can be used to review burns images and may be a suitable means of seeking expert advice (Blom, Boissin et al. 2017). Accuracy of total burn surface area as a result of viewing images on a smartphone was high, however, accuracy was low for burn depth.

Direct to Consumer Communication

One way to address delays in test results, missed results or lack of follow-up is to directly engage the patient in their test results. Callen, Giardina et al. (2015) found that patients support direct notification of their test results. Test results were also the most frequently accessed information when given access to their medical records through a patient portal. Although most emergency physicians in this study thought that a direct test notification system would reduce the number of patients lost to follow-up, just over half did not support direct notification of abnormal test results (Callen, Giardina et al. 2015). Emergency physicians were concerned about patient anxiety and confusion and thought that patients lacked the necessary expertise to interpret test results. Clinicians were also concerned about the responsibility of communication and release of results and follow-up. If physicians were not concerned that patients might seek potentially unreliable information, they were more likely to be comfortable with direct notification of abnormal test results. Furthermore, physicians were more supportive if they thought direct notification of abnormal results would reduce their workload (Callen, Giardina et al. 2015). This study did not evaluate whether direct notification of test results led to improved follow-up of abnormal test results. A survey of patient preferences for test result notification found that for normal test results, most patients preferred a phone call notification (Shultz, Wu et al. 2015).

What do citizens think?

During a citizen panel convened on 21 May 2018, 15 socio-demographically diverse Victorian community members were provided a plain language version of this briefing document. A third of the participants represented the general population, one-third had experienced a misdiagnosis and one-third had experienced difficulties with test result communication. During the deliberation about the problem, citizens were asked to share what they view as the key challenges in communicating test results more effectively to doctors and patients, specifically in the emergency department. Citizens were asked to reflect on their own experiences and those of family and friends to consider the underlying challenges and inform the types of interventions which may be appropriate. The key themes of the discussion are summarised below in Table 2.

Table 2: Summary of Citizen Panel Themes

Theme	Details
Communication challenges: misdiagnosis	• Conflicting diagnosis between specialists, which has led to instance of unnecessary surgery, unnecessary or over medication, and other physical and mental complications. • Instances where treating specialist dismiss second opinions from other doctors that do not confirm their own diagnosis (perceived bias of doctors and diagnostic dilemma for patient) • Specialists are biased towards their own diagnosis/treatments, which are not always in the best interest of the patients' wellbeing/circumstances. • Patients have been ignored when requesting tests or examinations for issues not perceived as present or important by the treating practitioner that have later been found to be important for diagnosis of a problem. • Misdiagnosis has led to expensive treatments (e.g. physiotherapy) that were not necessary.
Communication challenges: delayed diagnosis	• Difficulty obtaining results if doctors/specialists are not present (e.g. on holiday), which can lead to delays in treatment and unnecessary stress and/or physical discomfort. • Delayed diagnosis can impact other areas of life e.g. work. • Test results have been misplaced or sent to the wrong location due to technology issues (e.g. use of fax machines) • Lack of coordinated systems between different places (e.g. community health and hospitals)
Communication of test results	• Patient having to chase results, usually when there are considered to be no issues or urgency, but this should still be communicated. • Not always clear who should have the results available (e.g. GP, hospital, etc.). This can be heightened when doctors/specialists operate across the public and private systems. • Test results not always relayed to GP • Concerns raised on the suppression of information, where the patient is not being told everything when results are presented

	• Interpretation of results can vary between practitioner (e.g. blood tests and what is considered 'normal' range)
	• GPs get paid every time you go, so the current system doesn't encourage other forms of communication, such as over the phone.
	• Lack of understanding as to why technology is not used more?
	  o Email, text messages
	  o Opt in – tell doctor what you prefer to receive.
	• Lack of coordination of test results internally between hospital departments
	• Need for plain language to communicate results to patients

Suggested interventions to improve communication: starting tests earlier in ED	• Certain conditions and ordering of standard tests can be dealt with while waiting to be seen (already do this with vitals like BP and temperature). o In the children's they have a GP clinic in the waiting room to ensure they can concentrate on the more serious problems.

