Double-Checks for Medications: A Summary of the Evidence
January 30, 2013

Clinical Question: “For adults and children in the acute care setting, what is the effectiveness of the double-check process and independent double check process by nurses to ensure medication safety?”

Conclusions: There was insufficient evidence to either support or refute the practice of double-checking the administration of medicines; there were few detailed descriptions or definitions of the double-checking process; although double-checks are not as effective as system changes, double-checks work best when they are performed truly independently; double-checking is a labor intensive, time consuming procedure dependent on the availability of two qualified nurses; adherence to ruled-based double-check policies and protocols may not prevent MAE, as they may be impractical, promote unthinking mechanistic rituals/tasks, deemphasize problem-solving and professional judgment, reduce individual responsibility, and provide a false sense of security and overconfidence; nurses are compelled to adhere to policies, procedures, and protocols or be deemed negligent; an over-reliance on computerized technology to systematize drug administration will not eliminate errors, as this technology often discourages nurses from continuing a “natural” double-check to ensure drug accuracy; completion of a well-designed, easy-to-use checklist with a specific item for each high-risk error by a second individual is the most important factor for independent double-checks; it may be necessary to separate essential abstract thinking from mechanistic tasks and develop other strategies separate from double-check checklists; although all staff must be adequately trained in double-checks, all practitioners have an individual responsibility to maintain their professional practice.
**Recommendations:** Based on the evidence, the following recommendations are offered for consideration:

- Don’t use overuse double-checks when more fundamental re-engineering of the system is needed\(^1,^2,^4,^11\)
- Investigate nontechnical strategies addressing human factors, such as techniques for elimination of redundancies, in order to identify when double-checks add value in decreasing MAE\(^10\)
- Investigate inconsistencies in how staff is completing the double-check process and resolve them\(^11\)
- Double-checks should be limited to the following:\(^1,^4,^5,^9,^11\)
  - High-alert medications (chemotherapy, insulin, opiates, intravenous routes, and anticoagulants)
  - Complex processes (compounding, calculating doses)
  - High-risk patient populations (neonates, infants, children, and adolescents, elderly or pregnant patients; patients with severe congestive heart failure; and patients with known renal impairment or liver disease)
- Examine the role confirmation bias plays in the double-checking process and then shift confirmation bias to an area where it has the greatest potential to ensure medication safety\(^12\)
- Using a multidisciplinary approach, design practical double-checking policies and procedures suitable to all staff involved in medication-related activities, as based upon individual medical center’s unique needs and patient populations\(^5,^7\)
- Revise double-check policies to embed well-defined structures into the medication administration process\(^1,^2,^5,^11\)
  - Define/describe specific double-check processes to be implemented (See Appendix A, Table 1: Types of Double-Checks, Page 12)\(^5\)
  - Outline the double-check process and include the actual procedure\(^11\)
  - Use specific items, rather than general warnings\(^11\)
  - Include well-designed and easy-to-use checklists with a specific item for each high-risk error\(^1,^2,^11\)
  - Structure double-check questions from a yes or no “Isn’t this dose correct” question to one that provides actual data, i.e. “What dose did you calculate?”\(^11\)
  - Add an EMR forcing function to compel nurses to obtain a witness prior to documenting medication administration and bag changes\(^11\)
  - Ensure adequate staff training by using video vignettes to show the wrong way and the right way to do independent double-checks\(^2,^11\)

