APPENDIX 1. SEARCH STRATEGY

KQ1 – RURAL HEALTH PROVIDER NEEDS

DATABASE SEARCHED & TIME PERIOD COVERED:

LANGUAGE:
English

SEARCH STRATEGY:
Rural*[tiab] OR agricultur*[tiab] OR wilderness* OR frontier* OR (native AND reservation*) OR farmer OR farmers OR farming OR farm OR farms OR nonurban* OR "non-urban" OR remote*[tiab] OR outback* OR isolated[tiab] OR "small town" OR "small towns" OR village*[tiab] OR settlement* OR "Rural Population"[Mesh] OR "Rural Nursing"[Mesh] OR "Rural Health Services"[Mesh] OR "Rural Health"[Mesh] OR "Hospitals, Rural"[Mesh]

AND

AND

AND
predict* OR projected OR future OR trend*

DATABASE SEARCHED & TIME PERIOD COVERED:

LANGUAGE:
English

SEARCH STRATEGY:
Rural*[tiab] OR agricultur*[tiab] OR wilderness* OR frontier* OR (native AND reservation*) OR farmer OR farmers OR farming OR farm OR farms OR nonurban* OR "non-urban" OR remote*[tiab] OR outback* OR isolated[tiab] OR "small town" OR "small towns" OR village*[tiab] OR settlement* OR "Rural Population"[Mesh] OR "Rural Nursing"[Mesh] OR "Rural Health Services"[Mesh] OR "Rural Health"[Mesh] OR "Hospitals, Rural"[Mesh]

AND
"Health Personnel" OR physician* OR nurses OR nursing OR hospitalist* OR hospital staff* OR healthcare professional* OR health care professional* OR doctor OR doctors OR manpower

AND
need OR needs OR needed OR needing OR supply OR demand

Narrow by SubjectGeographic: - usa

KQ2 – DECISION FACTORS

DATABASE SEARCHED & TIME PERIOD COVERED:
SEARCH STRATEGY:
Rural*[tiab] OR agricultur*[tiab] OR wilderness* OR frontier* OR (native AND reservation*) OR farmer OR farmers OR farming OR farm OR farms OR nonurban* OR "non-urban" OR remote*[tiab] OR outback* OR isolated*[tiab] OR "small town" OR "small towns" OR village*[tiab] OR settlement* OR "Rural Population"[Mesh] OR "Rural Nursing"[Mesh] OR "Rural Health Services"[Mesh] OR "Rural Health"[Mesh] OR "Hospitals, Rural"[Mesh]
AND
AND
choice* OR choos* OR decision* OR decid*
AND
incentive* OR attract* OR pecuniary OR non-pecuniary OR income OR monetary OR economic* OR financial OR opportunit*) OR influen*

DATABASE SEARCHED & TIME PERIOD COVERED:
CIN/AHL – 1/1/2005-2/13/2015

SEARCH STRATEGY #1:
Rural*[tiab] OR agricultur*[tiab] OR wilderness* OR frontier* OR (native AND reservation*) OR farmer OR farmers OR farming OR farm OR farms OR nonurban* OR "non-urban" OR remote*[tiab] OR outback* OR isolated*[tiab] OR "small town" OR "small towns" OR village*[tiab] OR settlement* OR "Rural Population"[Mesh] OR "Rural Nursing"[Mesh] OR "Rural Health Services"[Mesh] OR "Rural Health"[Mesh] OR "Hospitals, Rural"[Mesh]
AND
"Health Personnel" OR physician* OR nurses OR nursing OR hospitalist* OR hospital staff* OR healthcare professional* OR health care professional* OR doctor OR doctors OR manpower
AND
choice* OR choos* OR decision* OR decid*

SEARCH STRATEGY #2:
Rural*[tiab] OR agricultur*[tiab] OR wilderness* OR frontier* OR (native AND reservation*) OR farmer OR farmers OR farming OR farm OR farms OR nonurban* OR "non-urban" OR remote*[tiab] OR outback* OR isolated*[tiab] OR "small town" OR "small towns" OR village*[tiab] OR settlement* OR "Rural Population"[Mesh] OR "Rural Nursing"[Mesh] OR "Rural Health Services"[Mesh] OR "Rural Health"[Mesh] OR "Hospitals, Rural"[Mesh]
AND
"Health Personnel" OR physician* OR nurses OR nursing OR hospitalist* OR hospital staff* OR healthcare professional* OR health care professional* OR doctor OR doctors OR manpower
AND
KQ3 & 4 – RECRUITMENT & RETENTION

DATABASE SEARCHED & TIME PERIOD COVERED:

LANGUAGE:
English

SEARCH STRATEGY:
Rural*[tiab] OR agricultur*[tiab] OR wilderness* OR frontier* OR (native AND reservation*) OR farmer OR farmers OR farming OR farm OR farms OR nonurban* OR "non-urban" OR remote*[tiab] OR outback* OR isolated[tiab] OR "small town" OR "small towns" OR village*[tiab] OR settlement* OR "Rural Population"[Mesh] OR "Rural Nursing"[Mesh] OR "Rural Health Services"[Mesh] OR "Rural Health"[Mesh] OR "Hospitals, Rural"[Mesh]
AND
AND
"Personnel Selection"[Mesh] OR recruit* OR retention OR turnover OR turn over* OR burnout OR burn* out
AND
interven* OR increas* OR program OR programs*[tiab] OR programme*[tiab] OR project*[tiab] OR projects*[tiab] OR telehealth OR telemedicine OR ehealth

DATABASE SEARCHED & TIME PERIOD COVERED:

LANGUAGE:
English

SEARCH STRATEGY:
Rural*[tiab] OR agricultur*[tiab] OR wilderness* OR frontier* OR (native AND reservation*) OR farmer OR farmers OR farming OR farm OR farms OR nonurban* OR "non-urban" OR remote*[tiab] OR outback* OR isolated[tiab] OR "small town" OR "small towns" OR village*[tiab] OR settlement* OR "Rural Population"[Mesh] OR "Rural Nursing"[Mesh] OR "Rural Health Services"[Mesh] OR "Rural Health"[Mesh] OR "Hospitals, Rural"[Mesh]
AND
"Health Personnel" OR physician* OR nurses OR nursing OR hospitalist* OR hospital staff* OR healthcare professional* OR health care professional* OR doctor OR doctors OR manpower
AND
recruit* OR retention OR retain* OR personnel selection OR turnover OR turn over* OR burnout OR burn* out
KQ5 – EDUCATION