Suggested interventions to improve communication: role of technology	• Patients can login and get results themselves.
	  o Italy has this system so you don't have to wait. Lack of understanding as to why Australia doesn't have this system.
	• Opt-in systems if you are happy to receive test results or notifications they are ready by text/email
	  o Can include time frames that reflect the urgency of results (i.e. within 2 weeks or straight away).
	• A logistics database that tracks the progress of tests (e.g. similar to those used by parcel companies) that can be accessed by patients and treating practitioners.
	  o Include automated system to notify doctors 'flags' when certain problems are found in test results
	  o If results are stored electronically you could easily get results to other doctors for second/third opinions (can support remote communities).
	• Registered database that uses Medicare numbers so it is trackable across Australia
	• Use of same tracking technology can be used in ER, which would support handover of patient status when waiting for test results and if there are any flags related to results.
	• Use of mobile technology in ER (e.g. iPad or doctors' mobile phones) to speed up the process of receiving/notifying test results.
	• Don't use fax machines
	• All comes down to the software, how it is organised and how well trained the people are that use it.
	• Desktop and mobile versions of the database so they can be easily accessed when required.

Suggested interventions to improve	• As standard, doctors should acknowledge they have received test results to patients (logistics software that shows where things are in the system and flags for the doctor to ensure they have contact patient).

communication: clear communication	• Online access that shows diagnosis, doctor, clinic, etc. so there is a log of information (roadmap) Computer system in ER that shows when tests are pending etc. and then notified when they are back (i.e. when someone is sat in the waiting room) and then the patient gets called up. Can support triage of urgent cases that may have previously been considered minor.
What role should patients play?	• It is not the role of the patient to chase up results as they are not in the chain of ordering, receiving results from other centres etc. • Ability to access previous test results so they can be taken to other doctors/centres (helps if you travel inter-state etc.). • Patient empowerment to ask questions or challenge test results
Internal communication (chain of logistics)	• Return to receiving results over the phone, rather than physically having to be present (saves time, money and can speed up treatment if required). • The centre/practitioner that orders test should be responsible for ensuring the patient is aware of test results.
Considerations for vulnerable populations	• Currently there is a lack of information that can impact patient treatment (e.g. if a patient is presented at ER who have allergies to drugs, they may not be able to communicate this, but it would be available if there were a central database). • Not everyone can use technology, so other forms of communication are still necessary • Ability to nominate other people to receive test results • Systems that translates test results (e.g. use of google translate if English isn't first language or voice activation for people with visual impairment) • Mobile technology would ensure those who do not have a permanent address are more likely to get information
Other issues/suggestions	• Unnecessary repeat tests ordered by different locations (community GP, hospital, private/public, etc.) that could be avoided if there is a central results site • View that doctors are rorting the system and actually don't care about the patient, but instead maximising profit with unnecessary appointments and procedures. • My health record, perception it is not that popular because of privacy. But it could potentially solve a lot of problems for patients when they want to access records. • Patients should receive their results in consultation with the doctor because test results can be technical/confusing. • Patients should have the opportunity to rate the service or easily have their say after treatment (e.g. similar to buying a product or commercial service). If this was part of the system centres/hospitals/Medicare might learn from the current service.

What can we learn from the experiences of Emergency Departments?

Interviews were conducted with a radiologist, an ED director, a paramedic, an ICU director who also worked with the Clinical Excellence Commission and a Clinical Director of Safety and Quality.

Communication challenges within ED

All interviewees recognised that there are a number of challenges regarding the communication of test results, especially within the fast-paced ED environment. Managing the workload and attending to test results in a timely manner were seen as key challenges.