   a. Systematic review to evaluate the evidence for double-checking the administration of medicines
      i. Systematic search of 6 electronic databases for double-checking of medication and dose calculation for either dispensing or administration in adults and/or children up to and including October 2010
      ii. 16 articles met inclusion criteria
         1. 3 quantitative studies; 1 RCT in a clinical setting
            a. Use of 2 nurses to administer medication statistically significantly reduced MAE rate; clinical advantage uncertain
            b. Policy of double-checking for all drugs dispensed by pharmacy staff reduced dispensing errors from 9.8 to 6 per year (data collected from 1994 to 1999)
            c. Old checklist vs. new checklist for double-checks: No significant difference in detection of pump programming errors; significant increase in detection of patient identification errors (80% new vs. 15% old) (White et al., 2010)
   b. There is insufficient evidence to either support or refute the practice of double-checking the administration of medicines
      i. Given the labor intensive issues impacting nursing time, it is surprising that double-checking is such a wide-spread practice with minimal evidence support
      ii. Clinical trials are needed to establish whether double-checking medicines are effective in reducing MAEs
      iii. Double-checking medicines should be evaluated scientifically
      iv. Double-checking should be used only in high-risk patient (neonates, infants) or with high risk medications (chemotherapy, opiates, intravenous routes)
   c. Independent double-checks defined: A procedure that requires two qualified health professionals, usually nurses, independently checking the medication before administration to the patients
      i. Independent = a second person follows a series of steps to confirm that they agree with the first person for example; to arrive at a calculation without prior knowledge of any previous calculation
   a. Double-checking medicines advantages:
      ii. Reduction in medication dispensing errors in pharmacy department
      iii. Reduction in patient identification errors for IV pumps (outpatient chemotherapy) (White et al., 2010)
   b. Double-checking medicines disadvantages:
      iv. Labor intensive
      v. Requires 2 qualified health professionals
      vi. Significant impact on nursing time
         1. Time consuming
      vii. Reduces responsibility
      viii. May be associated with deference to authority
      ix. Dependent on availability of sufficient nurses
   c. Single Nurse Single Check Process: Time Savings of 1 nurse (instead of 2 nurses) administering medications
      x. Save 17.1 hours of nursing time per 1000 medications administered
      xi. Nursing staff felt approximately 20 minutes saved on each medication round

Created by Cecelia L. Crawford, RN, DNP; © Kaiser Permanente, SCAL Regional Nursing Research Program, January 30, 2013
2. (Armitage & Knapman, 2003) Adverse events in drug administration: A literature review
   a. Literature review examining adverse events in drug administration
   b. Referenced in AHRQ EB Handbook for Nurses, Chapter 37, (Hughes & Blegen, 2008)
   c. Double-check not defined
   d. One recurring theme: it is extremely difficult to extrapolate a clear picture of drug error causation – there are many variables and some are confounding
   e. Most common cause of errors is the production process or system rather than the individuals working in it
   f. Medicine administration is not a solely ...“mechanistic task to be performed in strict compliance with the written prescription of a medical practitioner. It requires thought, and the exercise of professional judgment.” United Kingdom Central Council for Nursing, Midwifery and Health Visiting (UKCC 1992, cited in UKCC 2000, p.3)
   g. Employers have a duty to ensure workforce is adequately trained
   h. Practitioner has an individual responsibility to maintain their professional registration (practice)
   i. Single nurse administration does not necessarily increase number of errors( O’Shea, 1999)
      i. Perceptions remain that double-checking is a robust safeguard against error
      ii. Most reported drug errors occurred despite drugs being checked by two practitioners
   j. Policy and Procedure
      i. Many drug errors arise as a result of failure to follow policy
         1. 79% attributable to lack of adherence to guidelines
         2. Issues of accountability
      ii. Some policies and EBP protocols may promote unthinking ritual rather than a rigorous problem-solving approach
         1. Policies, procedures, and rituals may prevent or discourage qualified practitioners from being “present” throughout the entire medication administration process of prescription reading, preparation, and administration of a given drug
         2. Ritualistic practice provides a false sense of security and overconfidence
      iii. Some policies and procedures may be impractical
         1. Particularly in the context of heavy workload and rapid patient turnover
            a. Nurses may compensate by cutting corners
            b. Policies, procedures, and protocols may prove to be impractical but nurses are compelled to adhere to them or deemed negligent
            c. “This is not about bad people; it’s about good people under pressure, nobody wants to make a mistake” (Green, 2001)
            d. “Not usually due to inability to calculate basic sums, rather they can arise when the nurse or doctor is placed under unacceptable pressure in a difficult working environment” (Royal College of Nursing, 2000)
         2. Paradoxical argument: Lack of practice in administering drugs because of slow patient or low bed occupancy may increase risk of error
            a. Staff less familiar with policies and procedures and practical application
   k. Installation of computerized technology to systematize drug administration will not eliminate errors
3. (De Giorgi et al., 2010) Risk and pharmacoeconomic analyses of the injectable medication process in the paediatric and neonatal intensive care units
   a. Prospective risk analysis research study analyzing risk and financial outcomes related to adverse drug events processes and MAE detection
   b. Double-checks not defined
   c. Double-check process not adequately described
   d. Double-checks done by nurse/nurse and/or pharmacists
   e. Best cost-efficacy ratios were for 1) clinical pharmacist, 2) double-checks, 3) ready to use syringes
      i. Final analysis and conclusions stated that pharmacist and ready to use syringes as most promising safety tools