DATABASE SEARCHED & TIME PERIOD COVERED:
PUBMED - 1/1/2005-2/24/2015

LANGUAGE:
English

SEARCH STRATEGY:
Rural*[tiab] OR agricultur*[tiab] OR wilderness* OR frontier* OR (native AND reservation*) OR farmer OR farmers OR farming OR farm OR farms OR nonurban* OR "non-urban" OR remote*[tiab] OR outback* OR isolated*[tiab] OR "small town" OR "small towns" OR village*[tiab] OR settlement* OR "Rural Population"[Mesh] OR "Rural Nursing"[Mesh] OR "Rural Health Services"[Mesh] OR "Rural Health"[Mesh] OR "Hospitals, Rural"[Mesh]
AND
AND
training OR train*[ti] OR educat*[tiab] OR medical education OR education, professional
AND

DATABASE SEARCHED & TIME PERIOD COVERED:
CIN/AHL – 1/1/2005-2/24/2015

LANGUAGE:
English

SEARCH STRATEGY:
Rural*[tiab] OR agricultur*[tiab] OR wilderness* OR frontier* OR (native AND reservation*) OR farmer OR farmers OR farming OR farm OR farms OR nonurban* OR "non-urban" OR remote*[tiab] OR outback* OR isolated*[tiab] OR "small town" OR "small towns" OR village*[tiab] OR settlement* OR "Rural Population"[Mesh] OR "Rural Nursing"[Mesh] OR "Rural Health Services"[Mesh] OR "Rural Health"[Mesh] OR "Hospitals, Rural"[Mesh]
AND
"Health Personnel" OR physician* OR nurses OR nursing OR hospitalist* OR hospital staff* OR healthcare professional* OR health care professional* OR doctor OR doctors OR manpower
AND
training OR train OR trained OR educat* OR graduat* OR post-graduate OR postgraduate OR college

DATABASE SEARCHED & TIME PERIOD COVERED:
GREY LITERATURE REPORT – 1/1/2010-1/16/2015
NUMBER OF RESULTS: 76

SEARCH STRATEGY:
Rural
APPENDIX 2. LIST OF EXCLUDED STUDIES

This appendix lists the publications assessed as full text and not meeting inclusion criteria.

BACKGROUND

A large number of publications did not meet inclusion criteria for the review but were retained as background information. Publications either reported more information on an included study (multiple publication), potentially contained sources of studies potentially meeting inclusion criteria, or were used in the introduction and discussion.


[no author] Shortage of general surgeons coming? OR Manager. 2008;24(6).


Crouse BJ, Munson RL. The effect of the physician J-1 visa waiver on rural Wisconsin. WMJ : official publication of the State Medical Society of Wisconsin. 2006;105(7):16-20.


Everitt-Deering P. The adoption of information and communication technologies by rural general practitioners a socio technical analysis. [Internet Resource; Computer File; Archival Material]. 2008; http://eprints.vu.edu.au/1412.


Grobler L, Marais BJ, Mabunda SA, Marindi PN, Reuter H, Volmink J. Interventions for increasing the proportion of health professionals practising in rural and other underserved areas. The Cochrane database of systematic reviews. 2009(1):Cd005314.


Kochar MS. The J-1 visa waiver program for rural Wisconsin. WMJ : official publication of the State Medical Society of Wisconsin. 2006;105(7):13.


Lindsay S. Gender differences in rural and urban practice location among mid-level health care providers. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association. 2007;23(1):72-76.


Palmer RT. Exploring online community among rural medical education students: A case study. Dissertation Abstracts International Section A: Humanities and Social Sciences. 2014;75(1-A(E)).

Pathman DE. What outcomes should we expect from programs that pay physicians' training expenses in exchange for service? North Carolina medical journal. 2006;67(1):77-82.


Rural Healthcare Workforce: A Systematic Review

Evidence-based Synthesis Program


Quarry WA. A research study outlining the key issues and strategies needed to improve recruitment and retention among primary care physicians in rural communities. 2012.


Rabinowitz HK, Diamond JJ, Markham FW, Wortman JR. Medical school programs to increase the rural physician supply: a systematic review and projected impact of widespread replication. Academic medicine: journal of the Association of American Medical Colleges. 2008;83(3):235-243.


Publications excluded based on the study design, (eg. the publication did not report on empirical data).

[no author] Shortages of rural generalist physicians may be due to poor recruitment rather than retention problems. AHRQ Research Activities. 2005;293:19.


Berens D. Recruitment or retention: J-1 visa lessons. WMJ : official publication of the State Medical Society of Wisconsin. 2006;105(7):11.


Click IA. Practice characteristics of graduates of east tennessee state university quillen college of medicine: Factors related to career choices in primary care. Dissertation Abstracts International Section A: Humanities and Social Sciences. 2014;74(9-A(E)).


Farrell PM. Plan to address physician shortage requires proper support. WMJ : official publication of the State Medical Society of Wisconsin. 2005;104(6):73-74.


Lasher WF, Silverman SB. Relationship between residency training and practice location in primary care residency programs in Texas. [Internet Resource; Archival Material]. 2008; http://hdl.handle.net/2152/3687


Rural Healthcare Workforce: A Systematic Review


Nocella IC. Recruitment of family physicians into rural California: predictors and possibilities. 2005:x, 144 leaves.


Oklahoma. Physician Manpower Training C. Oklahoma Medical Loan Repayment Program. [Internet Resource; Archival Material]. 2012; Medium: Fact Sheet; Available at: http://digitalprairie.ok.gov/cdm/ref/collection/stgovpub/id/229002


Rosenblatt RA. Commentary: do medical schools have a responsibility to train physicians to meet the needs of the public? The case of persistent rural physician shortages. Academic medicine: journal of the Association of American Medical Colleges. 2010;85(4):572-574.

