QUERI

Rural Healthcare Workforce: A Systematic Review

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PREFACE

The VA Evidence-based Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted healthcare topics of particular importance to clinicians, managers, and policymakers as they work to improve the health and healthcare of Veterans. QUERI provides funding for four ESP Centers, and each Center has an active University affiliation. Center Directors are recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Centers. The ESP is governed by a Steering Committee comprised of participants from VHA Policy, Program, and Operations Offices, VISN leadership, field-based investigators, and others as designated appropriate by QUERI/HSR&D.

The ESP Centers generate evidence syntheses on important clinical practice topics. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The ESP disseminates these reports throughout VA and in the published literature; some evidence syntheses have informed the clinical guidelines of large professional organizations.

The ESP Coordinating Center (ESP CC), located in Portland, Oregon, was created in 2009 to expand the capacity of QUERI/HSR&D and is charged with oversight of national ESP program operations, program development and evaluation, and dissemination efforts. The ESP CC establishes standard operating procedures for the production of evidence synthesis reports; facilitates a national topic nomination, prioritization, and selection process; manages the research portfolio of each Center; facilitates editorial review processes; ensures methodological consistency and quality of products; produces “rapid response evidence briefs” at the request of VHA senior leadership; collaborates with HSR&D Center for Information Dissemination and Education Resources (CIDER) to develop a national dissemination strategy for all ESP products; and interfaces with stakeholders to effectively engage the program.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, ESP CC Program Manager, at Nicole.Floyd@va.gov.

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EXECUTIVE SUMMARY

INTRODUCTION

Approximately 20 percent of the US total population lives in rural areas. Patients living in rural areas are often underserved with regard to healthcare access. The complexity of rural healthcare provision requires careful and systematic evaluation of individual contributing factors. The purpose of this review is to examine the current literature quantifying current and projected health provider need, to explore geographic provider choices, to synthesize evidence on interventions to increase rural provider recruitment and provider retention, and to document the efficacy of student training for current rural healthcare in the US.

This topic was developed in response to a nomination by the Office of Rural Health (ORH).

The Key Questions (KQ) are:

1. What are the current versus projected healthcare provider needs by numbers and disciplines in the next 20 years in rural areas?
2. What factors influence healthcare providers' geographic choices for practice?
3. What interventions have been shown to increase rural healthcare provider recruitment?
4. What interventions have been shown to increase rural healthcare provider retention?
5. What is the efficacy of current rural-specific resident and healthcare profession student training and education efforts?

METHODS

The review is registered in PROSPERO: CRD42015025403.

Data Sources and Searches

We searched the electronic databases PubMed, CIN/AHL, Web of Science, SCOPUS, PsycINFO, ERIC, WorldCat, and Grey Literature Report for English-language research published in the last 10 years (2005-February 2015). In addition, we reference-mined pertinent reviews, accessed targeted online resources (www.raconline.org, http://bhpr.hrsa.gov/healthworkforce, www.ruralhealthresearch.org), and consulted with topic experts.

Study Selection

Two independent reviewers screened retrieved publications against the eligibility criteria; any disagreements were resolved by discussion in the review team.

Population(s): Studies in healthcare providers relevant to rural Community-Based Outpatient Clinics, Rural Health Clinics, and Critical Access Hospitals (family medicine, internal medicine, emergency medicine, and obstetrics/gynecology physicians; general surgeons; pediatricians; geriatricians; psychiatrists; nurse practitioners; and physician assistants) were eligible for inclusion for KQ2-4, providers and patients could provide data on KQ1, and providers in training were eligible for inclusion for KQ5.

Intervention(s): Interventions aiming to increase provider recruitment and retention were eligible for KQ3-5; studies addressing recruitment and retention regardless of the aim of the intervention were eligible for KQ3 and KQ4.

Comparator(s): Comparative studies documenting current needs and studies using statistical modeling techniques to predict future needs were eligible for KQ1, and no comparator was required for KQ2-5.

Outcome(s): Studies reporting on current and projected needs of healthcare providers and patient healthcare access measures were eligible for KQ1; provider-reported and otherwise analytically provided factors potentially associated with geographic practice choices were eligible for KQ2; recruitment and retention measures were eligible for KQ3-5.

Timing: Studies reporting on demand, provider choices, and effects of provider interventions and training in 2005 to 2015 were eligible. Studies making predictions for 2015 and beyond were also eligible for KQ1.

Setting: Studies addressing US rural healthcare settings were eligible for KQ1, KQ2, and KQ4, and US healthcare training sites were eligible for KQ5.

Data Abstraction and Quality Assessment

For KQ1, we extracted the geographic region, provider groups covered, the predictive timeframe, data source, definition of "rural," analytic method, results for rural healthcare, and the authors' conclusion. The quality assessment concentrated on the data source reporting (detection bias) and whether predictions exceed the sample (external validity).

For KQ2, we extracted the geographic region; targeted provider groups; number of participants; study design; definition of "rural"; results for provider and setting characteristics, financial aspects and other predictors; and the authors' conclusion. The quality assessment targeted the risk of bias due to response rate limitations (selection bias) and confounding variables (detection bias).

For KQ3 and KQ4, we extracted the geographic region, targeted provider groups, number of participants, intervention category and description, study design and comparator, recruitment and retention results, and the authors' conclusion. The quality assessment considered selection, performance, attrition, detection, and reporting bias.

For KQ5, we extracted the geographic region of the school and the rural placement, the provider groups in training, number of trainees, training content, school capacity, study design and comparator, definition of "rural," data source for outcome elicitation, recruitment and retention results, and the authors' conclusion. The quality assessment focused on the completeness of follow-up (attrition bias).

Data Synthesis and Analysis

Each key question was summarized in a narrative synthesis. KQ1 differentiated current and future need. The synthesis of KQ2 determined the evaluated factors and the associated strength of evidence. KQ3 summarized all interventions that aim to increase provider recruitment. KQ4

summarized all interventions that target provider retention. KQ5 summarized programs aimed at providers in training. The summary of findings tables were organized by outcome and the quality of evidence assessment followed the GRADE approach. VA provider samples were a preplanned subgroup analysis.

RESULTS

Results of Literature Search

The literature review identified 5,756 citations. In total, 446 publications were obtained as full text. Of these, 59 publications met inclusion criteria, contributing to one or more key question.

Summary of Results for Key Questions

KQ1: Rural Healthcare Provider Needs

We identified a small number of studies quantifying current healthcare provider needs for rural areas. Estimates were for specific geographic regions and time periods, and studies operationalized provider need differently. Hence it is difficult to make concrete or generalizable evidence statements regarding the number of healthcare providers needed across studies. However, all included studies reported current unmet healthcare provider needs that worsen with increasing rurality. There is a healthcare provider shortage in particular for primary care providers, mental health professionals, and general surgeons.

We also identified a very small number of published studies estimating future provider needs in rural healthcare. The 3 studies made predictions for primary care physicians, emergency physicians, and surgeons. We did not identify more than one study reporting on the same provider group or studies reporting on other provider groups of interest. All studies concluded that the supply is not likely to meet demand.

KQ2: Healthcare Providers' Geographic Choices for Practice

A large number of studies exploring the determinants of practicing in rural care has been published. Growing up in a rural community was the most consistent factor associated with practice location choice across the 24 identified studies. Education efforts for physicians, such as rural tracks, also seem to increase the likelihood of practicing in a rural community. Associations were also shown for the family of providers, exposure to rural communities, a primary care and family medicine focus, osteopathic education, recreation activities, and rural lifestyle; however, the evidence base is very limited. Although a large number of studies explored potential factors associated with practicing in a rural setting, studies are needed to determine the relative importance of the predictor variables.

KQ3: Rural Healthcare Provider Recruitment Interventions

We only identified 5 evaluations aimed at practicing providers. Studies assessed the J-1 visa waiver program and loan forgiveness programs. A J-1 visa evaluation reported that 53% of physicians did not complete their obligations, but of the respondents who had completed their commitment, 84% remained a median of 23 months longer than required. A state-wide evaluation of various recruiting programs reported that 80% of placed providers have remained at their initial placement site upon completion of their obligation. The loan repayment programs

reported on different outcomes and success measures. One study reported that 86% of surveyed rural physicians indicated that they continued medical practice at their sponsoring Minnesota healthcare facility after completing their service obligation. One evaluation reported that of those recipients whose obligated practice location was rural, 84% were practicing in rural areas and 28% of program completers were practicing in rural areas. One evaluation highlighted that 74% of recipients were already working in or intended to work in an eligible community when they were made aware of the program.

KQ4: Rural Healthcare Provider Retention Interventions

We did not identify any study evaluating an intervention specifically aimed at improving retention for healthcare providers in US rural healthcare facilities.

KQ5: Rural Student and Resident Training Programs

We identified 23 program evaluations focusing on providers in training. All reported on medical students and residents. Programs varied in their approach and recruitment success estimates. Results varied across datasets and programs but most estimates ranged between 35 and 65%. We did not identify factors that appeared to systematically affect success rates. Across approaches, studies reported a median success rate for rural healthcare recruitment of 53%.

DISCUSSION

The review demonstrates rural healthcare workforce needs, determinants of providers' geographic choices, the lack of intervention studies aimed at US providers, and a multitude of recent provider in training efforts.

The included studies quantified current and predicted shortages for rural areas for specific provider groups and for a defined period of time. The identified estimates of unmet needs underpin the perceived shortage of healthcare providers for rural areas as highlighted in numerous publications on the topic. However, the variability in the metrics used to define unmet need illustrate the difficulty in quantifying provider needs and comparing unmet needs across geographic regions and provider disciplines.

A large number of studies has addressed determinants of providers' geographic choices and showed growing up in a rural community as the most consistent factor associated with rural practice. This factor has also been identified in earlier datasets and it continues to play an important role in the current healthcare system. A second key variable that emerged in the literature was education efforts such as rural tracks for physicians. Although the choice of selecting a rural track may be in part determined by a personal affinity preceding the choice of school, multivariate analyses suggest that the effect cannot be entirely explained by the variable of growing up in a rural community. However, there is a lack of studies helping to differentiate the relative importance of a personal affinity for rural communities, motivation through rural training, and effects of interventions attracting trained healthcare providers into rural care settings on provider choices.

We only identified a very small number of studies aimed at the recruitment of healthcare providers for rural communities. This is consistent with existing reviews on the topic, indicating a need for more evaluations to support policy makers in adopting effective interventions to

increase the availability of healthcare providers in underserved areas. Programs such as the J-1 visa program need to be evaluated carefully. While half of physicians did not complete their obligations, of the respondents who had completed their commitments, over 80 percent remain longer than required. Research on loan forgiveness programs is sparse and the identified evaluations assessed different outcomes and results. Careful evaluation is needed given that existing research highlighted that a large proportion of participants were working in or intended to work in an eligible community when they were made aware of the program. Hence, programs may influence retention but may not necessarily be key to entering rural healthcare.

We did not identify any recent study specifically aimed at improving retention for fully trained healthcare providers in US rural healthcare facilities. The international literature on this topic also highlights that more research is needed to empirically evaluate suggested strategies. Our review focused on specific empirical evidence (*ie*, recruitment success), leaving out studies that concentrated on provider satisfaction with programs or other outcomes.

In the last 10 years a large number of studies has been published that evaluates programs for healthcare providers in training; however, the literature is dominated by studies focusing on medical students and residents. Across all approaches, about half the students trained for rural healthcare enter rural settings. Individual training programs vary widely in format and duration. More research is needed to parse out the specific aspects of the training experience that influence success and to determine the comparative effectiveness of different raining programs.

We did not identify published studies reporting on VA settings, and the definition of “rural” was operationalized differently across identified evaluations which added heterogeneity across studies. Future research should in particular concentrate on evaluating strategies to improve healthcare provider recruitment and retention.

Conclusions

- All included studies reported current unmet healthcare provider needs that worsen with increasing rurality. The small number of studies estimating future need also predicted unmet provider needs for rural healthcare.

- Growing up in a rural community is the most consistent factor associated with practice location. Education efforts for physicians, such as rural tracks, also seem to increase the likelihood of practicing in a rural community. More research on the relative importance of factors is needed.

- More research is needed to evaluate existing healthcare provider recruitment interventions for rural healthcare.

- There is a lack of evidence regarding interventions to support healthcare provider retention in rural healthcare.

- Current evaluations of rural training programs for medical students and residents suggest a median success rate of 53%.

EVIDENCE REPORT

INTRODUCTION

Approximately 20 percent of the US total population lives in rural areas;[1] exact estimates vary depending on the specific definition of rural.[2] Compared to their urban counterparts, rural communities tend to have older residents and report higher rates of chronic diseases.[3] In order to obtain healthcare services, members of these geographically dispersed rural populations must often travel great distances and incur significant costs.[4] Rural Veterans represent a third of the total VA enrolled population.

Surveys indicate that rural communities struggle with recruiting as well as retaining healthcare providers and experience a healthcare provider shortage with ongoing, long-term vacancies.[5-9] Estimates differ by provider group but, for example, less than 12 percent of US physicians practice in rural areas.[1] Hence one fifth of the nation's population resides outside metropolitan areas, but only about a tenth of the nation's physicians are to be found there. Prior publications have frequently concluded that the shortage will increase over time and that shortages of specific provider groups are more pronounced in rural areas compared to their urban counterparts.[10-14]

In order to ensure access to rural healthcare services, it is essential to reliably determine and quantify the current demand and shortage of healthcare providers. Furthermore, given the many years of training required for key healthcare personnel such as physicians, predictive studies are crucial to anticipate future provider workforce needs. Professional bodies, including state and national agencies, may then use study results and take adequate steps to ensure healthcare delivery in rural communities. Prediction models need to take a variety of variables into account, including current workforce status and anticipated workforce,[15,16] an aging population,[17] changes in patient case mix, federal and state programs that address already perceived shortages,[4,12,18,19] and changes in models of care with implications for demand of individual provider groups.[20-24]

In recent years, more research has concentrated on exploring determinants of geographic practice choices of healthcare providers. Insight into the relative importance of demographic characteristics and motivational factors may provide indications which groups of providers should be targeted to maximize return on recruitment efforts.[25] Systematically exploring the strength of associations may also contribute to selecting strategies that address demand, such as those that seem predominately normative (*ie*, matching inclinations and background of candidates), coercive (*eg*, a mandatory period of practice in rural healthcare), or utilitarian (*eg*, continuous education programs to support practitioners in rural healthcare) policy approaches.[26]

Many approaches have been suggested and resources spent aiming to increase the number of providers practicing in rural healthcare. The international literature has pointed out emerging evidence,[27,28] but it is not clear whether interventions can be applied to the unique US healthcare system and infrastructure. Our knowledge about which recruitment strategies are evidence-based and have indeed been shown to be successful and cost-effective in recruiting healthcare providers is limited. Furthermore, evaluating the effects of federal, state, or local programs is a complex undertaking and the relative importance and success rate of programs has to be evaluated within the context of the current healthcare system.