4. (Grissinger, 2006) The virtues of independent double-checks: They really are worth your time!
   a. Pharmacist focused opinion piece
   a. Independent double-check defined: 2 people calculate a dose separately and then compare their answers, instead of performing the calculation together, or have one person share the answer with the other before the double-check occurs
   b. Double-checks are not as effective as system changes
   c. Double-checks should be limited to the following:
      i. Situations that involve high-alert medications, such as chemotherapy (including methotrexate), insulin, opiates, and anticoagulants
      ii. Complex processes (compounding, calculating doses)
      iii. High-risk patient populations (children and adolescents, elderly or pregnant patients; patients with severe congestive heart failure; and patients with known renal impairment or liver disease)

5. (Henry, 2007) Using double-checks effectively: Taking time to perform steps correctly
   a. Opinion piece on double-checks advantages, disadvantages, types, and effective use
   b. Double-checks defined: (See Appendix A, Table 1: Types of Double-Checks, Page 12)
   c. Independent double-check system assumes that the first person has made a mistake
      i. If one person assumes the other person has done everything right, it negates the validity of the system
   d. Double-checks may lead to more errors, as staff learn to rely on others to catch their mistakes
   e. Conducting too many checks may dilute the effectiveness of the double-check process and increase errors
      i. Do not overuse the double-check system; system may not be workable and will fail
   f. Double-checks should be limited to the following: (Grissinger, 2006)
      i. Situations involving high-risk medications (chemotherapy, insulin, opiates, and anticoagulants)
      ii. Complex processes (compounding, calculating doses)
      iii. High-risk patient populations (children, elderly, pregnant patients, and patients with congestive heart failure, renal impairment, or liver disease)
   g. Policies and procedures need to be set by each individual facility based on need
6. (Hughes & Blegen, 2008) Medication Administration Safety (Evidence-Based Handbook for Nurses, Chapter 37)
   a. Evidence review of medication administration safety related to nursing care – a classic and seminal reference
   b. Double-checks not defined
   c. Lack of appropriate policies, procedures, and protocols can impact medication safety
      i. Double-checking policies are commonly used as a strategy to ensure medication safety
   d. Even when policies are in place, they may not necessarily improve safety
      i. Medication errors did not necessarily decrease with two nurses administering medications (double-checking). (Armitage, 2003; O'Shea, 1999)
      ii. Appropriate policies may not be followed
      iii. Conflicting research for double-checking policies as a medication safety strategy:
         1. When errors occur under these types of policies, failure to double-check doses by nurses were reported
         2. Following double-check policies did not necessarily prevent errors (Armitage, 2003)
         3. Failure to adhere to policies and procedures were associated with errors (O'Shea)
   e. Little evidence upon which to base interventions for medication safety
      i. Much data comes from voluntary self-reports of medication errors, which is neither reliable nor valid [such as (Sheu et al., 2009)]
      ii. Evidence most available is from evaluating quality improvement projects, not research
   f. Nurse is often the last provider in the medication process and is thus in a position to intercept medication errors
   g. Research base for practice interventions for medication safety is growing
      i. Still weak for most strategies currently recommended to improve medication safety
      ii. System-focused strategies include instituting policies and procedures such as RN independent double-checks
      iii. Specific issues most in need of research
         1. Independent RN double-checks: no research has been done describing, let alone testing, the effects of this policy