Rourke J. How can medical schools contribute to the education, recruitment and retention of rural physicians in their region? Bull World Health Organ. 2010;88(5):395-396.


Sharp DB. Factors related to the recruitment and retention of nurse practitioners in rural areas. University of Texas at El Paso. 2010;108.


Zigmond J. Help wanted. Benefits include an idyllic rural setting, a friendly community and some assistance paying off those hefty medical school loans. Mod Healthc. 2006;36(31):30-31.


DUPLICATE

Publications excluded because they are identical to another citation in the database.

Quinn KJHJL. Experiences influencing physician rural practice and retention a phenomenological study. [Internet Resource; Computer File]. 2009; 1 online resource (ix, 157 p.) Dissertation: Ph. D.; University of Missouri--Columbia; 2009. Available at: http://hdl.handle.net/10355/9673

INTERVENTION

Publications excluded due to the intervention (the publication did not report on an intervention or did not report on an intervention relevant to provider recruitment or retention).
Rural Healthcare Workforce: A Systematic Review


OUTCOME

A large number of studies were excluded because they did not report on healthcare provider recruitment or retention measures.


Bing-You RG, Bates PW, Epstein SK, Kuhlik AB, Norris TE. Using decentralized medical education to address the workforce needs of a rural state: a partnership between Maine Medical Center and Tufts University school of medicine. Rural and remote health. 2010;10(2):1494.


Marth NJ. Advanced practice registered nurse (APRN) supply in a rural state : trends to inform policy. 2010:vii, 74 leaves.


Owen JA, Conaway MR, Bailey BA, Hayden GF. Predicting rural practice using different definitions to classify medical school applicants as having a rural upbringing. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association. 2007;23(2):133-140.


Zink T, Power DV, Finstad D, Brooks KD. Is there equivalency between students in a longitudinal, rural clerkship and a traditional urban-based program? Family medicine. 2010;42(10):702-706.

PARTICIPANTS

Publications excluded because they did not report on healthcare providers or reported on providers outside the scope of the review.


Bradbury GB. Retention of staff nurses in a rural hospital setting in the eastern part of North Carolina: The impact of leadership style. Capella University. 2013;152.


Rural Healthcare Workforce: A Systematic Review


Rhyne RL, Daniels ZM, Skipper BJ, Sanders ML, VanLeit BJ. Interdisciplinary health education and career choice in rural and underserved areas. Medical Education. 2006;40(6):504-513.


Slagle DR. Rural Versus Urban: Tennessee Health Administrators' Strategies on Recruitment and Retention for Allied Health Professionals. [Internet Resource]. 2010; http://etd-submit.etsu.edu/etd/theses/available/etd-0702110-121920/


Rural Healthcare Workforce: A Systematic Review

Evidence-based Synthesis Program


SETTING

Publications excluded because they did not report on a healthcare setting or an US healthcare setting.


Deirdre J, Florence M, Olive Y. Putting the (R) Ural in Preceptorship. [Internet Resource; Archival Material]. 2012; http://dx.doi.org/10.1155/2012/528580

Eley D, Young L, Przybeck TR. Exploring temperament and character traits in medical students; a new approach to increase the rural workforce. Medical teacher. 2009;31(3):e79-84.


Kuhn MKM, Ochsen C. Demographic and geographic determinants of regional physician supply. [Internet Resource; Archival Material]. 2009; http://hdl.handle.net/10419/39775

Peach HG. Rural placement programs. Rural and remote health. 2011;11(3):1844.


Schneider HB. Attracting medical students to rural areas. CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne. 2008;179(8):801.


Solowiej K, Upton P, Upton D, et al. A scheme to support the recruitment and retention of allied health professionals to hard to fill posts in rural areas including commentaries by Kevin O'Toole; Matthew J Leach; Leonie
Rural Healthcare Workforce: A Systematic Review


**TIMING**

Publications excluded due to timing because they exclusively reported on practicing in rural care before 2005.


# APPENDIX 3. RISK OF BIAS ASSESSMENT

## KQ1 STUDIES

<table>
<thead>
<tr>
<th>ID</th>
<th>Data source reporting</th>
<th>External validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Branch, 2014⁴⁷</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
<tr>
<td>Camargo, 2008⁵⁶</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
<tr>
<td>Ghosh, 2011⁵¹</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
<tr>
<td>Hendryx, 2008⁵⁴</td>
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<td>Low risk</td>
</tr>
<tr>
<td>Maizel, 2009⁴⁸</td>
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</tr>
<tr>
<td>Rayburn, 2012⁶²</td>
<td>Low risk</td>
<td>Unclear</td>
</tr>
<tr>
<td>Rosenblatt, 2010¹</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
<tr>
<td>Stewart, 2013⁵⁹</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
<tr>
<td>Thomas, 2009⁵⁰</td>
<td>Low risk</td>
<td>Unclear</td>
</tr>
<tr>
<td>Williams, 2011⁵³</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
<tr>
<td>Wilson, 2011⁵⁵</td>
<td>Low risk</td>
<td>Low risk</td>
</tr>
</tbody>
</table>