Rural providers commonly treat a great diversity of conditions and perform a wide variety of procedures, often without specialized training and with limited access to professional support such as colleagues and educational opportunities.[29-31] In addition, the intersection of rural living and healthcare challenges may create additional barriers to care that providers are not trained to navigate, as for example shown in the following quote: *"I think when you work in a rural setting you can find yourself on call 24 hours a day. People will come to you in ways that are unseeing, unbelievably naive or intrusive, or completely innocent, almost with the expectation that you can do much more than you can."*[32] It is crucial that healthcare provider organizations support providers and identify appropriate efforts that ensure workplace retention of recruited providers.[33,34] However, evidence syntheses on the effectiveness and comparative effectiveness of interventions aiming to increase healthcare provider retention are sparse and frequently outdated, as the care environment has changed in the last decade through the increased use of internet applications and advanced communication technologies.[35-38] Telehealth and access to specialist input through online, real time exchanges, and easy access to high-quality videoconferencing technology can now support providers in remote locations. However, whether these innovations are successful in increasing retention of healthcare providers is an open question.

Finding ways to get physicians to practice in underserved areas has been an ongoing priority for organizations such as the Association of American Medical Colleges (AAMC). In 2006, AAMC called for a 30 percent increase in MD-granting medical school enrollment by 2015.[39] A systematic review with literature searches to 2006 highlighted efforts to target healthcare providers in training, for example by adding rural tracks to medical schools.[40] Since the review, a substantial amount of new research has been published and results of implemented programs and reforms to address shortcomings[41-44] should also have become apparent.

The complexity of rural healthcare provision requires careful and systematic evaluation of individual contributing factors. The purpose of this systematic review is to examine the research describing healthcare provider need, exploring geographic provider choices, synthesizing evidence on interventions to increase provider recruitment and provider retention, and documenting the efficacy of student and resident training for rural healthcare in the US in the last decade. The review concentrates on key healthcare provider groups with long training periods, requiring workforce planning ahead of time, and that are critical to rural Community-Based Outpatient Clinics, Rural Health Clinics, and Critical Access Hospitals. The review does not provide a historic overview but concentrates on research that addresses the review questions in a contemporary context, applicable to the current healthcare environment. We did not restrict to a particular definition of "rural" but limited to US studies to maximize relevance and applicability to the VA. The review aims to systematically document current published, empirical evidence reporting on the outcomes of interest for rural healthcare.

METHODS

TOPIC DEVELOPMENT

This topic was developed in response to a nomination by the Office of Rural Health (ORH), for an evidence review examining the literature describing access needs and limitations for Veterans in rural settings and the interventions that have been shown to improve the recruitment and retention of healthcare providers in rural settings. Key questions were developed with input from the topic nominator, the ESP Coordinating Center, the review team, and the technical expert panel (TEP).

The Key Questions were:

1. What are the current versus projected healthcare provider needs by numbers and disciplines in the next 20 years in rural areas?

2. What factors influence healthcare providers' geographic choices for practice?

3. What interventions have been shown to increase rural healthcare provider recruitment?

4. What interventions have been shown to increase rural healthcare provider retention?

5. What is the efficacy of current rural specific resident and healthcare profession student training and education efforts?

The review was registered in PROSPERO: CRD42015025403.

SEARCH STRATEGY

We searched the electronic databases PubMed, CIN/AHL, Web of Science, SCOPUS, PsycINFO, ERIC, WorldCat, and Grey Literature Report for English-language research published in the last 10 years (2005-2015). In addition, we reference-mined pertinent reviews, accessed targeted online resources including www.raconline.org, http://bhpr.hrsa.gov/healthworkforce, and www.ruralhealthresearch.org, and consulted with topic experts to identify pertinent US studies.

STUDY SELECTION

Two independent reviewers screened the titles and abstracts of retrieved citations. Citations deemed relevant by at least one reviewer were obtained as full text. Full-text publications were screened against prespecified eligibility criteria. Any disagreements were resolved by consensus decision after discussion by all investigators.

To be included in the systematic review, studies had to meet the following criteria, organized in the PICOTS framework:

KQ1 PICOTS: What are the current versus projected healthcare provider needs by numbers and disciplines in the next 20 years in rural areas?

- **Population(s):** Studies on healthcare providers relevant to rural Community-Based Outpatient Clinics, Rural Health Clinics, and Critical Access Hospitals (family medicine, internal medicine, emergency medicine, and obstetrics/gynecology physicians; general surgeons; pediatricians; geriatricians; psychiatrists; nurse practitioners; and physician assistants) were eligible for inclusion. In addition, studies using patient demographics relevant to adults to determine objective healthcare provider needs were eligible to provide data. Studies exclusively providing data for other professions and specialties were not eligible.
- **Intervention(s):** n/a
- **Comparator / Study design:** Studies eligible to demonstrate the current healthcare needs required a comparator (*eg,* rural vs urban settings). Studies eligible to predict future provider needs required the use of statistical modeling techniques; vague estimates (*eg,* "need is likely to increase") were not eligible.
- **Outcome(s):** Studies reporting on current and projected healthcare provider needs in rural areas were eligible. Studies only reporting on provider supply without needs or demand assessment were excluded. We accepted the author's definition of need, demand, shortage, or benchmarks (*eg,* existing guidelines for patient-provider ratio), and patient healthcare access measures (*eg,* projected number of required physicians to maintain patient-provider ratio). Studies addressing demand without specific numbers for the healthcare provider groups of interest and studies not providing data specifically to rural areas were not eligible.
- **Timing:** Studies reporting on provider need since 2005 regardless of the start of the evaluation period, and studies making predictions beyond 2015 were eligible.
- **Setting:** Studies had to report on US rural healthcare practice settings, using the authors' definition (remote, not urban, non-metropolitan), to be eligible.

KQ2 PICOTS: What factors influence healthcare providers' geographic choices for practice?

- **Population(s):** Studies in healthcare providers relevant to rural Community-Based Outpatient Clinics, Rural Health Clinics, and Critical Access Hospitals (family medicine, internal medicine, emergency medicine, and obstetrics/gynecology physicians; general surgeons; pediatricians; geriatricians; psychiatrists; nurse practitioners; and physician assistants) were eligible for inclusion. Studies exclusively providing data for other professions and specialties were not eligible. Studies presenting analytic data predicting healthcare providers' choices for practice were included but studies exclusively reporting data from other participant groups (*eg,* hospital administrators) reporting on perceived healthcare providers' choices were not eligible.
- **Intervention(s) / Independent variables:** Studies of provider-reported or other analytically derived factors potentially associated with geographic choices for practicing in rural care were eligible. Analytically derived factors were limited to variables preceding practicing in rural care such as demographic or provider training characteristics (*eg,* gender, growing up in rural community, rural track training). Studies exclusively associating training programs with practicing in rural healthcare were documented in KQ5.
- **Comparator / Study design:** Surveys and interviews with healthcare providers as well as analytic studies identifying predictors of practice in rural settings published in journal

articles or reports were eligible for inclusion. Studies only in abbreviated or other formats (*eg,* conference abstracts dissertations) were excluded.

- **Outcome(s):** Studies reporting associations and predictions for practicing in rural care were eligible. Studies only assessing factors associated with the intent of practicing in rural care and case studies reporting experiences of a single provider were not eligible.
- **Timing:** Studies reporting on practicing in rural care since 2005 were eligible regardless of the timing of the predictor variables (*eg,* growing up in a rural area), start of the evaluation period, exposure duration, or length of follow-up.
- **Setting:** Studies had to report on US rural (as defined by the author) healthcare practice settings to be eligible. Studies predicting practicing in rural versus very remote US areas were eligible but studies comparing choices between US and international settings were excluded.

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

- **Population(s):** Studies in healthcare providers relevant to rural Community-Based Outpatient Clinics, Rural Health Clinics, and Critical Access Hospitals (family medicine, internal medicine, emergency medicine, and obstetrics/gynecology physicians; general surgeons; pediatricians; geriatricians; psychiatrists; nurse practitioners; and physician assistants) were eligible for inclusion in the review. Studies exclusively providing data for other professions and specialties were not eligible. Interventions targeting providers in training were eligible for KQ5.
- **Intervention(s):** Interventions aiming to increase provider recruitment and studies addressing recruitment regardless of the aim of the provider intervention were eligible (*eg,* financial incentives, visa programs, educational interventions, improving the practice environment initiatives).
- **Comparator / Study design:** Studies with concurrent (*eg,* randomized controlled trials [RCT]) or historic (*eg,* pre-post) comparators were eligible, and post-only studies were eligible when they reported on a distinct cohort of participants.
- **Outcome(s):** Studies reporting on recruitment success measures and studies reporting on retention measures, such as extended practice in rural areas after a mandatory period of time required by the intervention, were eligible. Post-only studies were eligible only if they reported numerical recruitment or retention data together with a denominator (*eg,* number of participants in study group); publications making general statements such as "program was successful" were excluded.
- **Timing:** Studies reporting data on practicing in rural care since 2005 were eligible regardless of the timing of the intervention, start of the evaluation period, intervention duration, or length of follow-up.
- **Setting:** Studies had to report on US rural (as defined by the author) healthcare practice settings to be eligible.

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

- **Population(s):** Studies in healthcare providers relevant to rural Community-Based Outpatient Clinics, Rural Health Clinics, and Critical Access Hospitals (family medicine,

internal medicine, emergency medicine, and obstetrics/gynecology physicians; general surgeons; pediatricians; geriatricians; psychiatrists; nurse practitioners; and physician assistants) were eligible for inclusion. Studies exclusively providing data for other professions and specialties were not eligible.

- **Intervention(s):** Interventions aiming to increase provider recruitment and retention, and studies addressing recruitment and retention regardless of the aim of the provider intervention were eligible.
- **Comparator / Study design:** Studies with concurrent (*eg*, RCT) or historic (*eg*, pre-post) comparators were eligible. Post-only studies were only included if they reported on a distinct cohort of participants.
- **Outcome(s):** Studies reporting on provider retention measures (*eg*, staff turnover, employment duration, provider loss rate, moving to rural area) were eligible. Post-only studies were only included if they reported numerical recruitment or retention data together with a denominator (*eg*, number of participants in study group); publications making general statements such as "program was successful" were excluded.
- **Timing:** Studies reporting data on practicing in rural care since 2005 were eligible regardless of the timing of the intervention, start of the evaluation period, intervention duration, or length of follow-up.
- **Setting:** Studies had to report on US rural (as defined by the author) healthcare practice settings to be eligible.

KQ5 PICOTS: What is the efficacy of current rural-specific resident and healthcare profession student training and education efforts?

- **Population(s):** Studies in healthcare providers in training relevant to rural Community-Based Outpatient Clinics, Rural Health Clinics, and Critical Access Hospitals (family medicine, internal medicine, emergency medicine, and obstetrics/gynecology physicians; general surgeons; pediatricians; geriatricians; psychiatrists; nurse practitioners; and physician assistants) were eligible for inclusion. Studies exclusively providing data for students of other professions and specialties were not eligible.
- **Intervention(s):** Training and educational programs specific to rural healthcare and programs explicitly aiming to increase provider recruitment for rural areas were eligible.
- **Comparator / Study design:** Studies published in peer-reviewed journal articles were eligible regardless of the presence or the type of comparator. Studies not peer-reviewed or documented only in abbreviated form (*eg*, dissertations, conference abstracts were excluded).
- **Outcome(s):** Studies reporting on recruitment success measures were eligible. Studies only reporting on the intention to practice in rural healthcare or other effectiveness measures of programs and intervention-specific outcomes were excluded.
- **Timing:** Studies reporting data on practicing in rural care since 2005 were eligible regardless of the timing of the intervention, start of the evaluation period, intervention duration, or length of follow-up.
- **Setting:** Studies reporting on US training sites and reporting on US rural healthcare practice settings (as defined by the author) were eligible. Training sites were defined as formally recognized and accredited locations for healthcare student and resident clinical education.

Publications reporting on the same dataset were abstracted as one study.

DATA ABSTRACTION

For KQ1 studies (current and future provider need), we abstracted the geographic region the study aimed to cover, the targeted provider groups, the predictive timeframe category (current vs future demand) and the specified timeframe the study addressed, the data source, the definition of "rural" or other relevant case definition variables, the analytic method, the results for rural healthcare, and the authors' conclusion.

The evidence table for KQ2 studies (provider choices to practice in rural healthcare) documents the geographic region, the provider groups covered, the number of participants together with the response rate of all invited and eligible participants, the study design and comparators (where applicable), the results associated with predictions based on participant characteristics, results with regard to rural healthcare setting characteristics, predictive results regarding financial aspects, results for other potential predictors, and the authors' conclusions.

Studies reporting on interventions relevant to KQ3 (provider recruitment interventions) or KQ4 (provider retention interventions) documented the geographic regions included in the study, the targeted provider groups, the number of participants, the study design and the comparator (concurrent or historic), results regarding recruitment success, results regarding retention, and the authors' conclusion.

The evidence table for KQ5 (programs for healthcare providers in training) studies documents the geographic region of the school and the training / rural placement location, the discipline of the targeted providers in training, the number of trainees evaluated in the research study, the content of the training including duration of rural placement (where applicable), the capacity of the school, the study design (post-only, pre-post, comparative study with concurrent comparator, and random participant assignment), source of outcome data, definition of "rural," rural healthcare recruitment results, information on retention in rural healthcare, other notable outcomes, and the authors' conclusion.

QUALITY ASSESSMENT

Due to the diversity of included studies, the quality assessment primarily targeted study design-associated characteristics and inherent limitations in addition to key risk of bias dimensions appropriate for the type of question the study aimed to answer.[45]

For KQ1, the quality assessment concentrated on the data source reporting (detection bias) and whether predictions exceeded the sample (external validity).

For KQ2, the quality assessment targeted the risk of bias due to response rate limitations (selection bias) and confounding variables (detection bias).

For KQ3 and KQ4 (provider intervention studies), the quality assessment considered selection, performance, attrition, detection, reporting, and other key sources of bias. Selection bias assessed whether the study was based on a highly selective and not representative sample of the target population (*eg*, depending on survey respondents). Performance bias assessed whether fidelity to the intervention protocol was maintained. Attrition bias assessed the loss to follow-up. Detection

bias evaluated whether the data were based on a reliable source. Reporting bias assessed whether key outcomes were apparently missing from the analysis and results were based on surrogate measures of recruitment success (*eg*, number of offers made, not number of successfully recruited providers). The other source of bias category determined whether the study reported on a related concept rather than rural healthcare (*eg*, practicing in very rural areas).

For KQ5, the quality assessment focused on the completeness of follow-up (attrition bias).