7. (O'Shea, 1999) Factors contributing to medication errors: A literature review
   a. Literature review examining the factors contributing to medication errors
   b. Referenced in AHRQ EB Handbook for Nurses, Chapter 37, (Hughes & Blegen, 2008)
   c. Medication errors are a multidisciplinary problem and a multidisciplinary approach is required in order to reduce the incidence of errors
   d. Double-check not discussed or examined in the review of the literature
   e. Responsibility for correct administration of medication rests with the RN; each RN is accountable for his or her own practice
   f. Evidence review material for medication errors fell into two categories
      i. Definitions
      ii. Contributing factors
   g. 1992 United Kingdom study of single-nurse drug administration over a 6-month period
      i. Nurses underwent a series of lectures in pharmacology and a test of knowledge; those with scores of over 90% then gave drugs alone for 6 months
      ii. No MAEs were reported
      iii. Staff were of the opinion that single-nurse administration of drugs resulted in fewer errors
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h. Policy and Procedures for Medication Administration (Contributing Factor)
   iii. Up to 72% of MAE is attributable to staff’s failure to follow policy for safe drug administration
   iv. However, rules can lead to ritualistic behavior which can result in an error
   v. Rules, routines, and policies connected with medication administration provide the nurse with a sense of responsibility for safe drug administration
   vi. Rules, routines, and policies connected with medication administration can also provide the nurse with a sense of security
      1. Nurses rely on rituals, policies, and procedures to prevent them from making errors
   vii. Lack of adherence to policies may be due to the lack of a practical policy
      1. Develop a policy suitable to all staff involved in medication-related activities

8. (Olson, 2011) Practice check: Independent Double Checks
   a. Anecdotal opinion piece posted on a nursing blog describing her own experience with a near miss medication error, as framed by information from Institute for Safe Medication Practices FAQ
   b. Independent double checks defined from ISMP FAQ by author:
      i. "An independent double-check of a high-alert medication is a procedure in which two clinicians separately check (alone and apart from each other, then compare results) each component of prescribing, dispensing, and verifying the high-alert medication before administering it to the patient."
      ii. "While technological solutions such as computerized prescriber order entry and bar coding systems have great potential to detect human error, manual redundancies such as independent double checks still play an important role in error detection."
      iii. "Studies show that manual redundancies detect about 95% of errors." (No citation; might be the 1998 study by Campbell & Facchinetti)
      iv. "Independent double checks serve two purposes: (1) to prevent, though not dependably, a serious error from reaching a patient; and just as important, (2) to bring attention to the systems that allow the introduction of human error."
      v. "Independent double checks should be done on error prone processes such as the use of high alert medications."
   c. No references cited for Medication Use System diagram or Swiss Cheese diagram

9. (Sheu, Wei, Chen, Yu, & Tang, 2009) Using snowball sampling method with nurses to understand medication administration errors
   a. Descriptive survey design involving a self-report questionnaire regarding MAE
   b. MAE and near misses discovered mostly by colleagues
   c. Majority of MAE occurred on medical/surgical wards with complicated drug treatments prescribed
      i. Error prone environments
   d. Double-checks not defined
   e. MAE and near misses found mainly through double-check procedure mechanism by colleagues
   f. Study results suggest nurses should double-check medication administration for:
      i. Known high alert situations (IV pump meds or CPR meds)
      ii. 3 medications (insulin, 15% KCl and Pitocin)
   g. Study results suggest developing standard operating procedures (SOP) for high-alert medications
      i. Focus group admitted seldom follow SOPs
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   a. White paper outing MAE and their sources, processes, and possible solutions
   b. Need to investigate nontechnical strategies that address human factors, such as techniques for elimination of redundancies (e.g., identifying when double-checks add value in decreasing error)
   c. Double-checks not defined