## KQ2 STUDIES

<table>
<thead>
<tr>
<th>ID</th>
<th>Response rate</th>
<th>Confounding variables</th>
<th>Other limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chen, 2010⁵⁷</td>
<td>Unclear</td>
<td>High risk</td>
<td></td>
</tr>
<tr>
<td>DHHS, 2006⁵⁶</td>
<td>Unclear</td>
<td>High risk</td>
<td></td>
</tr>
<tr>
<td>Duffrin, 2014⁶⁷</td>
<td>High risk</td>
<td>High risk</td>
<td></td>
</tr>
<tr>
<td>Fordyce, 2012⁵⁸</td>
<td>Unclear</td>
<td>High risk</td>
<td></td>
</tr>
<tr>
<td>Glasser, 2010⁶⁸</td>
<td>Low risk</td>
<td>High risk</td>
<td></td>
</tr>
<tr>
<td>Hancock, 2009⁶⁹</td>
<td>High risk</td>
<td>High risk</td>
<td>Recall bias and small sample size with likely selection bias</td>
</tr>
<tr>
<td>Helland, 2010⁷⁰</td>
<td>Low risk</td>
<td>High risk</td>
<td></td>
</tr>
<tr>
<td>Heneghan, 2005⁷¹</td>
<td>High risk</td>
<td>High risk</td>
<td>Selection bias, response bias, did not address non-responders</td>
</tr>
<tr>
<td>Henry, 2007⁶⁵</td>
<td>High risk</td>
<td>High risk</td>
<td>Qualitative results only</td>
</tr>
<tr>
<td>Hughes, 2005⁷²</td>
<td>Unclear</td>
<td>High risk</td>
<td></td>
</tr>
<tr>
<td>Jarman, 2009⁷³</td>
<td>High risk</td>
<td>High risk</td>
<td></td>
</tr>
<tr>
<td>Kimball, 2007⁷⁴</td>
<td>Low risk</td>
<td>High risk</td>
<td>Qualitative study with selection bias</td>
</tr>
<tr>
<td>MacDowell, 2013¹⁰⁵</td>
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<td>High risk</td>
<td></td>
</tr>
<tr>
<td>Mason, 2012⁶³</td>
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<td>Unclear</td>
<td></td>
</tr>
<tr>
<td>Pepper, 2010⁷⁵</td>
<td>Low risk</td>
<td>High risk</td>
<td></td>
</tr>
<tr>
<td>Phillips, 2009⁸⁰</td>
<td>Unclear</td>
<td>Low risk</td>
<td></td>
</tr>
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### KQ3 AND KQ4 STUDIES

<table>
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<tr>
<th>ID</th>
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<th>Performance bias</th>
<th>Attrition bias</th>
<th>Detection bias</th>
<th>Other bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kahn, 2010&lt;sup&gt;83&lt;/sup&gt;</td>
<td>High risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>N/A</td>
</tr>
<tr>
<td>No Author, 2007&lt;sup&gt;85&lt;/sup&gt;</td>
<td>High risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>N/A</td>
</tr>
<tr>
<td>Renner, 2010&lt;sup&gt;62&lt;/sup&gt;</td>
<td>High risk</td>
<td>Unclear</td>
<td>Low risk</td>
<td>Low risk</td>
<td>N/A</td>
</tr>
<tr>
<td>Wheeler, 2009&lt;sup&gt;94&lt;/sup&gt;</td>
<td>High risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>Low risk</td>
<td>N/A</td>
</tr>
<tr>
<td>Wheeler, 2013&lt;sup&gt;96&lt;/sup&gt;</td>
<td>High risk</td>
<td>Unclear</td>
<td>Unclear</td>
<td>Unclear</td>
<td>Recruitment data no denominator, retention data not stratified by program</td>
</tr>
</tbody>
</table>

### KQ5 STUDIES

<table>
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</thead>
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<td>Antonenko, 2009&lt;sup&gt;96&lt;/sup&gt;</td>
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</tr>
<tr>
<td>Baker, 2012&lt;sup&gt;101&lt;/sup&gt;</td>
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</tr>
<tr>
<td>Bonham, 2014&lt;sup&gt;48&lt;/sup&gt;</td>
<td>High risk</td>
</tr>
<tr>
<td>Crane, 2014&lt;sup&gt;102&lt;/sup&gt;</td>
<td>High risk</td>
</tr>
<tr>
<td>Crump, 2013&lt;sup&gt;103&lt;/sup&gt;</td>
<td>Unclear</td>
</tr>
<tr>
<td>Deutchman, 2013&lt;sup&gt;98&lt;/sup&gt;</td>
<td>High risk</td>
</tr>
<tr>
<td>Deveney, 2009&lt;sup&gt;29,97&lt;/sup&gt;</td>
<td>High risk</td>
</tr>
<tr>
<td>Glasser, 2008&lt;sup&gt;68,104&lt;/sup&gt;</td>
<td>High risk</td>
</tr>
<tr>
<td>Kallail, 2010&lt;sup&gt;106&lt;/sup&gt;</td>
<td>High risk</td>
</tr>
<tr>
<td>Mason, 2012&lt;sup&gt;63&lt;/sup&gt;</td>
<td>High risk</td>
</tr>
<tr>
<td>Nash, 2008&lt;sup&gt;93&lt;/sup&gt;</td>
<td>High risk</td>
</tr>
<tr>
<td>Patterson, 2013&lt;sup&gt;99&lt;/sup&gt;</td>
<td>Unclear</td>
</tr>
<tr>
<td>Reference</td>
<td>Risk Level</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Phillips, 2009</td>
<td>Low risk</td>
</tr>
<tr>
<td>Phillips, 2013</td>
<td>Unclear</td>
</tr>
<tr>
<td>Quinn, 2011</td>
<td>Low risk</td>
</tr>
<tr>
<td>Rabinowitz, 2011</td>
<td>Low risk</td>
</tr>
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<td>Rabinowitz, 2012</td>
<td>Low risk</td>
</tr>
<tr>
<td>Rabinowitz, 2013</td>
<td>Low risk</td>
</tr>
<tr>
<td>Ross, 2013</td>
<td>High risk</td>
</tr>
<tr>
<td>Shipman, 2013</td>
<td>Low risk</td>
</tr>
<tr>
<td>Talley, 2011</td>
<td>Low risk</td>
</tr>
<tr>
<td>Whitacre, 2010</td>
<td>High risk</td>
</tr>
<tr>
<td>Zink, 2010</td>
<td>Unclear</td>
</tr>
</tbody>
</table>
### APPENDIX 4. PEER REVIEW COMMENTS/AUTHOR RESPONSES