DATA SYNTHESIS

The identified research is presented in a narrative synthesis for each of the 5 key questions. Evidence tables summarize each study meeting inclusion criteria.

Some publications were relevant to more than one key question, such as studies evaluating the success of a recruitment intervention and analyzing predictors of practicing in rural healthcare within intervention groups. All studies investigating geographic choices of practitioners were extracted for KQ2, regardless of whether the study also contributed to other evidence tables. Given the conceptual overlap, studies addressing programs aimed at students as well as practitioners were abstracted for KQ3 and KQ4 (provider recruitment and retention). Given the conceptual overlap, studies reporting on recruitment and retention measures were abstracted for KQ3 and discussed in the KQ4 section. KQ4 was reserved for studies that evaluated interventions that exclusively focused on the retention of practicing healthcare professionals. Studies evaluating programs exclusively aimed at students or residents, and not fully trained healthcare providers, were summarized in the KQ5 section.

RATING THE BODY OF EVIDENCE

Where possible a summary of findings and quality of evidence table was used to summarize the existing evidence. Based on the GRADE working group,[46] the quality of the evidence was categorized as follows:

High: We are very confident that the true effect lies close to that of the estimate of the effect.

Moderate: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.

Low: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.

Very low: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.

GRADE evaluates the quality of the evidence across all identified studies contributing to the outcome of interest. We took the standard criteria Study limitation and risk of bias, Inconsistency, Indirectness, Imprecision, Publication bias, Large effect, and Dose response, and All plausible residual confounding would reduce a demonstrated effect and/or would suggest a spurious effect if no effect was observed into account when grading the evidence. The starting point for all key questions was moderate evidence (not high evidence) because the data were not based on RCTs or equivalently strong research design studies. Risk of bias, Inconsistency,

Indirectness, Imprecision, and Publication bias can lower the quality, Large effect, Dose response, and All plausible residual confounding can upgrade the quality of the body of evidence (where applicable). Neither of the key questions could be answered by a standard intervention study such as an RCT, hence the grading rested primarily on study limitation, risk of bias, and inconsistency across studies assessing the same factor.

TECHNICAL EXPERT PANEL

The TEP guiding the project included: Nancy Maher, PhD, Program Analyst, Office of Rural Health, VHA Office of Rural Health; Stephanie Kondrick, VHA National Workforce Planner, Healthcare Talent Management Office; Ray Lash, MD, Director, ORH Rural Health Training Initiative, VA Maine Healthcare System; Dan Mareck, MD, Chief Medical Officer, Federal Office of Rural Health Policy/HRSA; George Zangaro, PhD, RN, Director, National Center for Health Workforce Analysis, HHS Bureau of Health Workforce; Randy Longenecker, MD, Assistant Dean, Rural and Underserved Programs and Professor of Family Medicine, Ohio University; Judy Howe, PhD, Director, ORH Rural Health Training Initiative, Bronx VAMC; Peter Kaboli, MD, Director of the Veterans Rural Health Resource Center — Central Region, Associate Professor at the University of Iowa Carver College of Medicine, Iowa City VA Medical Center; Thomas Klobucar, PhD, Deputy Director, Office of Rural Health, VHA Office of Rural Health (10P1R); and Janice Garland, MPH, Health Systems Specialist, Office of Rural Health, VHA Office of Rural Health (10P1R).

PEER REVIEW

A draft version of the report was reviewed by technical experts and clinical leadership. Reviewer comments and our responses are documented in Appendix 4.

RESULTS

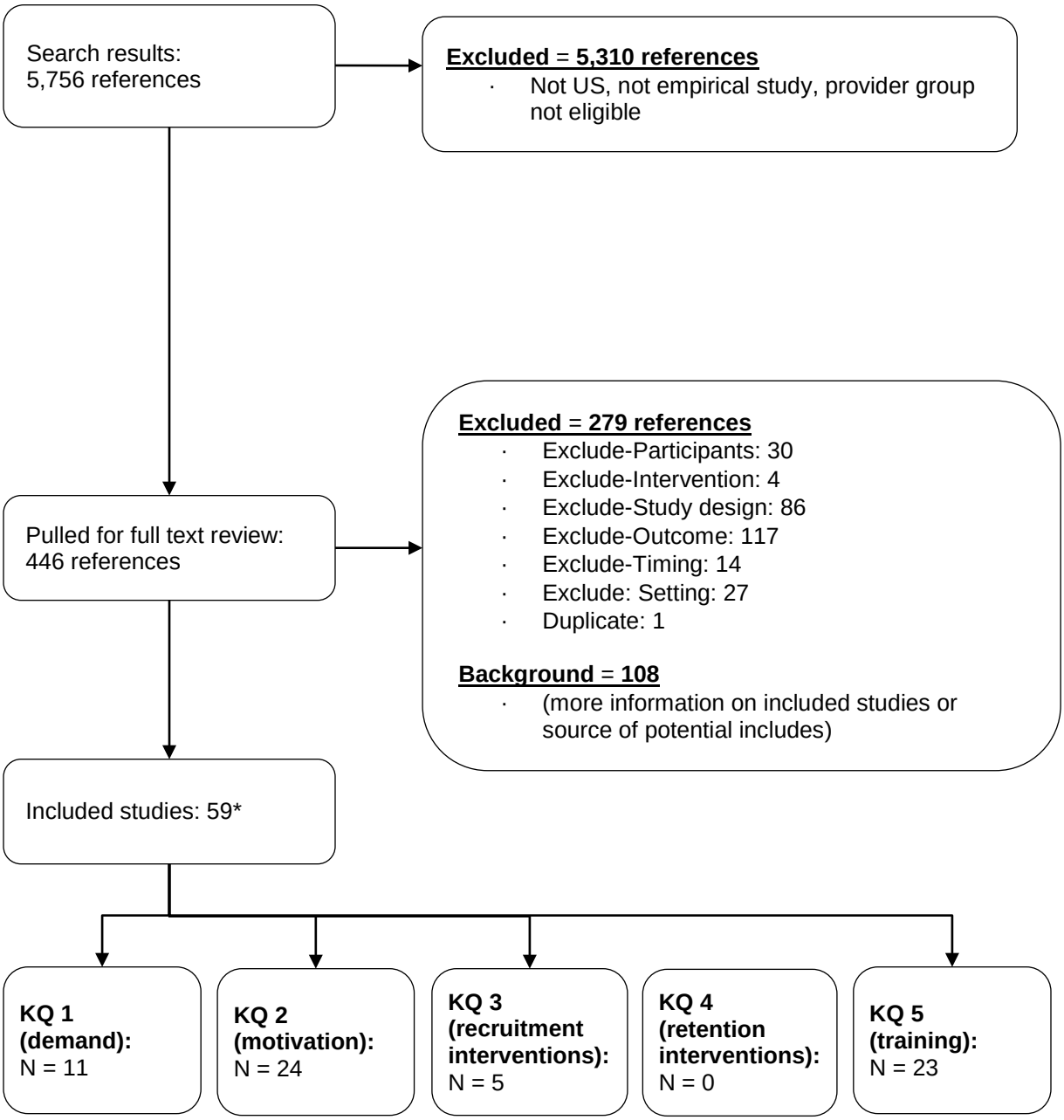
The identified research was summarized in a narrative synthesis.

LITERATURE FLOW

The literature review identified 5,756 potentially relevant citations. In total, 446 citations were obtained as full text. Of these, 59 publications met inclusion criteria, contributing to one or more key question. The flow diagram shows the number of identified studies through the literature search, studies meeting inclusion criteria, and the number of excluded studies with the reason for exclusion.

The publications not meeting inclusion criteria are listed in Appendix 2, ordered by reason for exclusion.

Figure 1: Literature Flow Chart



*Some studies address more than one key question.

KEY QUESTION 1: What are the current versus projected healthcare provider needs by numbers and disciplines in the next 20 years in rural areas?

The following evidence table (Table 1) summarizes all identified studies contributing to this key question with associated predictions of provider needs and study conclusions. Studies estimating current need are listed first, followed by 3 predictive studies.

Current Healthcare Provider Need

We systematically identified published studies investigating current healthcare provider demand and reporting specific estimates for the provider groups of interest. Identified studies used employer surveys,[47] state or national provider-specific files,[48-51] specialty-specific national provider membership rosters,[50,52] and existing data sets[1,52] to estimate current rural healthcare provider needs. Most studies reported on physicians[1,47-50,52] with one broadening to include allied health providers, advanced practice nurses, physician assistants or dentists,[47] and 2 reported on mental health professionals.[50,51] Provider groups consisted of family physicians and general practitioners,[1,47] psychiatrists,[47,50] psychiatric mental health advanced practice registered nurses (PMH-APRNs),[51] pediatricians,[47] emergency physicians,[47] obstetrics and gynecology or women's health providers,[47,52] and general surgeons[48,49]

When reporting provider need, results were presented as national unweighted or population-weighted estimates,[1,51,52] state-specific need,[47-49] county-level need[50] or reported vacancy rates.[47] Rurality was designated according to labor market regions,[47] state designation,[48] the US Office of Management and Budget's statistical area definition,[52] the US Department of Agriculture Rural-Urban Continuum Code (RUCC),[53,54] the Rural-Urban Commuting Area (RUCA) codes,[1,50] or were based on the National Center for Health Statistics (NCHS).[51] One study did not define rural.[49]

Predicted Future Healthcare Provider Need

We systematically identified published studies predicting future healthcare provider demand. Three identified studies used either state-specific physician provider files,[55] or existing national data sets.[53,56] Provider groups consisted of primary care physicians,[55] surgeons,[53] or emergency medicine physicians.[56] Predictive models reported tiered scenarios (best-case, worse-case, intermediate scenario),[56] population analysis algorithms,[53] or previously described models (*ie,* Health Resources and Services Administration [HRSA] model).[55] Metrics for assessing need were not standardized across studies; 2 studies reported national need in comparison to expected provider-to-population-based ratio[53,56] and one study reported county-based need for a state.[55]

Predictive time frames were 2005 to 2040[56], 2011 to 2030,[53] and 2005 to 2020.[55] Rurality was designated according to location outside of a county metropolitan statistical area,[56] RUCC,[53,54] or RUCA classification.[55]

Table 1. Evidence Table – KQ1 (Provider Need)

ID	Region Provider	Data Timeframe	Analysis	Definition of need Definition of rural	Results	Conclusion
Current Need						
Branch, 2014[47]	Alaska Allied health and ancillary services, counselors and behavioral therapists, nurses, physicians, and dentists	608 respondents (67%) out of 906 surveyed employers Timeframe: 2012	For each occupation, sample (unweighted) and population (weighted) estimates were calculated	Need: Estimated rural vacancy rates Rural: Labor market regions in Alaska, as defined by the Department of Labor: Anchorage (urban), Fairbanks (urban), Juneau (rural), Gulf Coast – Rural South Central (rural), North (rural), Rural Interior (rural), Rural Southeast (rural), and Southwest (rural).	Rural areas suffer from extreme shortages in traditional primary care occupations. Estimated rural vacancy rates were: family physicians (21%), family nurse practitioners (17%), physician assistants (19%), women's healthcare nurse practitioners (44%), psychiatric nurse practitioners (16%); psychiatrists (15%), emergency physicians (21%), general practitioners and family physicians (21%), pediatricians (16%). Estimated vacancy rates for general practitioners and family physicians in North (26%), Southwest (25%), Gulf Coast Rural Southcentral (18%), and Gulf Coast Rural Southeast (16%); all are rural regions	Alaska must address challenges inherent in developing and sustaining a high-quality and stable health workforce if it wants to maintain access to healthcare services and care for its residents far into the future. This can be accomplished by: 1) making long-term investments to prepare students in middle and high school for health-focused post-secondary programs, 2) developing and sustaining post-secondary programs to keep Alaskans here to study and practice, 3) examining laws and restrictions related to barrier crimes, alerting Alaska's youth to be aware of the career consequences of their actions, and 4) continuing to invest in state-based loan repayment and incentive programs for health providers to come to Alaska's rural communities to practice.

ID	Region Provider	Data Timeframe	Analysis	Definition of need Definition of rural	Results	Conclusion
Ghosh, 2011[51]	US Psychiatric mental health-advanced practice registered nurses (PMH-APRNs)	American Nurses Credentialing Center, listing of the employment ZIP codes of certified PMH-APRNs (N = 10,452) Timeframe: 2007	Geographical analysis of the distribution of PMH-APRNs	Need: Lower than expected number of providers, population-weighted Rural: Counties divided into 6 urban-rural categories on the basis of the 2006 National Center for Health Statistics (NCHS) classification scheme	A significant number of counties with low or very low concentration of PMH-APRNs were rural counties (N = 150). Among counties with very high cluster types (high concentration of PMJ-APRNs), a higher numbers of counties were from large central metropolitan (N = 35) and large fringe metropolitan areas (N = 80), emphasizing an uneven distribution of PMH-APRNs among urban and rural counties	The interdisciplinary approach, including both mapping and statistical analyses, identified shortage areas and provided the groundwork for directing future education, clinical practice, and public policy initiatives.
Hendryx, 2008[54]	Appalachian region in 13 states Mental health professionals: psychiatrists, clinical psychologists, clinical social workers, psychiatric nurse specialists, and marriage and family therapists	2005 Area Resource File merged with data from Bureau of Health Professions, US DHHS, HRSA. (N = 618 counties) Timeframe: 2005	Descriptive and bivariate analyses and a series of maximum likelihood logistic regression analyses	Need: HRSA-designated mental health professional shortage area Rural: Appalachian counties that were designated as nonmetropolitan according to US Department of Agriculture urban influence codes were selected, and metropolitan counties (code 1 or 2) were excluded.	Of the 268 non-metropolitan Appalachian counties, 69.8% were designated as mental health professional shortage areas, compared to 57.7% of non-metropolitan, non-Appalachian counties within the same states (p<.002)	Appalachian location is associated with mental health professional shortages, but this effect is driven by underlying social differences, in particular by lower education. This method of identifying Appalachia for comparative purposes may be applied to many other health services research questions and to other defined geographic regions.