Effective communication of diagnostic information begins in the pre-hospital setting, in which adequate handover from paramedics to ED staff is critical. One participant reported that treatment to progress appropriately in the ED setting and beyond, ED staff need to allow time to appropriately receive handover and understand the pre-hospital context.

> *"But that often is where I think the value of the ambulance notes comes in if there is any conjecture as to what's actually gone on. That is the point of reference. I think it does have value"*

While it was noted that many clinicians have a great deal of respect for paramedics, hierarchy issues still existed among some.

> *"There are clinicians out there who would just go 'He's just an ambulance driver, so whatever he says I don't really hold much weight in what he says and we'll do our own diagnosis here and move on'".*

Given that different disciplines often work in silos, communicating diagnostic information was difficult.

> *"The intern orders the tests, the radiologist reports the test, and nobody looks at how we link all the different stages for the patient and their care"*

It was reported that there is often a lack of documentation about whether results have been followed up.

> *"So we don't know whether it was read, we don't know by whom it was read, and we don't know if they checked my report against what the ED doctor actually thought"*

Furthermore, sometimes the notes of other health professionals are not read, let alone acted upon.

> *"With those critically unwell or injured patients, that's where it gets to be complex because there is a heightened sense of urgency and people tend to disregard the handover"*

Diagnosis in the ED

One of the main reported challenges related to closing the loop on test results in the ED is that patients are often discharged before all results have been returned. Furthermore, patients often don't attend scheduled outpatient appointments to follow-up on their results.

> *"So we hope that if we report a mass in the liver that someone will read our report. The problem is that reading our report depends on the patient coming back to outpatients or going back to their GP. And we know that perhaps up to 20% of patients never come back for their appointments, particularly if they're feeling better and the liver lesion is an incidental finding"*

While preliminary diagnoses can be made based on test results that are returned in a short timeframe, interpretation of preliminary results pending final reports can be subject to error depending on level of experience of the clinician.

"They're either choosing to interpret themselves and hope that they can see all the problems, or they're relying on people around that are more senior to do the same… nonradiological… or finally they're relying on provisional reports that are provided by registrars in training… the risk is they can then be subsequently altered to a very different report down the line"

Closing the loop on test results can be resource-intensive

Most follow-up systems rely on phone calls, which can be impractical with high volumes of patients and reports.

"80% of all of work is abnormal… It's a little bit impractical to make a phone call"

Discrepancies in test result reporting

Participants highlighted a major breakdown in communication in that test providers often don't know what the ordering clinician saw i.e. normal or abnormal

"We could see a very subtle fracture, but I don't know if the ED doctor saw it or not"

This means that the report could be significantly altered, however no one knows that there has been a discrepancy in the report and subsequently may not be followed up.

"Now, let's just take a case where the ED doctor thought there was a fracture there and the radiologist reports it as normal. Then the result goes to the ED fax machine as normal. And the ED checker, no matter who he is, just sees normal report. Fantastic. Don't have to worry about it. Into the rubbish bin. A patient's gone home with a plaster cast and there's nothing wrong with him because they're seeing an anatomical variation they thought was a fracture or something like that"

Ambiguity surrounding responsibility for closing the loop

Participants reported that while there is a legal responsibility on treating doctors to ensure that test results are followed up, responsibility for following up test results is often unclear.

"Responsibility is varied and results on multiple shoulders"

Most participants believed that a certain level of responsibility lies with the doctor who ordered the test, however it was also suggested that the radiologist may have an element of responsibility if they significantly amend a report.

"What is the responsibility of the radiologist when they amend a report significantly? The culture's unclear"

Patients were not deemed to be responsible for follow-up of their test results, however they do have a responsibility to attend a follow-up appointment if they are advised to do so.

"You can't say it's a patient responsibility, we're ordering the test"

Participants also mentioned that sending results to GPs follow up may not be enough to absolve the ED of responsibility.