<table>
<thead>
<tr>
<th>Comments</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appears comprehensive and very useful.</td>
<td>Thank you</td>
</tr>
<tr>
<td>Very thorough and complete.</td>
<td>Thank you</td>
</tr>
<tr>
<td>It appears VA studies on Workforce were not including in this synthesis. Was this by design?</td>
<td>We have limited this systematic review to studies in the public domain and applied this inclusion criterion consistently.</td>
</tr>
<tr>
<td>Aren't there unpublished data on VA health care workforce supply and demand?</td>
<td>Please see above</td>
</tr>
<tr>
<td>Specifically retention studies for National Health Service Corps program completers and reports from Community Health Centers regarding retention patterns would be helpful. That CHCs and RHCs were not included as part of the study should be further explained and clarified for readers since these sites are supported by federal rural workforce investments.</td>
<td>We have added more detail regarding completers as suggested. Inclusion criteria specified provider specialties, rather than types of healthcare delivery centers but we have added rural health clinics as one of the examples why the provider groups were selected.</td>
</tr>
<tr>
<td>In my opinion this report is outstanding! The authors did an excellent job of identifying the problem and evaluating the scientific rigour of the studies. Just a few suggestions: - page 7, line 43 &quot;Study Selection&quot; - I would recommend that the authors provide more detail on how disagreements were resolved (e.g., consensus, third reviewer, etc.).</td>
<td>Added as suggested</td>
</tr>
<tr>
<td>- Page 13, line 28 &quot;Technical Expert Panel&quot;. Please change Bureau of Health Professions to Bureau of Health Workforce. We had a merger last year and with it came the name change.</td>
<td>Revised as suggested</td>
</tr>
<tr>
<td>- Page 70, line 51 - &quot;Limitations&quot; The HRSA workforce projections covered many more specialties than psychologists and pharmacists. Would suggest changing to various health providers or health professions.</td>
<td>We have revised the sentence slightly to address this point.</td>
</tr>
<tr>
<td>- Page 71, line 10-11 &quot;Research Gaps/Future Research&quot; While the supply and demand microsimulation models used by HRSA are complex, they have been updated and do include the effect of the ACA in the calculations. The effect of the ACA in the HRSA model and other models indicates about a 2% effect in demand due to the ACA. HRSA has also put out supply and demand numbers for many health professionals other than physicians (e.g., allied health professions, dentists, nurses, etc.). While we have identified numbers of providers needed these estimates are based on current delivery models and this is an area that needs future research. Identifying a metric for upcoming delivery models will improve the estimates of providers needed (e.g., team-based care, PCMH, ACOs, etc.). Further, another area of research that is needed is not only identifying outputs of providers needed, but what skills are needed by the providers. I think it might be helpful to mention in this section that there is a need to identify the skills and competencies needed in the existing and new workforce. How do we go about training the existing workforce to work in the new delivery models such as team-based care, PCMH, ACO's etc.</td>
<td>Thank you for this suggestion, we have added this point.</td>
</tr>
</tbody>
</table>
### Rural Healthcare Workforce: A Systematic Review

<table>
<thead>
<tr>
<th>Page 71, line 26/27 - “Research Gaps/Future Research”</th>
<th>The HRSA demand model does account for the effect of the ACA. To date, the HRSA model and other existing models, have only found the ACA to have approximately a 2% effect on the demand of health professionals.</th>
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<td></td>
<td>We have revised the paragraph to avoid misinterpretation of the sentence.</td>
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<tr>
<th>Page 71, line 32 - “Research Gaps/Future Research”</th>
<th>One of the difficulties with comparing training programs across health professions is that there are so many differences in the time of training, locations used for clinical training and providing training in rural settings. Most medical schools are still training using the acute care setting and rarely have a rural track for students. I think that is where research needs to occur in the shift of training from acute care to rural/primary care settings.</th>
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<td>Added as suggested</td>
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</table>

This report is well written, carefully done, and nicely demonstrates the complexity and nuance of rural healthcare need, the determinants of provider’s geographic choices, and the many issues around provider recruitment and retention. With the exception of my comments regarding the lens of “place,” the discussion, limitations, and research gaps are well-written, thorough and justified by the review. My comments regarding the conclusions of the review are listed at the end of this review document.

### Methods:
- I only have one question regarding the selection criteria. How was it determined that a particular study was relevant to CBOC’s and CAH’s? Were there explicit criteria other than specialty?

<table>
<thead>
<tr>
<th>Comments regarding the key study questions:</th>
<th>KQ1: What are the current versus projected healthcare provider needs by numbers and disciplines in the next 20 years in rural areas?</th>
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<tr>
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<td>I find it interesting that the studies of general surgery use a somewhat arbitrary ratio of general surgeons/100,000 population, when the general surgeon in a rural community has a very different scope of practice, potentially underestimating the need. A general surgeon in an urban area has other specialty surgeons who can take up the slack. The same can be said about family physicians practicing in rural communities, where specialists are underrepresented relative to urban places and where generalists practice a wider scope. All of this complicates the question of provider need.</td>
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<tr>
<td></td>
<td>Thank you for this thoughtful comment. To at least partially address this point we have elaborated more on the definition of need in the discussion.</td>
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| This report nicely demonstrates the relative importance of the predictor variables, and identifies location of medical school as the strongest independent predictor, i.e. the geography of education and training, an even stronger factor than growing up in a rural place – the factor which this review concludes is the most consistent factor. This is one of the few studies to use multivariate analysis across a large number of variables. The Pepper study from Wyoming is an exception and found no association with place of training. Unfortunately, residency training programs in that region do not vary much by the usual measures of rurality. The Rabinowitz study in Philadelphia has the opposite problem, occurring primarily in an urban place with a region characterized by an intricate patchwork of rural and urban. |
|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                  | We agree with this observation and have expanded on the discussion.                                                                                                                                                                                                 |

| There is growing evidence that the place of education and training (the context) is as important if not more important than either individual characteristics or the program (often described in this review as “educational effort” or content). The difficulty is that the geography question has not been asked in most studies nor have research studies generally been addressed through that lens. Generally success under question KQ5 is attributed to the “training,” not the duration and “place” of training experiences. This represents a significant cognitive framing bias among researchers in many studies. |
|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                  | Very interesting point; we have added it to the future research section.                                                                                                                                                                                                 |
The fact that the Majority of rural providers did not grow up in small town, stems from the reality that, although growing up in a rural area is associated with a propensity for rural practice, there are too few such students even entering medical school, and of those who do, the majority still end up in urban practice. A modest percentage of a small number is an even smaller number. Therefore the selective admissions of individuals is unlikely by itself to address workforce needs, further supporting the importance of developing effective educational interventions and identifying effective contexts. In addition, although frequently articulated as conventional wisdom repeated in this report that “the choice to select a school with a rural track is likely to be influenced by an affinity to rural healthcare,” to my knowledge this statement has not been proven to be true. Given the adverse odds of medical school admission for many applicants, choice of medical school is often limited by where an individual gets admitted. Many applicants may have chosen to go elsewhere if they had been able to freely choose, but many do not have that luxury. The most frequently cited example of this, whether true or not, is among osteopathic students, some of whom admit they would have preferred to go to an allopathic institution and yet many go into rural practice. Very insightful comment. We have added more detail to the type of study that should be conducted in the future research needs section to at least partially address this point.