ID	Region Provider	Data Timeframe	Analysis	Definition of need Definition of rural	Results	Conclusion
Maizel, 2009[48]	Maryland Surgeons	Maryland Board of Physicians licensing files for 2006-2007 and interviews with medical directors of 52 acute care hospitals Timeframe: 2006 to 2007	Clinical FTE per 100,000 residents	Need: Benchmark 6.4 practicing general surgeons per 100,000 residents Rural: western (4 counties), southern (3 counties), and eastern (9 counties) regions. Metropolitan: central (5 counties and Baltimore). Suburban: capital region (2 counties)	The number of surgeons providing care to patients per 100,000 residents was below reported requirements in general surgery (western: 6.5, southern: 3.28, eastern: 6.26; vs central: 6.15, capital: 4.02). Surgeons in rural areas spent 86.3% of their time on patient care, as compared to 70.3% of surgeons in urban, suburban, or teaching settings	Critical shortages of qualified surgeons currently exist in many regions of Maryland, especially in rural regions. Administrative, teaching, and research activities significantly reduce the amount of time surgeons are able to devote to patient care, particularly in academic and suburban settings. Fewer surgeons are available to care for patients in Maryland, and they are significantly older than assumed in manpower databases. Access to surgical care in Maryland will be jeopardized if these issues are not considered in future healthcare workforce discussions.
Rayburn, 2012[52]	US Obstetricians and gynecologists (ob-gyn) fellows and jr. fellows	2010 US County Census File for women of reproductive age and the 2010 ACOG membership roster Timeframe: 2010	Ob-gyn distribution was divided into 2 county groups and state data were categorized as density of ob-gyns by state and district	Need: Absence of ob-gyn; benchmark: 1 per 10,146 general population or 2.5 per 10,000 women Rural: US Office of Management and Budget's statistical area definitions	Density of ob-gyns declined from metropolitan to micropolitan and to rural counties. The mean population in counties with no ob-gyns was much lower than in counties with 1 or more ob-gyns	An uneven distribution of ACOG Fellows and Junior Fellows in practice exists throughout the United States and may worsen if resident graduates continue to cluster in metropolitan areas. Meeting the needs of women in underserved areas requires creative innovations in enhancing a more uniform geographic distribution of providers.

ID	Region Provider	Data Timeframe	Analysis	Definition of need Definition of rural	Results	Conclusion
Rosenblatt, 2010[1]	US Medical school graduates 1988-1997	2005 AMA and AOA Masterfile Timeframe: 2005	Cross-sectional analysis	Need: Relative shortage of rural compared to urban physicians Rural: ZIP code-derived RUCA code; urban, large rural, small rural, and isolated small rural categories	Relative shortage of physicians in rural areas remains: urban areas have 210 physicians per 100,000 people, isolated small rural areas have 52. Generalists represent 35.9% of all physicians in the US but account for almost half of all physicians in large rural areas, indicating rural areas rely on physicians for their healthcare. Specialty supply diminishes as areas become smaller and more remote	The precipitous decline in the number of US medical graduates choosing family medicine residencies, and the decline in the number of graduates from these residencies despite the importation of large numbers of international medical graduates, has led to increasing shortages of rural physicians and threatened the integrity of the rural healthcare system. Future projections of population growth suggest that the shortages will worsen unless the private and public sectors work together to change the dynamics that affect the choice of medical career and practice location.

ID	Region Provider	Data Timeframe	Analysis	Definition of need Definition of rural	Results	Conclusion
Stewart, 2013[49]	Texas General surgeons	Texas Medical Board, the US Census Bureau/ Texas State Library and Archives Commission, and the Texas Department of State Health Services Timeframe: 2002 to 2012	Unadjusted data and data normalized per 100,000 population for 2002 and 2012	Need: Benchmark standard: 7 general surgeons per 100,000 population Rural: N/A	From 2002-2012, the Texas population increased 21%, actively practicing physicians 44%,and general surgeons increased 4%. The number of general surgeons per 100,000 population decreased 14% (P<.01). In 2012, 329 additional general surgeons were needed by benchmark standards. When analyzed by county, 449 additional general surgeons were needed in the individual counties. Effects were greater in nonmetropolitan areas (per capita general surgeons decreased by 21%)	The absolute increase in Texas general surgeons over the past decade has not kept pace with an increase in the Texas population. The general surgery workforce deficit based on the Texas state population underestimates the local workforce shortage, particularly in the nonmetropolitan areas of Texas.
Thomas, 2009[50]	US, counties Psychiatrists, psychologists, advanced practice psychiatric nurses, social workers, licensed professional counselors, marriage and family therapists	Supply data compiled from professional associations, state licensure boards, and national certification boards Timeframe: 2006	County-level need measured by estimating prevalence of serious mental illness, combining separate estimates of provider time needed derived from National Comorbidity Survey Replication, US Census, and Medical Panel Expenditure Survey data; shortage measured for prescribers, nonprescribers, and a combination; ordinary least-squares regression identified county characteristics associated with shortage	Need: Shortage = % unmet need for mental health visits within county Rural: 9-point rural-urban continuum code	77% of counties had a severe shortage of mental health prescribers or non-prescribers, with over half their need unmet. 96% had at least some unmet need for prescribers. Rurality and per capita income were the best predictors of unmet need. A 1-point increase in rurality on the Rural-Urban Continuum Code corresponded to an increase in unmet need of 3.3% points	These findings identified widespread prescriber shortage and poor distribution of nonprescribers. A caveat is that these estimates of need were extrapolated from current provider treatment patterns rather than from a normative standard of how much care should be provided and by whom. Better data would improve these estimates, but future work needs to move beyond simply describing shortages to resolving them.

ID	Region Provider	Data Timeframe	Analysis	Definition of need Definition of rural	Results	Conclusion
Predicted Need						
Camargo, 2008[56]	US Emergency medicine physicians	2005 NEDI-USA Timeframe: 2005 to 2040	3 models (best-case, worst-case, intermediate scenario), Emergency Medicine Workforce Calculator (http://www.emnet-usa.org/nedi/workforce.html)	Need: Demand estimate accounted for attrition, demand = # ED visits in 2005 per 3,548 visits, assuming 1 emergency physician 24/7 coverage = 5.35 FTE Rural: Located in a county not in a metropolitan statistical area	A total of 40,030 emergency physicians were needed to staff all EDs (55% of demand met); 6,450 (16%) were needed in rural EDs and 33,580 (84%) in non-rural EDs	Supply of EM residency-trained, board-certified emergency physicians is not likely to meet demand in the near future; alternative emergency physicians staffing arrangements merit further consideration.
Williams, 2011[53]	US Surgeons (ob-gyn and general surgeons)	AHA's Fast Facts survey in 2008 Timeframe: 2011 to 2030	Population analysis algorithm; Census figure of 309 million in 2010 as a baseline for US population, 3,012 urban hospitals, and 1,998 rural hospitals	Need: Ratio: 7.5 general surgeons per 100,000 Rural: RUCA classification	From 2011-2030, rural hospitals will have to recruit an average of 3.4 ob-gyns, 1.6 orthopedics, and 2.0 general surgeons for a total of 7 FTEs. Urban hospitals have to recruit 10 ob-gyns, 6 general surgeons, 5 ear, nose, throat surgeons, 2.5 urologists,1 neurosurgeon, and 1 thoracic surgeon	Rural hospitals will be in competition with urban hospitals for hiring from a limited pool of surgeons. As urban hospitals have a socioeconomic advantage in hiring, surgical care in rural areas may be at risk. It is imperative that each rural hospital analyze local future healthcare needs and devise strategies that will enhance hiring and retention to optimize access to surgical care.

ID	Region Provider	Data Timeframe	Analysis	Definition of need Definition of rural	Results	Conclusion
Wilson, 2011[55]	Kentucky Primary care physicians	Kentucky Board of Medical Licensure, Area Resource File, US Census Small Area Health Insurance Estimates, Kentucky State Data Center, and National Resident Matching Program Timeframe: 2005 to 2020	HRSA model applied to Kentucky's 120 counties	Need: Physician Supply Model and Physician Requirements Model (HRSA) used to estimate need (preventive, acute, and chronic care) and demand (all healthcare services wanted) Rural: US Department of Agriculture's RUCC	1,527 additional primary care physicians are needed to meet projected needs and 1,888 additional primary care physicians are required to meet projected demands by 2020 in Kentucky. 43% of the population resides in rural communities	No single policy can solve the shortage of primary care physicians; therefore, multiple approaches must be used at the local, state, and national levels; a new system of care, patient centering, to reform the healthcare system is also suggested.

Note: ACOG = American Congress of Obstetricians and Gynecologists, AHA = American Hospital Association, AMA = American Medical Association, AOA = American Osteopathic Association, 95% CI = cconfidence interval, DHHS = Department of Health and Human Services, FTE = full-time equivalent, HRSA = Health Resources and Services Administration, NCHS = National Center for Health Statistics, NEDI = National Emergency Department Inventories, PA = physician assistant, PMH-APRNs = psychiatric mental health-advanced practice registered nurses, RUCA = Rural-Urban Commuting Area, RUCC = Rural-Urban Continuum Codes

Summary of Findings and Quality of Evidence for Key Question 1

The summary of findings table summarizes the results for current and future provider demand across the included studies.

Table 2. Summary of Findings – KQ1

Provider need	# studies	Results for rural health
Primary care providers	2	Isolated rural areas have one-quarter the ratio of physicians per capita[1] Rural areas in Alaska continue to suffer from extreme shortages in traditional primary care occupations[47]
Psychiatrists and mental health professionals	2	77% of counties in US had severe shortage of psychiatrists.[50] Rural areas of Appalachia more likely to be designated mental health professional shortage areas [54]
General surgeons	2	Critical shortage in rural areas of Maryland [48] Per capita general surgeons in Texas decrease 21% from 2002-2012; 449 additional general surgeons required in individual counties[49]
Ob-Gyn in rural areas	1	Rural areas currently underserved for ob-gyn based on national data[52]
PMH-APRNs	1	Analysis of lower than expected numbers of PMH-APRNs highlights the uneven distribution among urban and rural counties[51]
Primary care physicians	1	Approximately 1700 additional primary care physicians needed in Kentucky by 2020 [55]
Emergency physicians	1	16% of emergency physicians need to be recruited to rural locations; demand is unlikely to be met based on national data[56]
Surgeons (ob-gyn and general surgeons)	1	Rural hospitals need to hire 7 physicians (on average) by 2030 to compete with urban hospitals, based on national data[53]

Although we identified 2 studies reporting on primary care provider needs, mental health professionals, and general surgeons, the included studies quantified healthcare provider needs for specific regions and specific years, and operationalized provider need differently. Hence it is difficult to make concrete evidence statements for the number of healthcare providers needed across the studies. However, all included studies reported current unmet healthcare provider needs that worsen with increasing rurality. Based on the existing evidence base, our confidence is high that there is a shortage for primary care providers, mental health professionals, and general surgeons.

We only identified one study each reporting on obstetrics and gynecology physicians and psychiatric mental health advanced practice registered nurses. Both studies did not provide an estimate of how many providers are needed to meet demand but pointed to the absence of providers in rural areas and reported a decreasing density from metropolitan to rural counties.

We identified 3 studies estimating future provider demand. All included studies predicted unmet provider needs that worsen with increasing rurality. However, the identified studies reported on individual healthcare provider groups: primary care physicians, emergency physicians, and

obstetrics/gynecology and general surgeons. We did not identify more than one study reporting on the same provider group. The studies reported specific estimates of how many additional physicians are needed, but it is difficult to judge our confidence in the estimates in the absence of replication, in particular given the complexity of future demand estimates. However, all 3 studies concluded that the supply is not likely to meet demand, regardless of the individual provider group studied.

We did not identify any published estimates from VA datasets.

KEY QUESTION 2: What factors influence healthcare providers' geographic choices for practice?

We systematically identified studies investigating factors that may influence providers' geographic choices for practice with regard to rural healthcare. A large number of studies contributed to this key question. Some identified studies used provider surveys and self-reported reasons for selecting rural healthcare; other studies were qualitative analyses of in-depth interviews with a small group of healthcare providers; some studies used existing datasets to identify predictors of practicing in rural healthcare.

The large majority (19) of identified studies evaluated physicians, 3 studies explored the choices for practice in physician assistants, and one included a range of healthcare providers eligible for a loan repayment program. Some studies differentiated allopathic and osteopathic degrees, and several limited to primary care physicians, emergency department physicians, and general surgeons. All studies addressed reasons for choosing to practice in rural areas in the last 10 years, that is from 2005 onwards. Of those studies that limited their study to a particular year, 4 used a 2005 dataset,[57-60] 2 a 2007 dataset,[61,62] and 2 a 2009 dataset.[63,64] The other studies used other years or a range of years with data for practicing in rural care. The number of participants ranged from 8[65] to datasets with information on over 175,000[57] healthcare providers.

The majority of studies reported on practicing in rural care. Others investigated specific outcomes such as practicing in a rural satellite clinic, or practicing in a small town. Although a number of studies used an urban-rural continuum to differentiate practice locations, outcomes were analyzed dichotomously (*eg*, rural versus not). Definitions of "rural" referred to federal taxonomies such as RUCA codes, US Department of Agriculture county-based Urban Influence Codes, RUCC, and the Rural Office of Management and Budget designation, and state definitions, including the Illinois Department of Public Health designations of rural areas and the California Office of Statewide Planning and Development (OSHPD) definition of Rural Medical Service Study Areas. One study used the Rural-Urban Density Typology (RUDT) based on population density and 2 studies referred to a population of less than 50,000 people. Other studies used local definitions (*eg*, the Hawaiian island O'ahu was considered urban, all other areas rural) or did not define "rural."

The evidence table summarizes all identified studies contributing to this key question. We differentiated the dependent variables (*ie*, the predictors or named choices for choosing rural care) by demographic background factors, variables associated with the training of the provider, financial aspects and incentives, aspects of the rural area, and other relevant results. The evidence table also shows the authors' conclusions drawn from the study.