"There's a perception that if they've told the GP to follow up then they've done their job"

Interventions to close the loop on test results in the ED

Participants referred to a number of potential interventions to close the loop on test results in the ED. While some of these interventions had been trialled and were successful, others were not. Furthermore,

they proposed a number of future interventions based on their experience of what would be feasible and sustainable in the ED.

Inclusive handover

At certain sites, paramedics have started to introduce a more inclusive handover procedure to reduce the number of times they need to repeat the pre-hospital information.

"We have moved more toward going in with the patient, showing them the monitor for example to show that everything's okay. Is everyone in agreement that everything is okay? Now we'll do the handover, and then we'll move the patient over, and you can start doing your stuff"

Sending all outstanding test results to one inbox for follow up

Most participants stated that test results are often sent to one inbox/person for follow up. The main issue with this method was that there is no way to document whether anyone has seen the test results and acted upon them. Furthermore, it is easy to 'select all' emails and 'delete' without reading them. Sending all test results to one person also becomes an issue when the person is on leave and critical test results are returned and not acted upon.

"There is no way for me to document that I've seen it. If I see some critical test results, I could be interstate or overseas"

Discharge checklist

One ED trialled the use of a discharge checklist which was provided to patients and accompanied by a discussion. The checklist contained items relating to understanding of diagnosis, receipt of test results and plans for follow up if test results were pending. There was a lack of engagement in this intervention from both patients and staff.

"*They kind of wouldn't read it and then just leave them in the waiting room and then we'd say 'Is there anything on the checklist you want to discuss?' It didn't really prompt discussion"*

Rostering of staff to follow up on test results

In one ED, two doctors were rostered on each day to ensure that results had been communicated to patients. The staff would view the outstanding test results and electronically sign each one off after follow up. While it was time consuming to make phone calls, it was feasible and effective.

"It just becomes business as usual. I think it's inexcusable to say that we can't afford to do this or that"

However, the success of this method was attributed to the actual rostering of staff, as the task was not done unless it was assigned to certain staff members. Furthermore, following up of test results needs to be the sole responsibility of these rostered staff on that day.

"If it's not on the roster, it won't be done. Every time it falls off the roster, it's not done"

Forward planning

One participant mentioned that imaging can take place offsite and it can be difficult to determine how results will be followed up. They suggested that it is important to establish upfront where the imaging will take place, who will receive the results and how they will be followed up, including an approximate time frame for receipt of test results and subsequent follow up.

"I don't know where the patient is going for their imaging and when the result is going to come out"

Standardising test result reports

One participant suggested that standardising radiology forms for every imaging department in Australia may improve consistency and clarity in reporting.

"It's like you need an upfront college-made process that says that's the same electronic radiology form for every imaging department in Australia"

Automatically share results with GPs

It was suggested an automatic system could be put in place to send test results directly to GPs when they are returned. While this would allow the GP to follow up on test results, it was noted that not all patients have a regular GP who could receive this information. Furthermore, one participant emphasised that sending test results to GPs does not necessarily mean that the sole responsibility for follow up has been passed onto them.

Automatically schedule appointment with patient for follow up

One participant proposed that when tests are ordered, an appointment for follow up could be automatically scheduled. This appointment could take place either in-person or virtually (phone or video conference).

"We should be doing more of that when we know that we're doing a test, we plan the appointment, whether it's a real or virtual appointment"

Real-time imaging reporting

One participant highlighted that reporting imaging results in real-time would eliminate a number of issues with closing the loop on test results. However, it was noted that this suggestion may be unrealistic from a resourcing standpoint.

"My view is all imaging should have real-time reporting"

Provide patients with test results

Providing patients with copies of their test results either in full or summary format, or via a centralised location (i.e. My Health Record) may increase the follow up of test results. While it should not be the responsibility of the patient to follow up their test results, participants suggested that patients would be less likely to delay follow up of a critical test result.

"Why don't we ultimately let a patient get a copy of the results? When the result says it could be cancer, they're not going to let it go"

Establish responsibility

Most participants highlighted the need to establish a shared understanding about who is responsible for following up test results.