This review also lends support for scaling up efforts such as those reported by Patterson et al, that seek to follow unit record data over a career and use geography (GIS; geocoding of education and training experiences, as well as “lived experience” in a rural place – building a web of relationships, i.e. experiential place integration) as an examined factor in career decisions and retention in practice over time. The qualitative study by Hancock et al (Evidence Table 3) is the only study I found in your references that addresses this in any depth. Unfortunately, that study does not address specific interventions, such as deliberate rural placement in education and training. If it’s not too late, here is an important addition to the literature that is relevant to KQ2: Wendling AL; Phillips J; Short W; Fahey C; Mavis B. Thirty Years Training Rural Physicians: Outcomes From the Michigan State University College of Human Medicine Rural Physician Program, Academic Medicine, just published ahead of print September 2015.

KQ3: What interventions have been shown to increase rural healthcare provider recruitment?
KQ4: What interventions have been shown to increase rural healthcare provider retention?

Unless geography (“place”-ment) is considered an intervention (see discussion above), I agree that the evidence base for any one intervention in recruitment and retention is painfully limited. One question that needs to be answered is, “For those loan repayment individuals who remained in a rural place, is there evidence for the effect of duration in a rural place independent of other predictive factors?”

I was surprised that Community Apgar did not make it into the review. The Community Apgar project is specifically designed to answer KQ3 and KQ4, and I am curious as to why it was excluded. It does identify modifiable factors important to recruitment and retention. Although published in the international J Rural & Remote Health, it clearly reports on work in Idaho. This instrument has now been used successfully in multiple States to identify factors that increase retention. Unfortunately, although presented in multiple forums over the past 4 years, I am unaware that these more recent results have yet been published in the peer-reviewed literature. Schmitz D; Baker E; Nukui: Epperly T. Idaho rural family physician workforce study: the Community Apgar Questionnaire. Rural Remote Health 2011;11(3):1769. Epub 2011 Jul 25. We have added this interesting point to the future research section.

The article by Wendling was published after the search date for our systematic review; however, for the interested reader we have added a reference to the paper to the discussion section.

We restricted the review to evaluations of specific interventions and the reference is an analytic study assessing individual variables. We have added the study to the future research section for suggestions for potentially promising interventions that should be tested.
KQ5: What is the efficacy of current rural-specific resident and healthcare professions’ student training and education efforts?
I’m not sure why this article was excluded from KQ5, because it does compare RTT programs with the other family medicine residencies in NM:

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<tr>
<th>The study was outside the scope of the intervention because it reported on data before 2005.</th>
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<tr>
<td>To address this comment we have highlighted this in the future research section.</td>
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</table>

There is a lack of comparative studies across a variety of settings or even all settings, and across medical students or residents in any one region or in any one specialty. It is very important that comparative effectiveness be demonstrated, and unfortunately, studies using case-control methods and/or multivariate analyses are difficult to find. The database from which to run such queries is still quite limited in capacity and attention to geography. Encouraging developments in this regard are (1) the “RTT Masterfile” referenced in Patterson et al and (1) the NRHA Rural Medical Educator group’s developing project with the Data Commons, both of which seek to create a database of unit record data, including place of education that should be able to address questions of comparative effectiveness. The accrediting bodies of both medical school and residency have not generally kept geographically relevant data, choosing with regard to their database structure, whether by intention or simply omission, to be agnostic of place.

CONCLUSIONS (From the end of the report)
• All included studies reported current unmet provider needs that worsen with increasing rurality. The small number of studies estimating future need also predicted unmet provider needs that worsen with increasing rurality. Justified.
• Growing up in a rural community is the most consistent factor associated with practice location choice. More research into the relative importance of factors is needed. Except for context of education and training – that seems to be the most consistent factor across KQ2 through KQ5, and is explicitly identified in multiple studies (e.g. Hancock, Patterson)

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<thead>
<tr>
<th>We have expanded the conclusion section and provided more detail to address this comment.</th>
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<td>To address this point we have added an analysis stratified by intensity operationalized as more than 6 months cumulative time spent in rural locations.</td>
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• More research is needed to evaluate healthcare provider recruitment interventions for rural healthcare. Justified.
• There is a lack of evidence regarding interventions to support healthcare provider retention in rural healthcare. Justified.
• Current evaluations of rural training programs for medical students and residents suggest a median success rate of 53%.

Hidden in the median statistic is the variability associated with duration of education and training in a rural place (the lens of geography and place, as opposed to educational program or effort). As well as the intensity of training (multiple rural locations over years of training compared to a single 4 week experience,) and its broad impact. Although the metanalysis has not been done, and the data is incomplete (geocoding is not a strength of medical school or residency data), there is a consistent theme among studies across KQ2 through KQ5 that warrants further exploration.

Except for the 3 references noted above (one of which has only appeared in the past month), I commend the team for identifying and appropriately vetting a comprehensive list of relevant literature.

Thank you.
This comprehensive and needed report on the state of rural healthcare with respect to provider demand, provider geographic choices, strategies to increase provider recruitment and retention, and the success of approaches to increase students choosing to practice in rural areas. Unfortunately, the synthesis did not reveal a large body of evidence in these areas, pointing to the need for targeted research examining successful approaches and specific workforce projections.

I find it very interesting that the strongest association with rural practice is growing up in a rural community, measured by various proxies. One wonders if interventions to attract and retain other providers are futile given the fact that rural practice may be in part of one's psyche. Targeting providers from all disciplines who have spent early years in rural settings seems a logical approach (e.g., pipelines from colleges and universities in rural communities to professional schools with rural emphases, pipeline programs for high school students in rural schools). As the report notes in its Research Gaps/Future Research section on page 71, multi-variate analyses which simultaneously study the effects of personal background (e.g., rural upbringing, gender, SES), training needs and interventions are needed to determine the relative importance of different factors.