Table 3: Evidence Table – KQ2 (Provider Choice Assessments)

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Chen, 2010[57]	Clinically active MDs, DOs, and international medical graduates (IMGs) who graduated from medical school between 1987-1997 Practicing physicians	N = 175,649 Analytic study Rural: RUCA and county designations Outcome: Practicing in rural location in 2005	In 2005, 18% of DOs, 11% of MDs, and 13% of IMGs are practicing in a rural location. 31% of rural physicians were women (37% of MDs and 31% of DOs female). An increasing proportion of female physicians entered rural practice over the study period (7.8% to 9.8% female MDs, 12.2% to 17.7% female DOs). Overall, 94% of physicians were MDs and 6% DOs, but 18% of DOs and 11% of MDs practice in a rural care	Of the 1.4% MDs trained in rural residency, 36% were in rural practice. Of the 3.6% DOs trained in a rural residency, 50% were in rural practice. Rural residents were 3x more likely to practice in rural areas (RR 3.4, P<.001). Rural residents account for 5% of MDs and 10% of DOs in rural areas. 60% of rural family medicine residents were in rural practice and were 3x more likely to practice in rural care (RR 2.8, P<.001). Only 9% of rural family providers trained in a rural residency	N/A	N/A	N/A	The proportion and number of physicians entering rural practice has remained stable compared with earlier analyses. However, recent trends such as declining primary care interest are not yet reflected in these data and may portend worsening shortages of rural physicians.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
DHHS, 2006[66]	US 18 specialties	N = N/A Analytic study Rural: N/A Outcome: Working in rural area	Female physicians are less likely to work in rural areas	N/A	N/A	N/A	N/A	The growth and aging of the US population will cause a surge in demand for physician services; if current healthcare utilization and delivery patterns continue, the overall supply of physicians should be sufficient to meet the expected demand through the next 10 years.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Duffrin, 2014[67]	Current members of the North Carolina Medical Board who are listed as primary care physicians Primary care physicians practicing in family medicine, internal medicine, ob-gyn, general practice, and pediatrics	N = 975 Survey Rural: County of <50,000 people Outcome: Practicing in rural area and practicing physicians in 2012	Population of hometown =<11,000 was associated with working in non-metro area (p = .007, 1st subgroup)	N/A	Pay as a factor in choosing a work site, financial support from a hospital, and medical school loan repayment were correlated with rural practice (effect size not reported)	N/A		Federal and state incentives should continue; having been raised in an area of 11,000 or less was highly predictive of future rural medical practice and could be used in the recruitment of physicians and residents to increase the ultimate yield for rural areas.
Fordyce, 2012[58]	MDs and DOs from 2005 AMA and AOA Masterfiles Practicing physicians, non-federally employed, aged 70 years or younger	N = 231,660 Analytic study Rural: RUCA classification (urban, large rural, small rural, or isolated small rural) Outcome: Practicing in rural areas in 2005	IMGs comprised 22.2% of total clinically active workforce, but contributed 19.3% to the rural PCP workforce, some geographic variation. IMG PCPs were more likely than other PCPs to practice in rural persistent poverty locations (12.4% vs 9.1%). The proportion of rural PCP workforce represented by IMGs decreased with increasing rurality.	DOs comprised 4.9% of clinically active workforce but contributed 10.4% to rural PCP workforce, some geographic variation. DO PCPs were more likely than allopathic PCPs to practice in rural places (20.5% vs 14.9%). Proportion of rural PCP workforce represented by DOs increased with increasing rurality	N/A	N/A	N/A	DO and IMG PCPs constitute a vital portion of the rural healthcare workforce; their ongoing participation is necessary in addressing existing rural PCP shortages and handling the influx of newly insured residents as the ACA comes into effect.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Glasser, 2010[68]	Recently located rural physicians and graduates of a rural medical education program in rural Illinois	Interviewees (N = 20), graduates (N = 107) Other design Rural: Illinois Department of Public Health designations of rural areas Outcome: Practicing in rural county	Major reason for practicing in a rural location was family ties to the community (50%).	N/A	2nd major reason for practicing in a rural location was a loan or scholarship obligation (30%).	Top attributes potentially affecting retention were hard work/long hours (25%) and patients not paying enough or being uninsured (20%). Most positive factors were patients' appreciation (45%), lifestyle/ work-life balance (20%), and meeting individual and community needs (20%)	N/A	Keys to success in rural physician retention seem to include identifying and recruiting medical students of rural origin and focusing on a healthy practice environment; policy makers need to work with local government, schools and employers to offer programs to identify local youth for induction in rural healthcare.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Hancock, 2009[69]	PCPs practicing in rural northeastern California and northwestern Nevada PCPs	N = 22 interviewees Other design California OSHPD Rural Medical Service Study Areas (density <250 persons per square mile, no census-defined place >50,000) Outcome: practicing in rural areas in northeastern California and northwestern Nevada (2006-2007)	Rural exposure via upbringing and recreation, and a history of strong community or geographic ties facilitates future rural practice.	Rural exposure via education facilitates future rural practice	N/A	N/A	Exposure facilitates through desires for familiarity, sense of place, community involvement, and self-actualization	Results support a focus on recruitment of rural-raised and community-oriented applicants to medical school, residency, and rural practice. Local mentorship and ''place-specific education'' can support the integration of new rural physicians by promoting self-actualization, community integration, sense of place, and resilience.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Helland, 2010[70]	Emergency medicine residents who graduated from 2006 to 2008 and practice in rural EDs, and a random sample practicing in urban EDs. Emergency medicine physicians	N = 197 Survey Rural: Based on US Department of Agriculture county-based Urban Influence Codes Outcome: Practicing in rural EDs (graduated 2006-2008)	Rural practice location was associated with 18 childhood years in a rural area (42% rural vs 24% urban), but was not associated with 1 to 17 years or 0 years of childhood spent in a rural area. Important factors reported for choosing practice location included family/spouse (81% rural vs 72% urban) and previous time spent in similar area (61% rural vs 53% urban)	Emergency medicine board certification was associated with rural practice. Practice location was not significantly correlated with rural residency rotation. No difference was observed between rural vs urban providers reporting residency rotation as an important for choosing practice location. 25% of urban physicians considered practicing in a rural area immediately after graduation	Cost of living, salary signing bonus, and loan repayment were not rated as important. There was a significant difference in ratings between urban and rural providers for the importance of loan repayment	Important factors for choosing practice location included lifestyle (78%), but not access to CME, service to the underserved, autonomy/scope of practice, or access to specialists. 43% vs 56% of rural vs urban providers rated ED volume as very important; 53% vs 68% access to amenities/recreation	Rural and urban physicians reported similar plans for duration of practicing in their type of area for greater than 10 years (57% vs 60%) and for less than 2 years (6% vs 5%)	Promising strategies for recruiting new residency graduates to rural EDs are selection of individuals with a rural upbringing and higher salaries; increasing the availability of rural rotations during emergency medicine residency also may help to motivate and prepare some new graduates to practice in rural EDs.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Heneghan, 2005[71]	General surgeons practicing in the US General surgeons	N = 421 Survey Rural: OMB designation, Goldsmith modification Outcome: Difference in ratings between rural and urban surgeons	N/A	N/A	Reporting income as having a high impact on practice location was lower among rural surgeons (19.8% rural vs 36.1% urban, p = .0002)	The impact of potential for professional growth, availability of hospital facilities, quality of surgical community, and quality of medical community (all factors p<.001) on location preference were rated differently between rural and urban groups. Quality of life was not rated as an important factor	N/A	Although rural and urban surgeons do not differ in age or the importance of lifestyle in deciding career location, different factors do impact their choice of location; practice pattern and educational needs varied markedly between rural and urban general surgeons.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Henry, 2007[65]	Physicians assistants (PAs) in Texas who work autonomously in a rural health clinic, sole PCP in community for >24 months. Town with <5,000 persons, no other primary care within 25 miles. PAs	N = 8 Survey Rural: Town with < 5,000 people Outcome: Important factor influencing to work in a rural satellite clinic in 2005	Majority (7/8) did not grow up in small town. Confidence to practice without physician was an important factor influencing to work in a rural clinic	N/A	N/A	Desire for small-town life, importance of knowing patients on a personal level, and spouse value of small-town life influenced work in rural clinic	N/A	In order to increase retention rates, PAs committed to autonomous, rural primary care would benefit from additional training, particularly in emergency medicine, the benefits of community involvement, and adaptation to the local culture.
Hughes, 2005[72]	Family practice graduates from UCSF-Fresno residency from 1970-2000 with US high school addresses Family practice graduates	N = 178 Analytic study Rural: RUCA 7-9 (small towns), 10 (rural) Outcome: Practicing in rural areas	Rural high school location was significantly associated with practice in rural areas (OR 5.7, CI 2.0 to 16.4), controlling for high school in high minority areas, medically underserved areas, rural training track, age, gender, minority, and Hispanic ethnicity. 32% of graduates practicing in a rural location graduated from a rural high school, compared with 11% in a non-rural practice	Rural training during residency was associated with rural practice (OR 2.7, CI 1.2 to 6.4) when controlling for rural high school, minority % population of high school, high school in medically underserved area, age, gender, minority, Hispanic	N/A	N/A	N/A	Census data from the residency graduate's high school predicted rural practice and practice in a proportionally high-minority community, but not in a federally designated medically underserved area.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Jarman, 2009[73]	Surgery residents graduates of all 4 Wisconsin programs from 1994-2008 General surgeons and subspecialty surgeons who completed general surgery residency	N = 45 Survey Rural: Rural = population of <50,000 people Outcome: General surgery practice in rural location 1994-2008	Factors associated with rural vs urban practice included attending a nonurban high school (p = .001) or college (p = .001), location spouse/ partner grew up (p = .022), and having a child before/during medical school (p = .043). Graduates in an urban setting were more likely to have a parent with a medical occupation (p = .03). Practice location was not associated with sex, birthplace (US-only, rural vs non-rural), parental occupation, having a parent who grew up on a farm, participation in high school or college sports, participation in high school academic club, playing a musical instrument, listening to all types of music, being married, being married during college or before, or having children	Factors associated with rural practice included completing a rural clerkship (p = .001) and having chosen a surgical residency program committed to rural training (p = .046). Factors negatively associated with rural practice included completion of a fellowship (p<.001) and teaching surgical residents (p<.001). Practice location was not associated with clinical research during residency or bench research during residency	N/A	Factors positively associated with rural practice included interest in hunting birds (p = .010) or large game (p = .001). Graduates in rural practice more often cited "broad scope of practice" as an important reason. Practice location was not associated with current hobbies, fishing, hunting small game, happiness with location, spouse's happiness with location, or satisfaction with scope of practice		General surgery residency graduates and their spouses who choose rural practices are more likely than those selecting urban practices to have rural backgrounds and interests; completing a rural clerkship during medical school and choosing a residency program committed to rural general surgery preparation are strongly correlated with rural practice.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Kimball, 2007[74]	Female physicians practicing in rural Wisconsin Physicians	N = 10 Other design Rural: Wisconsin communities <16,000 people Outcome: Motivation to enter rural practice, reasons for choosing practice location	70% had a rural background. 60% stated they were always interested in rural practice. Reasons for choosing location included proximity to family (60%) or personal connection to area (60%). 60% stated that family obligations did not influence decision to practice in current community. Family obligations (10%) and spouse's job location (30%) influenced some participants	20% stated that their medical school had encouraged rural practice, 40% stated that it was discouraged, 40% stated that no specific practice location had been emphasized	N/A	Reasons for choosing practice included liking the community (60%), good access to specialist backup (20%), and full scope of practice (10%)	N/A	The participants provided insight into motivating woman to enter rural practice, finding a balance between the challenges and benefits of rural medicine, and promoting the future of rural healthcare.
Mason, 2012[63]	1990-1999 UMC graduates practicing in Mississippi (MS) from 2004 MS Board of Medical Licensure Physicians	N = 927 Analytic study Rural: N/A Outcome: Practicing in small town in 2009	Factors not associated: attended high school in MS, attending college in MS, internship in MS, began practice in MS, moved practice to MS, age, sex, race, or marital status	UMC graduates were not more likely to practice in rural areas in MS than physicians who graduated elsewhere. PCPs were 2.4 times (P<.001) more likely to practice in small town areas than specialists (controlling for all other factors)	Salary or student loan debt were not predictors of practicing in small towns (multivariate analysis).	N/A	N/A	Health educators and policy makers should consider broadening the enrollment policies and greater emphasis should be placed on recruiting physicians.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Pepper, 2010[75]	Physicians in Wyoming All MDs and DOs	N = 693 Survey Rural: 2003 Department of Agriculture RUCC codes 3 to 9 Outcome: Practicing in less-populated county in 2007	Being raised in a rural area was associated with practicing in a less populated county ($p < .05$) in a multivariate analysis. Living in Wyoming as a child ($p < .099$) and attending medical school in a bordering state ($p < .01$) was not significant. There was no association with gender, being raised in a bordering state, completing an internship or residency in a bordering state, or plans to move out of state	There was no association with medical school location	N/A	N/A	N/A	Rural backgrounds and training independently predict practice location decisions.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Phillips, 2009[60]	US allopathic medical students Physicians	N = 322,131 Analytic study Rural: RUCA codes Outcome: Rural practice in Rural Health Clinic (2001-2005)	Rural practice was strongly associated with being born in rural county (OR 2.35). Rural practice was associated with being male (OR 1.49), married (OR 1.47), age at graduation (OR 1.03). Rural practice was associated with plans to serve in underserved areas (RR 3.40)	Rural practice was associated with attending medical school in rural area (OR 2.93), career in family medicine (OR 2.65), as well as attending a public medical school (OR 1.66), community related medical school (OR 1.20), and experience in Title VII funded school (OR 1.11). Rural practice was associated with practice taking a rural (RR 1.9) or community health (RR 1.63) elective, family medicine clerkship (RR 1.44), experience with a Title VII school (RR 1.31), primary care residency (RR 1.22)	Rural practice was associated with NHSC loan repayment (OR 2.06), NHSC scholarship (OR 1.88), medical school debt $200-250K (OR 1.34), medical school debt $150-200K (OR 1.24), medical school debt $100-150K (OR 1.29), medical school debt $50-100K (OR 1.19), and medical school debt $1-50K (OR 1.06)	N/A	N/A	If rural–born students interested in serving the underserved also have rural training experience, it may have "multiples of effect". Schools, residency programs, and medical education funders should consider this. Schools should institute a series of interview questions about rural and other underserved patients and should give these weight in acceptance. They could also become markers for targeted mentoring and training experiences.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Rabinowitz, 2012[61,76]	MD graduates from Jefferson Medical College Physicians	N = 3006 Analytic study Rural: Rural county = 2007 Rural-Urban Density Typology (RUDT) Outcome: Practicing in rural area in 2007	3 predictors of rural practice (p<.001): growing up in a rural area, entering medical school with plans for rural practice, and entering medical school with plans to be a family physician. Of graduates with all predictors, 45% practiced in rural areas; of those with 2, 33%; of those with 1, 1%; and of those with 0, 12% practiced in rural areas. The RR for rural practice was 3.9 (CI 2.7-5.7, p < .001) for those with 3 predictors, 2.9 (CI 2.0-4.2, p < .001) for those with 2 predictors, and 1.8 (CI 1.2-2.8, p < .01) for those with 1 predictor. Medical students' specialty plans were strongly related to rural practice (p < .001)	N/A	N/A	N/A	N/A	Three factors known at the time of medical school matriculation have a powerful relationship with rural practice 3 decades later; relatively few students without predictors practice in rural areas, which is particularly significant given subsequent factors known to be related to rural practice – for instance, rural curriculum, residency location or spouse.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Renner, 2010[62]	Colorado Healthcare professionals that participated in loan repayment program	N = 93 Survey Rural: ZIP code with RUCA designation above and including 4.0 Outcome: Practicing in rural care in 2007	Rural providers were more likely to have gone to a rural high school than urban providers (38% vs 9%, p = .007)	N/A	58% reported that salary was an important factor. Signing bonus, amount of loan repayment, and other incentives were less important. 42% reported the loan program had an important influence on the specific community they chose to practice	Rural providers rated location (83%), scope of practice (79%), and family fit with community (73%) as the most important factors. School opportunity for children were rated less important for rural providers	N/A	Loan repayment programs targeting rural Colorado usually enroll providers who would have worked in a rural area regardless of loan repayment opportunities, but are likely to play a role in provider's choice of specific rural community for practice.
Schiff, 2012[77]	Physicians practicing in Hawaii who graduated from the University of Hawaii School of Medicine from 1993-2006. Physicians (all specialties)	N = 177 Analytic study Rural: O'ahu considered urban; all other islands rural Outcome: Practicing in rural settings in Hawaii (1993-2006)	Hawaii-schooled physicians who attended rural high schools were 9x more likely to practice in a rural location than those who went to high school on a neighbor island (p<.0001)	No significant association between rural practice and primary care specialty (p = .09)	N/A	N/A	N/A	If the State of Hawaii wants to expand the physician workforce in the rural areas of Hawaii, recruiting more students from rural areas is an excellent path to take.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Shannon, 2011[78]	Physician assistants in West Virginia who completed a rural rotation during clinical education Physician assistants (PAs)	N = 168 Analytic study Rural: ZIP code approximation of the RUCA code classification Outcome: Rural practice in West Virginia in 2005-2010	Using gender, school, student evaluation of rural field experience, change in interest in rural health, confidence in community activities, confidence in meeting the needs of rural populations, rural high school hometown, rural practice intent, likelihood of West Virginia (WV) practice, only the variables rural high school hometown and likelihood of WV practice correctly predicted rural practice; 77% of students who predicted rural practice were in rural practice, 63% who did not predict it were in rural practice (p<.04)	N/A	N/A	Confidence in community activities, and confidence in meeting the needs of rural populations, did not predict rural practice	N/A	This study suggests moderate predictive validity of PA student reporting on rural practice and on West Virginia practice intent; such methods may have potential in prediction of the future rural PA workforce.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Smith, 2012[64]	US PAs	N = 312 Survey Rural: < = 50,000 people Outcome: Rural setting for first practice in 2009	Respondents who graduated from a rural high school and singles were significantly more likely to practice in a rural setting (both p<.05). No significant difference between rural practice and degree, race, gender, and age at graduation. Support of and for significant other was the most important factor for first practice location	Specialty distribution (primary care, specialty, other) was significantly different between urban and rural groups (p<.05)	N/A	N/A	Six factors emerged from factor analysis: hours of work/ compensation, support of/for significant other, community and job amenities, educational resources /access to care, practice opportunities, and location	Respondents felt that support of and for the significant other was the most important factor in their first practice-location choice; recruiters may wish to pay closer attention to spousal opportunities and should not underestimate the impact of family in the decision about work location.
Snyder, 2014[79]	PAs actively practicing in Indiana who graduated from 2000-2010, and had email addresses available. PAs	N = 157 Survey Rural: Respondent-defined Outcome: Location of initial job, location of current job (2000-2010)	N/A	71% indicated educational dept had no influence on location of initial job	Males were more likely to perceive debt as influencing initial job location (χ^2 = 11.65, p<.05).	N/A	34% of urban PAs would have practiced in a rural area if they had received federal or state loan forgiveness for educational debt, 30% would have reconsidered.	This study provides evidence that debt may influence practice specialty and location choice. Further studies are needed to determine how gender might account for decisions to practice in certain specialties and location.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Stenger, 2008[80]	Massachusetts physicians practicing in areas of the state designated as rural from 2004-2005 Practicing physicians	N = 160 Survey Rural: Non-metropolitan county designated non-urban by RUCA or population < 10,000 and population density < 500 people per square mile Outcome: Practicing in rural area in 2004-2005	Most rural physicians (73.2%) had grown up in larger towns with populations of 10,000 or greater	N/A	N/A	Responses to why remaining in rural practice included feeling established with a strong sense of connection to patients and place, overall satisfaction with practice, and being in a great place to live	Factors associated with higher satisfaction included not feeling overworked (p = .043), or professionally isolated (p = .004), and being involved in practice (p = .045) and community (p = .036).	The findings reaffirm the importance of rural medical education opportunities in physician recruitment, retention, and practice satisfaction and indicate that a major source of physicians for rural and small town communities is physicians who have been raised in urban/suburban communities and who were trained outside of the region but who were prepared to live and to practice in rural and small town communities.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Whitacre, 2010[81]	Medical students at Oklahoma State University College of Osteopathic Medicine Medical students between 1997-2002	N = 190 Analytic study Rural: population < 50,000 Outcome: Rural practice location	Being raised in a rural area was associated with rural practice (p<.05)	Rural practice was associated with summer rural externship (p<.05), but not with all early clinical experiences	N/A	N/A	N/A	Programs implemented by an osteopathic school can influence where graduates choose to practice; programs taking place in both the 1st and 4th year of training have an impact on rural practice location, implying that students can be influenced both early and late in their medical school careers.