   a. 2012 white paper describing the current evidence concerning double checks
   b. Independent double-check defined: “Having the two parties do their checks separated from each other by both distance and time prevents them from both following the same error. Theoretically that separation could also keep the identity of the first checker unknown to the second checker, thus avoiding the deference to authority factor.”
   c. There is insufficient evidence to either support or refute the practice of double checking the administration of medicines and that clinical trials are needed to establish whether double checking medicines are effective in reducing medication errors (Alsulami et al., 2012)
      i. Further research is needed to determine in a more scientific way best practices and what parts of double checks are effective in reducing errors (Alsulami et al., 2012)
   d. Double-checks remain a relative weak safety intervention and they are prone to errors…
      i. …but, done correctly, the independent double check probably does provide an additional element to the defenses against errors
   e. Literature suggests a medication error reduction of 30% when using a double-check system (This statement conflicts with the often cited 1998 study by Campbell & Facchinetti, which established an error detection rate of 93 to 97%)
   f. Double-checks work best when they are performed truly independently
      i. All high risk medications need an independent double-check
      ii. Double-checks should be limited to:
          1. High alert medications (insulin, heparin, chemotherapy, TPN)
          2. Very complex processes
          3. High risk patient populations
   g. Don’t use double-checks when more fundamental re-engineering of the system is needed
   h. Continue “natural” double checks nurses do when they check the accuracy after a pharmacist has dispensed a drug
      i. Over-reliance on computers often discourages these types of double-checks
   i. Armitage 2008 incident reports of MAE and multidisciplinary staff interview for contributing factors:
      i. Medication errors occur despite double-checking
      ii. Four themes staff felt contribute to failure of double-checks to prevent MAE
          1. Theme One: Deference to authority
             a. Perceive first checker is above them in “hierarchy”
             b. Perceive first checker is better at mathematical calculations
          2. Theme Two: Reduction of responsibility
             a. Someone else will catch any mistakes made
             b. Computer says it is okay, so it must be okay
             c. Social interactions and unrelated conversations interfering with double-check process
          3. Theme Three: Auto-processing
             a. 2 people standing together with one reading item by item and other nodding assent to each item
          4. Theme Four: Lack of time
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iii. Suggested solutions:
1. Element often missing in double-check: A cognitive element asking “does this drug make sense for this patient?” and “has appropriate monitoring been put in place.”
2. Checklists: there is a science to developing checklists (White et al., 2010)
   a. Very specific items, rather than general warnings, significantly improved certain error types
   b. General reminder has virtually no impact
   c. Most important factor in independent double-checking is completion by the second person of a well-designed checklist with specific items for each high-risk error.

j. Double-checks are a form of social redundancy and require one fallible person to monitor the work of another fallible person
i. When people hear and see what they expect to hear and see, their effectiveness is reduced
ii. Double-checks are seldom carried out as recommended
   1. Double-check for the high hazard medication routine is followed in only 45% of hospitals (Smetzer, 2003)
iii. Double-checking often becomes a “superficial routine task” and people may lose sight of its importance
iv. People who are aware others are duplicating their efforts may diffuse responsibility and lead some individuals to overlook safety checks

k. Strategies to improve Double-Checks
i. Investigate inconsistencies in how staff is completing the double-check and resolve them
ii. Revise the double-check policy and procedure to include structures into the medication administration process
   1. Well defined double-check processes
   2. Include actual procedure
   3. Add a forcing function to EMR to force nurse to obtain a witness prior to documenting medication administration and bag changes
   4. Use video vignettes to show the wrong way and the right way to do independent double-checks

12. (White et al., 2010) Checking it twice: An evaluation of checklists for detecting medication errors at the bedside using a chemotherapy model
   a. High fidelity simulation experimental research study comparing two checklists for administering outpatient chemotherapy
   b. Completion of a well-designed, easy-to-use checklist with a specific item for each specific high-risk error by a second individual is the most important factor for independent double-checks
      i. Checklists remain a necessary safety tool for clinicians performing long series of mechanistic tasks and must be designed to support this activity
   c. Table of 7 important steps in developing a checklist for double-check process
   d. Definition of independent double-check:
      i. A process involving two individuals, in which the responsibility of the second individual is to verify the work performed by the first
      ii. The word ‘independent’ refers to having a second person follow a series of steps to arrive at a calculation or setting; those steps are performed with no prior knowledge of any previous calculation or setting
   e. One frequently cited 1998 study by Campbell & Facchinetti established an error detection rate of 93 to 97%; however, this study did not include details of how the double-checks were performed
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f. Not clear what elements or components of a double-check yield the highest success in detecting errors

g. Use of a checklist during the independent double-check process:
   i. Wide range in error detection rates from 0% to 90%, depending on the type of error
   ii. Detection rates were much higher (80 to 90%) when specific instructions were given detailing what to look for and where to look for it (i.e., pump programming and patient identification)
      1. Human checking processes are not failsafe: 10-20% of errors still went undetected when they were accompanied by specific instructions
   iii. Significantly detected:
      1. Identification errors (check identification from patient’s armband to drug label increased error detection by 65%)
   iv. Did not significantly detect:
      1. Mismatches between medication order and label
      2. Clinical errors via addition of general reminder to stop and think critically (abstract critical thinking)

h. Medication error detection: Nurses had to mechanistically compare data from one source (rate on drug label) against data from another source (rate on pump) to determine if the two matched.