Another glaring gap noted by the report is the need for studies examining factors associated with non-physicians practicing and staying in rural practice. There is a small body of literature pointing to the need for professional communities of practice, continuing professional education, and mentoring programs which are not addressed by distance education. Rural providers have reported that they leave rural practice because of isolation and lack of professional colleagues.

The report also reveals the need for VA-specific studies as currently none exist. However, I would draw your attention to the Tumosa et al. paper noted above, Health care workforce development in rural america: when geriatrics expertise is 100 miles away. The VA Office of Rural Health supports the Geriatric Scholars Program, a multi-modal education intervention aimed at bringing geriatrics knowledge and skills to rural VA providers. The program has found to have impacted geriatric competencies pre and post-education. I think the review would be remiss not to refer to this program.

I guess it is the nature of an evidence-based synthesis, but the paper, while a strong technical piece, lacks some texture in that it does not draw on published work on rural practice and the challenges of rural practice. For instance, there is an excellent manuscript by Chipp et al (#31 in the reference list of the report) which reflects on challenges of rural practice through the voices of practitioners. If possible, some of this qualitative data in the summary or introduction would give this generally excellent review a bit more "life" and underscore the need and challenges of rural practice.

Specific comments:
- P. 2, line 42: the tense needs to be changed from future to past tense
- P. 3, line 6: perhaps there should be a bit of background on the GRADE approach for readers unfamiliar with this method
- P. 6, line 40: please define "contemporary context"
- P. 7, Topic Development: Who determined the synthesis' key questions?
- Title of report should be 'Rural Healthcare Workforce: A Systematic Review'.
- Page 1, line 13 change to "increase rural provider";
- Page 4 line 3 can you elaborate on type of sponsoring facility?