ID	Participants	N, study design, outcome	Results – demographic background	Results – training	Results – financial aspects	Results – rural care characteristics	Other results	Authors' conclusions
Zink, 2010[82]	Medical students at 2 University of Minnesota campuses that did or did not participate in a rural training program Medical students	N = 3,365 Analytic study Rural: OMB's definitions; communities not listed were considered metropolitan if within 50 miles of an urban center, otherwise designated as rural Outcome: Rural practice in 2008	In multivariate analysis, rural practice was associated with being raised in a rural community (OR 2.82, CI 2.1-3.79), but not with being raised in rural community and training in a rural program (OR.63, CI 0.35-1.15), or being raised in a rural community and Duluth campus (OR 0.56, CI 0.33-0.96)	Rural practice was associated with participating in a rural program (OR 4.62, CI 3.01, 7.07) and training at Duluth campus (rural focus) (OR 4.09, CI 2.81, 5.96)	N/A	N/A	N/A	RPAP and UMN-Duluth provide significant, complementary educational programs that lead more graduates to choose rural and primary care practices; efforts across the nation to address the crisis in rural primary care should build on these successful efforts.

Note: AMA = American Medical Association, AOA = American Osteopathic Association, CI = 95% Confidence interval, CME = Continuing medical education, DHHS = Department of Health and Human Services, DO = Doctor of osteopathic medicine, ED = emergency department, IMG = International medical graduates, MD = allopathic medical doctor, NHSC = National Health Service Corps, Ob-gyn = obstetricians and gynecologists, OR = odds ratio, OSHPD = Office of Statewide Health Planning and Development, PA = physician's assistant, PCP = primary care provider, OMB = Office of Management and Budget, RR = risk ratio, RUCA = Rural-Urban Commuting Area, RUCC = Rural-Urban Continuum Codes, UCSF = University of California-San Francisco

Summary of Findings and Quality of Evidence for Key Question 2

This section summarizes the relative importance of individual factors that have been assessed in more than one study. The predictors are documented in the order of provider characteristics, provider training, financial aspects, and setting characteristics. Most studies asked or obtained responses regarding the demographic background of healthcare providers currently practicing in rural care. Half the studies addressed the training of healthcare providers (*eg*, graduating from a rural track school). A third of studies addressed financial aspects such as debt. About as many studies addressed aspects of rural communities or aspects of rural healthcare (*eg*, access to support from specialists).

The number of studies shown in Table 4 reflects how many studies have addressed the predictor variable regardless of the direction and strength of association with the outcome variable (entering rural healthcare practice). The table differentiates positive associations and results suggesting no associations. Results from multivariate analyses that control for confounding variables are listed first, followed by other results.

The table also documents the quality of evidence (QoE) which influences how confident we are in making evidence statements based on the identified research. Key criteria were the number of available studies reporting on the variable of interest, confirmation in multivariate analyses, and conflicting results across studies.

Table 4: Summary of Findings and Quality of Evidence – KQ2

Predictor variable	# studies	Results and consistency across studies	GRADE
Proxy for rural background	16	Association Significant association with rural high school in multivariate analysis[72,78] Significant association with being raised in rural area in multivariate model[81,82] Significant correlation with nonurban high school or college[73] Significant difference between groups due to rural high school[64] Significant association with population of hometown[67] Qualitative analysis suggests rural exposure via upbringing[69] Significant difference due to rural childhood[70,77] 70% of rural providers had a rural background[74] Born in rural county increased odds (OR 2.65)[60] Being raised in a rural area was associated with practicing in a very rural area vs rural area in a multivariate analysis[75] A combination of growing up in a rural area, plans to practice in rural area, and plans for family medicine showed a positive association[61] Higher proportion of attending rural high school in rural vs urban providers[62] No association Majority of rural providers did not grow up in small town[65,80]	High
Gender	8	Association Being male increased odds (OR 1.49)[60] Slightly smaller number of female rural practitioners than in overall population[57] Conclusion female physicians are less likely to practice in rural areas[66] No association No association with gender in multivariate analysis[63,75,78] No difference by gender groups[64,70,73]	Very low

Predictor variable	# studies	Results and consistency across studies	GRADE
Family	7	Association Family ties reported as major reason[68] Family/spouse reported to be a very important factor[70] Significant association with location partner grew up in[73] Proximity to family listed as motivation[74] Significant association with having a child during or before med school[73] Conclusion that support of and for significant other is most important factor[64] No association Having children not associated with practice location[73] Family obligation did not influence decision[74] Job of spouse was rated as very important only by 28% of participants[62] Spouse's job location was cited by only 30%[74]	Low
Age	3	No association Age not associated with practicing in rural area [72] Age not associated with practicing in small town[63] Age at graduation not associated with rural setting for first practice[64] Age at graduation OR 1.03[60]	Low
Marital status	3	Association Singles were significantly more likely to practice in a rural setting as first employment[64] Being married increased odds (OR 1.47)[60] No association Being married was not associated [63,73]	Very low
Race, ethnicity	2	No association Practicing in small town not associated with race[63] Rural setting for first practice not associated with race[64]	Low
International medical graduate (IMG)	2	Association IMGs comprise 22% of the clinically active workforce but contribute 19% to rural PCP workforce[58] No association 13% of IMG compared to 18% DOs and 11% MDs are practicing in a rural location[57]	Very low
Exposure	2	Association Qualitative analysis suggests exposure via recreation facilitates future rural practice[69] Previous time spent in similar area was an important factor[70]	Low
Training			
Rural rotation in training or residency	10	Association Rural residency training showed an association in multivariate analysis controlling for rural upbringing[72] Rural programs increase odds in addition to being raised in a rural community[82] Rural residency trainees are 3x more likely to practice in rural areas[57] Interviews suggest that exposure via education facilitates rural practice[69] Rural clerkship and rural residency training were associated[73] Optional summer rural externship increases probability[81] Medical school in rural area OR 2.65, rural elective RR 1.53-1.93[60] No association UMC graduates were not more likely to practice in rural areas than physicians who graduated elsewhere[63] Medical school had discouraged rural practice for 40% of practitioners[74] No association with medical school location[75] No difference in rural rotation between rural and urban practitioners[70]	Moderate

Predictor variable	# studies	Results and consistency across studies	GRADE
Primary care and family medicine focus	4	Association Primary care physicians are 2.4x more likely to practice in small towns than specialists in a multivariate analysis[63] Rural family medicine residency graduates were 3x more likely to practice in rural care[57] Specialty distribution (primary care, specialty) was significantly different between rural and urban groups[64] Career in family medicine OR 2.65, family medicine clerkship RR 1.26-1.44[60] Career in primary care OR 1.06, primary care residency RR 1.22-1.79[60] No association No significant association with primary care specialty[77] Career in primary care OR 1.06[60]	Low
Osteopathic degree	2	Positive association 6% of workforce were DOs but 18% practice in rural care[57] 4.9% of the workforce but contribute 10.4% to rural primary care[58]	Low
Financial Aspects			
Student loan or scholarship	6	Association 2nd major reason was a loan or scholarship obligation[68] Medical school loan repayment was correlated with rural practice[67] NHSC loan repayment, NHSC scholarship, and debt increased odds[60] Significant difference in ratings between urban and rural providers for importance of loan repayment[70] Loan repayment program had an important influence on the community providers chose to practice for 42%[62] No association Student loan debt was not a predictor of practicing in small towns[63] The amount of loan debt was a less important factor[62] For 71%, educational debt had no influence on initial job[79]	Very low
Salary	5	Association Importance of income as a factor in practice location was different between rural and urban groups[71] 58% found the salary an important factor[62] Pay was correlated with selecting rural care[67] No association Salary was not a predictor of practicing in small towns in a multivariate analysis[63] Salary / signing bonus was rated as very important by only 24-28%[70]	Very low
Setting Characteristics			
Scope of practice	4	Association Broad scope of practice was cited as an important reason for general surgeons[73] Scope of practice was important to 71% for healthcare providers[62] No association Scope of practice was rated very important only by 30% of emergency department physicians[70] Full scope of practice was important to 10% female physicians[74]	Very low
Recreation activities	3	Association Access to amenities/recreation was rated as important for choosing practice location[70] Recreation activities were rated as important by 58%[62] Hunting birds and large game was associated with rural practice[73] No association Currently hunting or fishing, fishing, and hunting small game showed no	Low

Predictor variable	# studies	Results and consistency across studies	GRADE
		difference[73]	
Lifestyle, small town life	2	Association Lifestyle was rated as very important[70] Qualitative interviews identify desire for small town life as important[65]	Low

Provider Characteristics

Regarding provider characteristics, a large number of studies have investigated a rural background (17 studies, high QoE) and have overwhelmingly shown a positive association with this factor. The result was also found in 2 multivariate analyses which control for confounders, suggesting that the finding is not better explained by other, confounding variables. However, 2 studies pointed out that of the identified providers in rural healthcare, most did not grow up in a rural community.[65,80] We graded the evidence as high, despite the study design limitations and given that the factor cannot be analyzed in a strong research design such as RCTs.

Gender has been addressed in a number of studies but it remains unclear whether female healthcare providers are less likely to choose rural healthcare (9 studies, very low QoE). Study results were conflicting, may be confounded by changes over time, or may be provider group-specific.

Preferences of family, spouse, and children may be an important factor for choosing the geographic location (7 studies, low QoE). However, the existing evidence is somewhat conflicting, and the factor has not been addressed in multivariate analyses. Consequently, the relative importance of this factor, compared to rural upbringing for example, is unclear. There were conflicting results for marital status, with studies reporting increased odds, decreased odds, and no association (4 studies, very low QoE).

The association of provider race and ethnicity has been reported in 2 studies and both did not find an association. However, this is a common characteristic and a large amount of data may be available to answer this question which could not be considered (2 studies, low QoE of no association). Two studies investigated whether the country of origin of the healthcare provider can predict practice location but the evidence is unclear (very low QoE).

Two studies reported on the effect of exposure to rural areas, not specific to childhood experiences or provider training. Both suggested an association but the studies were not designed to quantify the strength of association and size of effect (low QoE).

Training

Regarding the effect of healthcare provider training on the geographic choice of practice, a large number of studies assessed the effect of rural tracks or a rural rotation as part of the healthcare provider training or medical residency (11 studies, moderate QoE). The choice to select a school with a rural track is likely to be influenced by an affinity to rural healthcare; however, 2 studies reported an association in addition to rural upbringing, lending support to the importance of this factor.[72,82] But it should be noted that not all studies documented an association. We only considered evidence here from studies that looked at more than one predictor of rural practice; the success of training approaches is documented in KQ5.