"The system will look like this, you will agree to a set of rules, who ultimately is responsible for the radiology films of inpatients"

"It's like dropping your kids off at school and not deciding who's going to pick them up in the afternoon. Like how is that gonna work?"

Alert systems

Implementing warning systems into EMR technology may provide an additional checkpoint to ensure that test results are followed-up. At discharge, a pop-up message could appear in the EMR to state that test results

haven't been followed up. Alternatively, the discharge printout could alert the patient to the fact that no one has signed off on their radiology report.

"Then the patient could say 'You're sending me home, but I've noticed that nobody's read my radiology report. Can you tell me it's okay?' That's the patient engagement that would be much more effective"

"We don't even have an alert button that says you're about to be discharged, nobody's clicked on your formal radiology report. How simple would that be?"

Levels of follow up importance

Test results could contain recommendations for follow up timeframe i.e. critical test results pushed to ED for immediate follow up, less critical within 48 hours, normal within 4 days etc.

Participants highlighted that different communication methods should be used for different levels of urgency i.e. text message for urgent results.

Electronic follow up systems

A few participants described ways in which electronic systems could be designed to encourage follow up. They suggested that test results could be deposited into folders and they are not removed from the folders until they have been viewed, acted on and signed off. Similar systems have been implemented in health services. The importance of having a backup i.e. treating unit in case the treating clinician was unavailable was emphasised.

"But the problem is that the doctor could go on holidays the next day… So we've got to have a backup system"

One participant also suggested that there needs to be a clear location to document whether you have seen a result.

"In our electronic health record it's not clear where to document the followed up test results. So some people do it in an interesting note episode, somebody doing the patient file, we're half paper, half electronic. So closing the loop is really difficult if not almost impossible"

Discrepancy reporting

Participants stated that any new systems need to include a clear place to document discrepancies in reporting and sending this to a separate work list for checking.

A few participants suggested that EMRs should retain all iterations of test reports and store them in an easily accessible location so that health professionals can see both preliminary and final reports and review discrepancies.

"They take the radiology report down, and they put the consultant's report up, and don't show you that there was a report beforehand, which was clearly different than the following report. That's a huge risk. That still goes on"

Questions for deliberation

1. What are the biggest challenges in communication of diagnostic information in the Victorian ED setting?

2. Should a behaviour change intervention focus on clinician-to-clinician, clinician-to-patient or both types of communication interaction?

3. Is there a specific condition that could be a focus?

4. What identified behaviour change interventions are:
    a. Behaviourally focused
    b. Feasible
    c. Testable in the short term i.e. 6-months
    d. Scalable across Victoria
    e. Measurable (i.e. sufficient volume, measurable diagnostic outcomes)
    f. Sustainable?

5. Which is the highest priority for a pilot study and why?

6. What are appropriate success measures for a pilot study?

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Appendix 1: Project Methods

The Forum Approach

This project is based on the Forum approach, an established method of promoting evidence- informed practice change, which involves four key activities:

1. Defining a major challenge through consultation with key stakeholders to understand the issues and complexities;
2. Gathering from published literature and further consultation the information necessary to properly consider the challenge, and presenting this in a briefing document (i.e. this document);
3. Convening a structured stakeholder dialogue to connect the information from the briefing document with the people representing key stakeholder groups who can make change happen; and
4. Reporting outcomes through a dialogue summary and related academic publications and briefing the organisations and individuals who can effect change about their role in developed strategies.