i. Clinical decision error detection: Nurses had to compare data from one tangible source (dose in mg from MD order) against their abstract clinical knowledge, in the context of a specific patient, to determine if all MD order details were appropriate.
   i. Use of specific instructions assisted nurses with mechanistic error-detection tasks
   ii. Use of specific instructions with a general reminder to think critically and remember the Five Rights of medication administration did not assist with the abstract task.
   iii. Nurses were much better at detecting error requiring mechanistic tasks than those requiring critical thought
   iv. More difficult to detect strategic mistakes than tactical mistakes
   v. If abstract thinking tasks are essential to the final medication administration process, it may be necessary to separate these from mechanistic tasks and develop other strategies separate from checklists

j. Further research is needed to determine how best to assist clinicians in switching between mechanistic tasks and abstract problem solving during the medication administration process

k. Elimination of confirmation bias during independent double-checks:
   i. Confirmation bias was shifted from point of checking the pump to the point of checking the newly completed checklist against the prescription details
   ii. Nurses might still see what they expect to see on the order as they verify it
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Reference List


Table 1: Types of Double-Checks in Order of Reliability

<table>
<thead>
<tr>
<th>Type of Double-Check</th>
<th>Reliability</th>
</tr>
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<tbody>
<tr>
<td>1 One person performing a calculation twice</td>
<td>Least reliable of all double-checks since it is easy for one person to perform the same miscalculation twice, particularly when faced with multiple priorities and fatigue.</td>
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<tr>
<td>2 A second person looking at the calculation to confirm</td>
<td>Slightly more reliable than the first method because it allows for a second opinion; however, trust in a peer’s competence or time demands can increase the risk for error.*</td>
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<tr>
<td>3 A second person re-doing the calculation after having watched the first person perform the calculation</td>
<td>More reliable method then the first two methods, since the person doing the double-check is actually performing the calculation; however, observing the first person doing the same calculation makes it easy to duplicate his or her error.</td>
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<tr>
<td>4 A second person doing the calculation without having seen the first person’s calculation</td>
<td>Called an independent double-check, and is the most reliable of the four methods since it eliminates one practitioner from biasing the other.*</td>
</tr>
</tbody>
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Second person goes through entire process independently up to point of actually drawing up medication; assumes that the first person has made a mistake. One person assuming the other person has done everything right negates the validity of the system.


# Double-Checks for Medications: A Summary of the Evidence

**January 30, 2013**

## Electronic Database Search Methodology

**Literature search topic:** Medication Double Checks and Independent Double Checks by Licensed Nurses

**Date:** January 18, 2013

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### Contextual Links

- **Contextual Links #1**
  

- **Contextual Links #2**
  

- **Contextual Links #3**
  

### Articles from Literature Reviews

- Articles from January 2013 Literature Review: Database (5) + Contextual Links (3) = 8
- Addition Articles from November 2012 Literature Review = 1
- Reference Articles from Clinical Expert (Pharmacist) = 3
- Total Articles Reviewed = 12
- Total Articles included in January 2013 Literature Review = 10

**Inclusion Criteria:** Double checks, independent double checks, nurses, acute care setting

**Exclusion Criteria:** Medication safety procedures other than double checks, health care professional other than nurses (e.g. physicians, pharmacists)
## Collaborative Center for Integrative Reviews and Evidence Summaries

### CCIRES® Evidence Leveling System (ELS)

<table>
<thead>
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<th>LEVEL</th>
<th>DESCRIPTION</th>
<th>RELEVANT ARTICLES</th>
<th>ARTICLE NUMBER</th>
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<td>A</td>
<td>Meta-analysis of multiple large sample or small sample* randomized controlled studies, or meta-synthesis of qualitative studies with results that consistently support a specific action, intervention, or treatment</td>
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* A large sample has adequate power to detect the observed effect with confidence (as seen in significant Confidence Intervals). A small sample may lack confidence in the power of the desired effect (Polit & Beck, 2008)
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