Other characteristics addressed in more than one study were a primary care and family medicine focus which was associated with greater odds of practicing in rural care (5 studies, low QoE). The direction of causation for this association is unknown. Finally, 2 studies reported on differences between allopathic and osteopathic degrees in medicine, highlighting that osteopathic providers represent a smaller proportion of the workforce but contribute proportionally more to rural healthcare, but the statistical significance was not reported (2 studies, low QoE).

Financial Aspects

Regarding financial aspects, student loans have been investigated in several studies; however, the results indicate that it may depend on who was asked (8 studies, very low QoE). Student loans may be important factors for some healthcare providers, but even a large proportion of loan recipients indicate that they would have chosen rural care regardless of the program. The effect of loan forgiveness programs on rural recruitment and retention are documented in the next section (*ie*, KQ3).

Salary has been addressed as a factor in a number of studies but it remains unclear whether pay is a deciding factor for choosing rural healthcare (5 studies, very low QoE). Existing research shows conflicting results and the relative importance of the effect is not known.

Setting Characteristics

As mentioned above, there were relatively few studies addressing rural healthcare setting characteristics and their influence on the choice of the practice location (4 studies). Most studies that addressed these aspects reported on the scope of practice. Results were conflicting across studies and it is unclear whether an expected broader scope affects the geographic choice (very low QoE). Identified studies addressed different healthcare provider groups and results may vary by provider group. Unfortunately, there is not more than one study available that reported on the same group. Hence, the effects are not replicated and we could not evaluate any systematic differences between provider groups.

Three studies reported on recreation activities and there was some evidence suggesting that this factor affects the choice of practice (low QoE). However, one of the contributing studies reported conflicting results within the study, with associations depending on the exact predictor variable.[73]

Finally, the lifestyle in rural communities has been investigated in 2 studies. Both reported a positive association with the choice for practice. The variable has not been assessed in multivariate analyses and the strength of association in not known (low QoE).

We did not identify any VA datasets.

KEY QUESTION 3: What interventions have been shown to increase rural healthcare provider recruitment?

This section describes the identified intervention evaluations directed at healthcare providers in rural communities. This includes programs for which healthcare providers that have completed their initial training period are eligible, rather than interventions exclusively designed for students and residents still in the process of completing their training. The evidence table lists evaluations of programs directed at recruitment as well as studies of programs directed at recruitment or provider retention in rural healthcare.

The included studies addressed effects of the J-1 visa waiver program and state-wide loan forgiveness programs. One of the evaluated programs addressed physicians,[83] one physicians and nurses,[84] and 3 a range of healthcare professionals including physicians, dentists, physician assistants, nurse providers, midwives, and mental health specialists.[62,85,86] All studies were post-only study designs with no historic or concurrent comparator. Three relied, at least in parts, on the responses of surveyed participants; the response rate ranged from 55 to 80%.

The J-1 Visa Waiver Program has been in place since 1994 and was expanded in 2002; it allows states visa waiver slots on an annual basis. The evaluation assessed the effects of the program on the state of Washington where selected physicians are obligated to work for an approved employer for 3 years for primary care physicians and 5 years for specialists.[83] The loan forgiveness programs were established to increase the number of healthcare providers in rural[85] or rural or underserved areas.[62,84] One study reported on all state-wide recruiting interventions for West Virginia.[86]

All evaluations assessed state-wide effects. Studies reported on the uptake of the program, the percentage of physicians fulfilling their obligation (*eg*, 3 years of practice at a designated site), and other results relevant to recruitment and retention.

The evidence table summarizes the studies and evaluated programs.

Table 5. Evidence Table – KQ3 (Provider Recruitment Interventions)

ID	Region Providers	Participants	Intervention	Study design Definition of rural	Recruitment results	Retention results	Authors' conclusions
Kahn, 2010[83]	Washington state J-1 visa waiver physicians	77 of 141 returned survey (response rate 55%); 155 physicians began J-1 waivers in Washington state between 1995 and 2003; addresses of 141 were located	Under the 1994 Conrad J-1 Visa Waiver Program (updated and expanded in 2002), each participating state is allocated 30 visa waiver slots annually to administer through its state health department. After states recommend physicians for visa waivers, these doctors are obligated to work for an approved J-1 waiver employer for the duration of their commitment period, which in Washington state is 3 years for primary care physicians and 5 years for specialists	Post-only study Rural: ZIP code Version 1.11 of RUCA Codes (based on 1998 Census commuting data and 1988 ZIP codes) to classify addresses and Version 2.0 (based on 2000 Census commuting data and 2004 ZIP codes) to classify the current work addresses of the 127 physicians we located; 10-point scale	155 began program, 68% practiced primary care; 37% completed their obligations in rural areas. Of these, 47% practiced in large rural cities/towns, 32% in small rural towns, and 21% in isolated small rural towns	Of 141 tracked physicians, 23% are still working for their assigned employer; of respondents who had completed commitments 84% remained longer than required (median 23, mean 25 months, range 0-120); the average RUCA rating for original J-1 waiver locations was 3.02 (higher numbers indicate more rurality), whereas the average current employment RUCA category was 1.51; physicians appear to have moved toward more urban areas (p<.001)	In Washington state, the Conrad Program has increased the number of physicians in underserved areas who frequently stay beyond their obligations. The significant movement away from rural areas for postobligation employment, however, highlights the long-term need to continue state efforts to recruit physicians to these areas.

No Author, 2007[85]	Minnesota Physicians, NPs, nurse midwives, nurse anesthetists, advanced clinical nurse specialists, physician assistants, dentists, pharmacists, allied health and nursing faculty, nurses	564 participants from 1990 to 2007, 405 surveyed, 73% response rate	In 1990, the Minnesota State Legislature created and funded a program to recruit physicians to practice in rural Minnesota. Since then the program has expanded to assist 564 practitioners in rural Minnesota or other high-need locations. After almost 17 years of operation and growing from an annual state appropriation of $320,000 to $1.295 million in 2007, the Minnesota Loan Forgiveness Programs have served over 300 healthcare facilities and educational institutions throughout the state. In the past 7 years, Minnesota has invested $7.789 million in the Loan Forgiveness Programs	Post-only study Rural: Designated rural sites for areas outside metropolitan counties (Hennepin, Anoka, Ramsey, Dakota, Washington, Carver, and Scott) and excluding Rochester, Moorhead, St. Cloud, Duluth, and Mankato	>240 responders have chosen rural or high-need settings in the past 8 years as a result of the program; 44% of respondents said it was important to very important in influencing their decision to choose primary medical practice (70% in 1999). Distinct decline in physician applications in 2007 (1/3rd fewer applications than 2006, > 50% reduction since 2003	86% of respondents continued medical practice at their sponsoring facility (placement site) after completing their service obligation	The Loan Forgiveness Programs are successfully meeting their program goals and increasing the number of healthcare providers and educators in rural Minnesota and specialty locations.

Renner, 2010[62]	Colorado Healthcare professionals (39% physicians)	97 respondents (response rate 80%)	Colorado health professional loan repayment program (CHPLRP): began in 1992, rewards physicians, dentists, PAs, NPs, certified midwifes and mental health specialists with up to $35,000 per year of educational loan repayment for working in any rural or urban HPSA in Colorado with minimum 2-year commitment. Colorado Rural Outreach Program (CROP): created in 1998, rewards all types of healthcare professionals (including but not limited to physicians, NPs, PAs, nurses, mental health services, dental health services, and allied health professionals up to $10,000 per year for educational loan for up to 3 years. Provider must work in a rural community in Colorado to be eligible and program requires 1 year service commitment. Dental Loan repayment program: began in 2002, provider must work with underserved populations in either rural or urban areas to be eligible	Post-only study Rural: RUCA ZIP code designation above and including 4.0	57% of respondents worked in rural communities. Of rural participants, 74% were working in or intended to work in an eligible community when they were made aware of the loan repayment program. Of those planning to work in a rural community regardless of loan repayment option, 42% reported the program had an important influence on the specific community they chose	Of the participants already working in rural communities, 38% reported loan repayment as being important to retention. Of rural participants, 22% cited the desire for a higher income as an important reason to leave their communities regardless of loan repayment	Loan repayment programs enroll providers who would have worked in a rural area regardless of loan repayment opportunities, but are likely to play a role in provider's choice of specific rural community for practice; they also appear to influence rural provider retention, though financial concerns are generally less influential for non-retained rural providers than are family preferences and professional dissatisfaction.

Wheeler, 2009[84]	Oklahoma Graduates of Oklahoma State University Osteopathic College	333	The Physician Manpower Training Commission (PMTC) was established by the Oklahoma state legislature in 1975 with the primary mission of increasing the number of physicians and nurses in rural and underserved areas of the state	Post-only study Rural: N/A	PMTC has provided financial assistance to 333 graduates, 30 graduates opted to repay the loan and terminated their contract, resulting in 303 program completers since 1978. Of all program completers, 83% continue to practice medicine in Oklahoma; 28% of these are practicing in rural areas of the state. 62% of alumni who participated in PMTC's funding programs are practicing in rural areas	51 program completers completed their contractual practice obligation but are either no longer in active practice or have left the state. For those whose obligated practice location was in a rural area, 84% are currently practicing in a rural location	Clearly, PMTC programs have been successful in the recruitment and retention of graduates to rural practice in Oklahoma.

Wheeler, 2013[86]	West Virginia Primary care physicians, sub-specialists, specialists, physician assistants, and family nurse practitioners	not defined	The Division of Rural Health and Recruitment administers several financial incentive programs: the National Health Service Corps loan repayment program (primary care physicians, physician assistants, nurse practitioners, certified nurse midwives, general and pediatric dentists, dental hygienists, behavioral healthcare providers, nursing faculty, and practicing nurses; 2-year service obligation); State Loan Repayment (10 providers per year; physicians, nurse practitioners, dentists, physician assistants, pharmacists; obligation to work 2 years in rural West Virginia; recipients eligible to reapply for additional 2 years); Recruitment & Retention Community Project (for facilities located in a federally designated MUA/MUP; one-year commitment, with the employer matching the award, for a total of $20,000.00); the J-1 Visa Waiver Program (communities unable to recruit a US citizen to provide healthcare are allowed to recruit a foreign physician); Recruitable Community Program (promoting volunteerism).	Post-only study Rural: West Virginia is the second most rural state in the nation, and the only state that is located entirely within Appalachia	Through these various programs, the Division of Rural Health and Recruitment has placed a total of 154 NHSC providers; 52 SLRP providers; 47 RRCP providers; and 94 J-Visa physicians since 2008	Currently, 80% of these providers have remained at their initial placement site upon completion of their obligation	The Division of Rural Health and Recruitment works diligently to alleviate some of those shortages and to strengthen the healthcare safety net in West Virginia, and utilizes the most up-to-date and relevant provider recruitment and retention strategies available.

RUCC = Rural-Urban Continuum Codes, RUDT = Rural-Urban Density Typology, RR = relative risk, OR = odds ratio

Summary of Findings and Quality of Evidence for Key Question 3

In addition to the small number of identified evaluations we did not identify studies reporting on the same outcome within the recruitment or the retention outcome category. Hence, no summary of findings table was completed and results are narratively described.

One of the identified evaluations was a J-1 visa waiver program evaluation on state level. Of all J-1 visa waiver placements in the study, about one-third were in rural areas. The J-1 visa evaluation reported that 53% of physicians did not complete their obligations. But of the respondents who had completed commitments, 84% remained a median of 23 months longer than required.[83]

The Minnesota loan forgiveness program highlighted that 86% of surveyed physicians continued medical practice at their sponsoring healthcare facility.[85] The Colorado program reported that 57% of respondents worked in rural communities. The evaluation also highlighted that 74% of J-1 visa waiver recipients were already working in or intended to work in an eligible community when they were made aware of the program. Furthermore, 38% of those working in rural communities reported loan repayment as being important to retention.[62] The Oklahoma assistance program reported that of those recipients whose obligated practice location was rural, 84% were practicing in rural areas and 28% of those who fully completed their service obligation were practicing in rural areas.[84] An evaluation of Virginia Division of Rural Health and Recruitment programs stated that 80% of placed providers have remained at their initial placement site upon completion of their obligation.[86]

We did not identify any VA datasets.

KEY QUESTION 4: What interventions have been shown to increase rural healthcare provider retention?

We did not identify any evaluation of a provider intervention that was exclusively directed at retaining fully-trained providers practicing in rural healthcare. All other intervention studies aimed at providers are included in the evidence table for KQ3 (interventions to improve recruitment, alone or in combination with improving retention). Studies examining interventions for providers in training are discussed in the KQ5 section.

Summary of Findings and Quality of Evidence for Key Question 4

Of the small number of identified provider intervention studies (see evidence table 5), some reported on the outcome retention. The J-1 visa evaluation and loan forgiveness programs reported that 80% or more of respondents remained longer than their required obligations, although only one study reported the duration.[83,85,86]

KEY QUESTION 5: What is the efficacy of current rural-specific resident and healthcare profession student training and education efforts?

This section documents the identified evaluations aimed at resident and healthcare profession student training. All identified studies are documented in the evidence table; the summary of findings section synthesizes results across studies.

Thirteen studies assessed the training of medical students, while 9 examined the training of residents, and one a combination. The most common resident specialties were family medicine and general surgery, with one study each examining residents in emergency medicine,[87] psychiatry,[88] and across all specialties.[89]

The majority of the included studies evaluated a single training program at one institution. Rabinowitz et al reported on multiple cohorts at the Jefferson Medical College, Pennsylvania.[90,91] One study reported on different programs at the University of Minnesota,[82] while another study reported the effect of different components of a program.[92] Total numbers of participants (including controls) ranged from 7[93] to 3,365.[82,94,95] The studies utilized internal records or internally distributed surveys for determining practice locations after graduation. Four studies used external records such as the AMA Masterfile or state licensure records.

The majority of training programs evaluated consisted of embedding a student or trainee in a rural community for all or part of their medical training. Experiences ranged in duration from 4 weeks[93] to 5 years.[96] Studies of individual training programs reported capacities ranging from 2[29,97] to 60[98] trainees per year.