The Forum approach of evidence review and structured stakeholder dialogue was established by John Lavis in Canada in 2009. Subsequently Dr Peter Bragge and Professor Russell Gruen were funded by the Victoria Transport Accident Commission from 2012 - 2015 to lead the first Australian-based Forum program, which focused on addressing high-priority challenges in brain and spinal cord injury care, research and policy. Outputs of the NTRI Forum program have been published online and in peer-reviewed literature. Satisfaction in the NTRI Forum process was high based up on participant surveys, with a mean score of 6.4 / 7 (where 1 is 'Failed' and 7 is 'Achieved') for ranking of how well the briefing document achieved its purpose (N =114, response rate 45%) and 6.0 / 7 for the stakeholder dialogue (N=192, RR 76%).

Rapid Review Methods

Search Strategy

A comprehensive search of the following databases was undertaken; PubMed, PsycINFO, Web of Science Health Systems Evidence and Google Scholar. The PubMed search strategy is reproduced below:

Table 3: *PsycINFO search strategy*

	Search string
1	Physician OR clinician OR emergency department OR ED OR health service OR hospital OR consultant OR junior doctor OR consumer OR patient
2	Test results OR closing the loop OR health information OR point of care testing OR centrali?e heatlh information disconfirming information OR radiology OR pathology OR understanding specificity OR understanding sensitivity OR level of diagnostic experience OR connecting test result OR health information exchange OR communication transfer OR information transfer OR information linkage OR test linkage OR linking medical records OR test turnaround time OR real time results OR point of care testing
3	diagnostic accuracy OR diagnostic error OR misdiagnos?s OR incorrect diagnos?s OR over diagnos?s OR under diagnos?s OR delayed diagnos?s OR missed diagnos?s OR diagnostic outcome OR ambiguous symptoms

Screening and selection

Two reviewers screened the citations against the inclusion and exclusion criteria listed in Table 4. Data extracted from the included articles was used to inform a commentary on the implications closing the loop on test results in Emergency Departments

Table 4: *Inclusion and Exclusion Criteria*

	Include	Exclude
Study Type	• Systematic or narrative reviews. Reviews of quantitative or qualitative studies will be included	• All primary study designs.
Population	• Doctors or medical students, radiology, pathology, allied health, nurses, paramedics	
Study Design	• Observational or interventional	
Study Setting	• Emergency Departments or other medical / healthcare settings	• Non-healthcare settings
Intervention	• Primary aim of intervention to improve timeliness or inclusion of test results in diagnostic decisions	• Diagnostic accuracy of tests
Outcome	• Diagnostic error or diagnostic accuracy • Effectiveness, timeliness, efficiency, group processes, team-work or decision-making	
Publication status	• English-language • Peer-reviewed journal publications or reports • Published 2013 - 2018	

Citizen panel methods

Facilitation framework

Understanding Diagnostic Error

- What perspective do you bring to today? Including what challenges or other experiences you've encountered with diagnosis in healthcare. This doesn't need to be in the Emergency Department.
- What are your main concerns about misdiagnosis?
- What are your main concerns about test results?

How could we close the loop on test results?

- Based on your experience, what do you think could be done to make sure test results are completed and followed-up as necessary?
- Why did you choose this?
- What role, if any, should patients have in their test results?

What factors make it hard to solve the communicating test results?

- What are the main challenges to achieving these outcomes and expectations?

Participants

Socio-demographically diverse Victorian community members were recruited through ACI Research Services.

Procedure

The citizen panel convened on the 21st of May 2018 and participants gave informed consent. Citizens were provided with a plain language version of this briefing document. During the deliberation of the problem, citizens were asked to share their perceptions about communication and shared understanding of wound care in the post-operative and immediate discharge settings. Citizens were asked to reflect on their own experiences and those of family and friends to consider the underlying challenges and inform the types of interventions which may be appropriate.

One-on-one interview methods

The interviews were semi-structured, allowing the interviewers to explore emerging themes as well as salient issues (Spencer, Ritchie et al. 2003). The interview framework was as follows:

1. What does your current role involve and how long have you been in this role? Do you have any other experience in ED settings (and if so, what role and for how long)?
2. From your perspective, what are the biggest challenges in connecting information and test results in the setting of ED?
3. From your perspective, what mistakes, errors and oversights occur in and around the ED in regards to information sharing?
4. How do clinicians make diagnostic decisions in light of pending information/test results?
5. What areas within the information/test journey are most prone to error?
6. In your experience, what strategies to close the loop on test results are feasible and sustainable in Emergency Departments?
7. Are you aware of strategies to connect information in ED that have not worked? If so, why do you think they were unsuccessful?