<table>
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<tr>
<th>Page 1</th>
<th>Page 2</th>
<th>Page 3</th>
<th>Page 4</th>
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<tbody>
<tr>
<td>Thank you, very insightful comments.</td>
<td>This is an interesting paper but does not report on our outcomes of interest; we have added the reference to the discussion on provider satisfaction with programs.</td>
<td>We have added more detail to the introduction and the discussion to highlight the challenges faced by rural practitioners.</td>
<td>We have added more information but the information in the original article was very limited.</td>
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<td>Page/Line</td>
<td>Text/Comment</td>
<td>Action/Response</td>
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<tr>
<td>11, line 7</td>
<td>&quot;what qualifies as a training site?&quot;</td>
<td>We have added a definition to the methods section</td>
<td></td>
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<tr>
<td>23, page 8</td>
<td>why did you not included unpublished VA data on workforce?</td>
<td>Please see above</td>
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<tr>
<td>68, line 6</td>
<td>&quot;what constitutes small?&quot;</td>
<td>Added</td>
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<tr>
<td>68, line 59</td>
<td>spell out HRSA</td>
<td>Revised</td>
<td></td>
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<tr>
<td>6, lines 6-8</td>
<td>can this point be elaborated in discussion?</td>
<td>Added as suggested</td>
<td></td>
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<tr>
<td>51 -53</td>
<td>can the international literature be elaborated on further? Those approaches could work in VA.</td>
<td>The existing studies are described in detail in the discussion (page 69-70)</td>
<td></td>
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<tr>
<td>26-28</td>
<td>can the new research recently published be further elaborated?</td>
<td>These are the studies included in our report. They are described under key question 5, evidence table 6.</td>
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<tr>
<td>71 - Future research - gaps</td>
<td>Can we specifically say we need further research on the following: 1) Factors impacting rural workforce in VA. 2). Simpler models to predict supply and demand for a range of health professions in a given geographic area, 3) How US and state policies affect supply and demand of health professionals, 4) How and where technology can best ameliorate shortages of providers, 5) how and where new models of care can best ameliorate shortage of providers;</td>
<td>Thank you for these suggestions, we have added points 1, and 3-5 to the section; regarding 3) we are not sure that simpler models are possible; as shown, there are a number of factors contributing to predictions</td>
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<td>32</td>
<td>can this be elaborated? how easy access to CME opportunities, e- consults with specialists, mini residencies, provider education and consult networks impact retention of primary care providers in rural</td>
<td>Without empirical evidence it is difficult to speculate; to address this point we have added the topics to the future research section.</td>
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<td>Since many if not most of the readers of this report will only read the executive summary, it’s important to explicitly state what has been found by this very well done, thorough review of the literature. The Discussion section should be expanded to state explicitly what has been found by the review. It’s probably true that more research would be helpful, but as a policy maker, that does not help determine where to put resources in 2016. The stated findings and conclusions should point to what the current literature--the known body of evidence--points us to, especially where possible enhancement of policies appear to be helpful (e.g. rural training tracks vs loan repayment programs) to make a difference in this decade.</td>
<td>We have expanded the discussion as suggested</td>
<td></td>
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<tr>
<td>International interventions are mentioned but without reference, and in fact in Discussion by Key Question Section, for KQ3, international references make up most of the discussion for KQ3. Should explain use/non-use of international references/models.</td>
<td>The discussion section places the identified research in context of the international literature.</td>
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<tr>
<td>(not all publications have been received at the time of the draft report) Presumably these publications will have minor impact, but would be useful to know which ones were not included in the analysis.</td>
<td>The studies have been added to the final report.</td>
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<tr>
<td>ES, KQ1: It seems reasonable that this is the main finding, yet the lead sentence defines a limitation</td>
<td>Duly noted but given the scope of KQ1 this seems justified</td>
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<td>We have added information on the variability of the reported metrics to address this comment.</td>
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<tr>
<td>ES, KQ2: I didn’t see any cited studies that programs did NOT improve likelihood. Seems reasonable to make a stronger declarative statement that is supported by a large # of studies, rather than couching as “seems to increase likelihood.”</td>
<td>We have added a discussion of the study limitations to the discussion section to address this point.</td>
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<tr>
<td>It would be helpful to quantify the number of physicians. Less than half completed and of those are large percentage stayed longer. How many and how much longer? This is important because the J-1 visa program is well known and policy makers need to know more about its impact.</td>
<td>Added.</td>
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<tr>
<td>Can you define the difference between recipients and program completers?</td>
<td>Added as suggested.</td>
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<tr>
<td>May point to an important policy issue that needs further discussion, which is that there has not been high quality research conducted about provider retention. Retention is obviously a priority the need to understand retention factors is also a priority. How about NHSC retention rates as a model?</td>
<td>Thank you for this interesting comment.</td>
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<tr>
<td>It would be helpful for the authors to expand this discussion for uninformed readers as to why rural healthcare needs are more complex than metropolitan or urban needs. What are the factors that determine complexity? Am not clear on why the discussion focuses mostly on what is not included in this very thorough review rather than on what the literature demonstrates.</td>
<td>We have revised the wording and expanded the introduction to address this point.</td>
<td></td>
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<tr>
<td>Conclusion KQ1: I think you mean population needs</td>
<td>We have reworded the sentence to make it clearer that studies reported unmet healthcare provider needs.</td>
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<tr>
<td>Conclusion KQ3: With the average U.S. medical school graduation rate of entering rural practice at about 5%, (even the AAMC (Shipman) study of new schools it peaks at only 8+%), there appears to me that there is good evidence as cited in bullet #5 that rural training programs are successful. Though more research may be needed, there are findings that could be highlighted, e.g. the rather poor success of J-1 visa programs, and +/- success of loan programs that have been somewhat central in recruitment/retention efforts over last several decades.</td>
<td>We acknowledge the point but to address it we have expanded the discussion regarding the lack of comparative effectiveness studies to provide more information regarding the interpretation of results.</td>
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<tr>
<td>Would be helpful to compare/contrast what the literature shows for these 3 interventions, e.g. in a table format.</td>
<td>To address this point we have highlighted that Table 5 provides an overview of studies and evaluated programs.</td>
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<tr>
<td>Introduction normative, coercive, utilitarian: An interesting way to sort the strategies. Not evident, based on discussion and conclusions, that this approach was used in the analysis or conclusions.</td>
<td>The small number of provider interventions unfortunately did not allow meaningful stratification.</td>
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<tr>
<td>Intro, Evidence syntheses are sparse and care environment has changed: Not sure what this means</td>
<td>Reworked for clarification.</td>
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<tr>
<td>Intro, AAMC call for 30% increase:-Is there evidence that increased production of medical graduates has focused on increasing rural education?</td>
<td>Only one included study assessed this question and it concluded that despite expansion, the characteristics of matriculating medical students changed little, except at new schools.</td>
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<tr>
<td>The Methods section is very nicely done and self-explanatory. Clearly written. The quality assessment exercises and rating the body of evidence are particularly helpful.</td>
<td>Thank you.</td>
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<tr>
<td>KQ1, we did not identify studies reporting on the same provider group: Please clarify. Unclear what this means.</td>
<td>Revised to clarify.</td>
<td></td>
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<tr>
<td>Evidence tables: These tables are very helpful to understand the content of the literature as well as the review process.</td>
<td>Thank you.</td>
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<tr>
<td>Table 4: This table is very useful in understanding and synthesizing the strength of the literature.</td>
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<td>KQ2, most rural healthcare providers did not grow up in a rural community: It would be helpful to at least postulate, not necessarily in the results, but possibly in the discussion section, what factors may be at play that influenced those from non-rural backgrounds to choose a rural practice career.</td>
<td>Added as suggested</td>
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<td>It seemed as though a number of the recruitment publications also include retention information, e.g. Rabinowitz, 2013 who assessed “PSAP” graduates from 1978 – 1986 to assess continuation of rural practice. Unclear why the inclusion criteria for this KQ is limited to studies that only include retention data, or why retention data cannot be gleaned from studies that incorporate both recruitment and retention intervention outcomes. That the only finding for this KQ relates to the J-1 program is surprising and limits the effectiveness of the report.</td>
<td>To address this point we have clarified throughout that we didn’t find interventions that focused on retention in fully trained providers practicing in rural care (rather than trainees). We have also added information on retention reported in studies addressing students.</td>
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<tr>
<td>The referenced figure (not shown in this Word version due to formatting incompatibility), needs clarification. Axes are not well labeled…Is the Y axis # of studies or interventions? Is the X axis the number of participants or school graduates? A helpful table would be to report %/# entering rural practice of intervention group c/w %/# without intervention.</td>
<td>We have added a note section to the figure to address this point</td>
<td></td>
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<tr>
<td>Would be helpful to cite comparison percentage from slow/low growth schools.</td>
<td>Added as suggested</td>
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<tr>
<td>This statement seems to contradict prior statement. “Hence it is difficult to make specific evidence statements for the number of healthcare providers needed across the studies.” Doesn’t the statement that there is a shortage imply a known or estimated quantity/metric that would alleviate the shortage?</td>
<td>We have clarified the wording to address this point</td>
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<tr>
<td>The review is thorough and the data extraction, along with quality assessments are very nicely done. My concern is that the report itself has not synthesized the information so that the reader comes away with new knowledge about what has been described and reported in the literature. Concluding that the problem is “complex” and more research is needed is in all likelihood accurate, however after reviewing almost 450 publications and thoroughly extracting 56, I would expect more declarative statements that include what the extracted information tells us.</td>
<td>More declarative statements are hampered by the number of studies contributing to some of the KQs and limitations in study designs; we feel we have made our statement as strong as the evidence will support.</td>
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<tr>
<td>p. 4, line 30: Is this report only targeting MDs? what about nursing, pharmacists, psychologists, etc.? It appears other professions are not really mentioned throughout the report.</td>
<td>Nurse practitioners and physician assistants were also included but not pharmacist or psychologists; we have added this point to the limitation section</td>
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<tr>
<td>p. 10, line 18: Acronym should be spelled out when first mentioned as opposed to later in the document.</td>
<td>Revised</td>
<td></td>
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<tr>
<td>p.24, line 55: Is there not more data or information to include here to support this statement?</td>
<td>No, abstracted as reported</td>
<td></td>
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</table>