Participants

Participants were purposively selected based upon their experience and / or expertise in the area of misdiagnosis in Emergency Departments (Patton 1990).

Procedure

Participants were contacted by BehaviourWorks Australia via VMIA and invited to take part. Research aims and procedures were outlined in an explanatory statement given to all participants prior to the interview. All interviews were conducted via telephone. Interviews lasted between 25 and 45 minutes. Interviews were conducted by BW and AL between April and May 2018. Interviews were digitally audio-recorded, transcribed verbatim, anonymised and stored securely.

Analysis

Interview transcripts were coded and analysed thematically (Boyatzis 1998) using a computer-assisted qualitative data analysis software program (NVivo10, QSR International Pty Ltd 2014). Interview transcripts were coded according to emergent themes and any emerging topics relevant to the topic. Direct quotations from interview transcripts were used to illustrate key themes. The participant categories (I.e. role and responsibilities) have been de-identified.

Appendix 2: Rapid review quality appraisal

Table 5: Quality appraisal of included systematic reviews

Criterion (AMSTAR 2)	Al Deeb 2014	Asha 2015	Benabbas 2017	Chartier 2017	Fields 2017	Hasselberg 2014	Joshi 2013	McCaughey 2017	Meyer 2012	Rubano 2013	Vrablik 2015
1. Did the research questions and inclusion criteria for the review include the components of PICO?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?	Partial yes	No	No	No	Partial Yes	Partial Yes	No	Yes	Yes	No	No
3. Did the review authors explain their selection of study designs for inclusion in the review?	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
4. Did the review authors use a comprehensive literature search strategy?	Yes	Yes	Partial Yes	Partial Yes	Yes	Partial yes	Partial yes	Partial yes	Yes	Partial yes	Partial yes
5. Did the review authors perform the study selection in duplicate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
6. Did the review authors perform data extraction in duplicate?	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
7. Did the review authors provide a list of excluded studies and justify the exclusion?	No	No	Yes	No	No	No	No	No	N/A	Yes	No
8. Did the review authors describe the included studies in adequate detail?	Partial yes	Partial yes	Partial yes	Partial Yes	Partial yes	Yes	Yes	Partial yes	N/A	Yes	Partial yes
9. Did the review authors use a satisfactory technique for assessing the risk of bias in individual studies that were included in the review?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes
10. Did the review authors report on the sources of funding for the studies included in the review?	No	No	No	No	No	No	No	No	N/A	No	No
11. If meta-analysis was performed, did the review authors use appropriate methods for statistical combination of results?	Yes	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A	Yes	No
12. If meta-analysis was performed, did the review authors assess the potential impact of risk of bias in individual studies on the results of the meta-analyses or other evidence synthesis?	Yes	Yes	Yes	Yes	Yes	N/A	N/A	N/A	N/A	Yes	Yes
13. Did the authors account for risk of bias in individual studies when interpreting/discussing the results of the review?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes
14. Did the review authors provide a satisfactory explanation for and discussion of heterogeneity observed in the results of the review?	Yes	Yes	Yes	Yes	Yes	No	Yes	No	N/A	Yes	Yes
15. If they performed quantitative synthesis, did the review authors carry out an adequate investigation of publication bias (small study bias and discuss its likely impact on the results of the review)?	Yes	N/A	No	No	Yes	N/A	N/A	N/A	N/A	No	No
16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
TOTAL yes / applicable items	12/16	11/16	11/16	10/16	12/16	7/13	7/13	5/13	7/7	11/16	7/16