Studies evaluating multiple training programs reported on sample sizes ranging from 123[99] to 322,131[60] participants. Few of these multiple-institution studies included details for the year of graduation or completion of training. The majority of these studies discerned practice locations from publicly available data such as the AMA Masterfile, while one study used data reported by the individual training programs examined [98] and one used a survey distributed by the authors.[87] Studies evaluated rural tracks across medical schools,[98,99] assessed resident training in Critical Access Hospitals or Rural Health Clinics, compared 3 different rural programs that combine preferential admissions of students likely to practice in rural areas with a rural curriculum,[91] assessed the effect of the expansion of medical schools on rural healthcare or Title VII funding,[100] evaluated rural rotations for emergency medicine residents,[87] and assessed which US medical schools provide physicians for the Appalachian region of the US.[101]

Most studies reported on the outcome of recruitment of graduated trainees to a rural area, and 5 studies reported on retention in these areas. One study reported only on matriculation of medical students from rural backgrounds.[100] In studies that formally defined "rural," the designation referred to federal taxonomies such as RUCA codes or RUCC. In 7 studies, the designation of an area as rural was determined by the training program or was not specifically discussed. Only 6 studies included a comparison or control group against which to compare outcomes, with the rest of the studies reporting only on the group of trainees undergoing the rural-specific training.

The evidence table summarizes all identified studies contributing to this key question. The table includes information about the training programs, outcomes, and the authors' conclusion from the study. The table lists single institution studies first, followed by evaluations across multiple training institutions.

Table 6. Evidence Table – KQ5 (Provider Training Evaluations)

ID	Location Capacity	Students N Data source	Program description	Study design Definition of rural	Recruitment results	Retention results	Other results	Authors' conclusion
Single-institution Program Evaluations								
Antonenko, 2009[96]	North Dakota University of North Dakota (UND) School of Medicine and Health Sciences Capacity: 1986-2008 = 44 residents	General surgery residents N = 44 Internal records	General surgery residency started in 1982, first graduates in 1986. ACGME-required rotations include anesthesiology, pathology, plastics, orthopedics, ears, nose and throat, and urology, pediatric surgery and trauma surgery as 4th-year residents; 1 month in each of first 2 years at Belcourt Indian Health Services Hospital on on the Turtle Mountain Indian reservation in central North Dakota	Post-only Rural: N/A	47% of graduates continue to practice in rural areas; of those pursuing fellowship training, 16% practice in rural areas (58% general surgeons who did not take fellowship training practice in rural sites)	N/A	N/A	The program continues to provide the best training consistent with the practice requirements of its graduates – particularly those who chose to practice in smaller communities and rural sites.

Bonham, 2014[88]	University of New Mexico (UNM) New Mexico Capacity: 60 residents from 1991-2010	Psychiatry residents N = 60, 37 responded to survey (62 % response rate) Internal database	The UNM Rural Psychiatry Residency Program (UNM RPRP) was developed in 1991 to improve residency education about rural mental health and to increase the number of psychiatrists in rural and underserved communities. All trainees participate in an 8-week seminar about rural mental health, cultural competence, and public mental health systems. 1/3 of residents elect to participate in community site visits in PGY-2 and PGY-3 years. During the PGY-4 year, residents work in community settings for 2 days a week throughout the year. Residents return each week to the university for didactics and to see their psychotherapy patients and supervisors. Participants receive sponsorship to attend the meeting of the Rural and Community Psychiatry Network of New Mexico. This network is designed to support efficacy and retention of providers in rural communities by reducing the experience of provider isolation. At the meeting, residents meet psychiatrists who	Post-only Rural: Metropolitan (continuously built-up areas of 50,000 or more), large rural town (10,000–49,999), small rural town (2,500–9,999), or isolated small rural area (outside of urban areas or urban clusters).	37% of program graduates were practicing psychiatry in rural communities compared to 10 % of the graduates in the traditional program. Of all graduates who were currently practicing in rural communities, 75% were practicing in large rural towns, 20% in small rural towns, 6% in isolated small rural areas	N/A	N/A	Purposeful and well-coordinated educational opportunities situated in rural community health clinics can address some of the barriers for recruiting and retaining psychiatrists in rural areas. Practical skill-building at the individual, agency, and system level is integral in training psychiatrists for work in these communities. In particular, the use of telepsychiatry emerged as an important practical application for the provision of rural mental healthcare.

			practice in rural communities and begin to build the personal and professional networks on which they will rely as professionals.					
Crane, 2014[102]	North Carolina Hendersonville Family Medicine Residency Program Capacity: 37 graduates from 1999-2010	Family medicine residents N = 37 Internal database	Rural-track training program to address the growing shortage of primary care physicians in rural North Carolina. Designed to develop successful rural health physicians	Post-only Rural: N/A	65% graduates practice in rural communities	N/A	60% work in a full or partial health professional shortage area	Rural-track training programs have generally been more successful than traditional family medicine residencies in placing graduates in rural or underserved practice settings. Our program contributes to improving access to care and new models of care and warrants further investigation in how training can be scaled to address North Carolina's continuing shortages of rural primary care physicians.

Crump, 2013[103]	University of Louisville, Kentucky Trover campus in Madisonville (ULTC) versus main campus in Louisville Capacity: 6-10 medical students per year	Medical students N = 1391 AMA Masterfile linked to medical school graduation list	After completing their first 2 years of basic sciences, students move to Madisonville and complete all required clinical rotations and most electives there or in the smaller surrounding communities. The small class size provides a personal connection between faculty and student. Students are based within a rural integrated health system with a 400-bed hospital staffed by 80 primary and secondary care physicians. The system includes 10 satellite clinics within a 30-min drive that are in towns of 4,000-8,000 that host portions of clinical rotations. Trover students participate in the same lectures as the Louisville students via live video connection and all curriculum elements, teaching materials, and evaluation systems are identical. Clinical rotations on the ULTC provide the opportunity for 1-on-1 learning with an experienced clinician preceptor. On ~1/3 of rotations, a family medicine resident is on the teaching service as well. All 3rd-year students regardless of	Comparative study Rural: RUCC, nonmetropolitan RUCC codes as a surrogate to identify rural/small-town practice	55% of ULTC graduates chose nonmetropolitan practices compared with to 9% of Louisville graduates (p<.001)	N/A	N/A	These data support the value of a small regional rural clinical campus in optimizing the affinity model to place rural students into rural practice. The ULTC students showed equivalent adjusted test scores and slightly narrowed the gap in unadjusted USMLE scores compared with the main campus students.

			rotation meet for small-group, problem-based learning sessions using the iterative process 2x/month. A longitudinal teaching skills program assists the community-based faculty in guiding the students through their required clerkships					
Deveney, 2009[29,97]	Oregon Health Sciences University Grants Pass, Oregon Capacity: 2 4th-year residents per year	General surgery residents N = 70 Internal results	Grants Pass has a population of 25,000 with a 125-bed hospital, residents are placed for a year-long 4th-year rotation	Post-only Rural: Site with population <50,000	Graduates are more likely to practice in a site of population <50,000 (p = .02) than graduates before the program	N/A	N/A	The need for more general surgeons who are prepared and willing to serve rural communities is well-recognized. Based on our experience over the past 7 years, we believe that residents will benefit from a training program that provides extensive exposure to procedures unique to a rural practice.

Glasser, 2008[68,104,105]	Rockford, Illinois Rockford, Illinois Capacity: 159 graduates from 1993-2007, typically admits 15-20 students	Medical students N = 216 Internal database	The curriculum is based on observations of other rural medical education programs. A key concept is the integration of clinical medicine and population health. PY1 topics: population-based approaches to rural healthcare, agricultural hazards and farm safety, health resources in rural communities, rural mental health issues, and community-based rural health research. PY2: chronic disease management, rural clinical cases discussion, complementary and alternative medicine, rural health issues, and community-oriented primary care (COPC). PY3: introduction to Community Project Resource Book and Community Structure Project, perspectives on practice location and practice arrangement decisions, ethical dilemmas, coding and optimized reimbursement, the IRB process, and COPC work sessions. In years 1 and 2, there are also field trips and special events (*eg*, "Southern Exposure;" the "No Harm on the Farm" tour; and the Illinois Rural Health Association meeting) to	Post-only Rural: RUCA	67% of graduates practice primary care in towns of 20,000 people or fewer or practice in communities classified as RUCA codes 4 and higher. 2010 publication reports 70% practice in rural area. 2013 publication reports 61% practice in towns of 20,000 people or less, with 23% practicing in towns of 5,000 or less, 56% practice in RUCA code 4 or higher areas	82% have stayed at their original practice site, 8 graduates with 3 or more years in primary care practice have relocated to rural communities	N/A	Our program can serve as a model at many levels, including recruitment, collaboration, curriculum, and retention. Future challenges include recruiting students from the growing number of rural minority populations, expanding the number of program slots, and integrating the program with other health professions to address the needs of rural populations.

			provide students with the opportunity to observe and participate in rural health communities and organizations. The course grades are part of the final medical school transcripts. The 3rd-year curriculum serves as preparation for the 4th-year, 16-week preceptorship in a rural community. Students select 1/25 rural communities. For each site, the local hospital has agreed to provide room and board for the student as well as a primary care physician to serve as preceptor.					

Kallail, 2010[106]	Kansas N/A Capacity: 14 students per year	Medical students N = 104 Internal database	Applicants must be Kansas residents with significant experience living in a rural Kansas community. They must demonstrate intellectual promise, the intention to practice medicine in rural areas of Kansas, and a commitment to service by exhibiting the dedication and compassion necessary to be a competent and caring physician. The application and selection process is similar to regular medical school admissions. The primary difference is that Scholars applicants interview after their undergraduate sophomore year and enter medical school 2 years later after successful completion of program requirements. Each program participant must demonstrate achievements in academic programs and a significant, informed interest in rural healthcare. Scholars are assigned a rural primary care physician mentor beginning in the junior year of college. The mentors are usually from Scholars' hometowns or nearby. Scholars shadow for a minimum	Post-only Rural: Based on population density (either frontier, rural, or dense rural)	63% of graduates practice in rural, non-metropolitan communities (11/12 in Kansas); of those in rural communities, 11 are family physicians, and 1 is a general surgeon	N/A	84% practice in either a rural or urban under-served community	As one component of the effort to provide physicians for Kansas, our program showed beneficial outcomes for attracting applicants who want to practice in rural or other medically underserved communities and who maintain that interest over the long process of medical education. The designation of medical school positions for 14 Scholars in Rural Health enhances the likelihood of success for maintaining a pipeline of physicians for rural Kansas.

			of 200 hours over the 2 years. They write 4 case reports and write a paper on a population-based, community health issue.					
Mason, 2012[63]	Mississippi N/A Capacity: N/A	1990-1999 UMC graduates practicing in Mississippi N = 927 Mississippi State Board of Medical Licensure	University of Mississippi Medical Center (UMC) is the only medical school in the state and Mississippi is one of the most rural states in the nation; about half of new practicing physicians come from UMC's graduating classes	Post-only Rural: N/A	UMC graduates are not more likely to practice in rural, small towns, or geographically isolated areas in Mississippi than physicians who graduated elsewhere	N/A	Primary care physicians are 2.4 times (P<.001) more likely to practice in small town areas than specialists, all else being equal	Health educators and policy makers should consider broadening UMC's enrollment policies and greater emphasis should be placed on recruiting physicians.
Nash, 2008[93]	University of Texas (UT) Medical Branch at Galveston Weimer, Texas (138 miles from university) Capacity: 2-3 residents	Family medicine residents N = 7 Internal records	UT Galveston implemented a rural training track (RTT) in 1998. Residents spend 4 weeks living and working in a rural Texas community supervised by clinical family physician faculty. In 2000, the RTT was expanded to a longitudinal rural curriculum (spending 28 weeks in rural communities)	Post-only Rural: N/A	86% of graduates entered practice in rural areas	N/A	N/A	Although the program is small, the RTT has shown proportionally impressive success with graduates choosing rural practice in Texas.

Quinn, 2011[92]	University of Missouri School of Medicine Rural communities in Missouri Capacity: Preadmission program: up to 15 students/year. Summer Community Program: 20 to 30 students/year. Rural Track Clerkship: 20 to 35 students/year. Rural Track Elective: 5 to 7 students/year.	Medical students in their 2nd-4th years N = 344 MUSOM Alumni Association database, the National Residency Match Program, and the American Board of Medical Specialties, as well as information gleaned from Internet searches and from personal correspondence with program participants	The program has 4 facets: 1. Preadmissions program for rural students (Rural Scholars). A cooperative effort between 6 designated institutions and the MUSOM, designed for students from rural backgrounds. Rural Scholars are accepted into the MUSOM, conditional on academic achievements, professional conduct, and participation in required activities. Program activities include biannual retreats, mentoring relationship with a rural physician, and community service. Rural Scholars also participate in the Summer Continuity Program, the Rural Track Clerkship, and the Rural Track Elective. 2. Summer Community Program for rising 2nd-year students. Students work closely with physicians practicing in smaller communities for 4-8 weeks. 3. Rural Track Clerkship (RTC) Program for 3rd-year students. The RTC Program offers all 3rd-year medical students the choice of completing 1-3 of their 7 required	Post-only Rural: RUDT, population density thresholds of the US Census Bureau's classification system, Office of Management and Budget's urban population nucleus requirements, and other criteria to classify counties as "rural," "mixed rural"	Preadmission Rural Scholars program: 50% report first practice location to be rural or mixed rural. Only in the Rural Track Clerkship: 64% first practice location rural or mixed rural. Rural Track Clerkship + Summer Continuity Program or Rural Track Elective: 56% first practice location rural or mixed rural; Any aspect of the Rural Track Pipeline Program: 57% first practice location rural or mixed rural	N/A	N/A	The longitudinal program successfully recruits students for rural and primary care practice to address the healthcare needs of Missouri.

			core clinical clerkships in rural training sites. Students live in the community while completing their clinical rotations. 4. Rural Track Elective Program for 4th-year students. Medical students may choose to complete a variety of required monthlong primary care or specialty electives at 1 of 10 community-based rural clerkship sites. Beginning with the graduating class of 2013, Rural Scholars are required to take at least 1 elective.					

Rabinowitz, 2011[90,107]	Jefferson Medical College - Pennsylvania 3rd-year family medicine clerkship in rural location, and senior outpatient subinternship in family medicine Capacity: 104 PASP graduates between 1992 and 2002	Medical students in Jefferson Physician Shortage Area Program (PSAP) versus those that did not participate in PSAP N = 2394 Jefferson Longitudinal Study (JLS) of Medical Education database from 1992-2002; 2007 alumni database	PSAP initiated 1974 at Jefferson Medical College. Recruits and selectively admits medical school applicants who have grown up in a rural area and who are committed to practicing family medicine in a rural area, especially Pennsylvania. During medical school PASP students have a family physician faculty mentor, take required 3rd year family medicine clerkships in a rural location, take their senior outpatient subinternship in family medicine (usually rural location) and receive a small amount of additional financial aid (usually in form of repayable loans). On completion of medical school, PSAP graduates are expected to complete family medicine residency and practice family medicine in a rural location of their choosing, although no formal mechanism exists to ensure compliance.	Comparative study Rural: Rural-Urban Density Typology (RUDT), % rural or urban, population in urbanized areas, population density Alternate definition: rural counties are those where less than 50% of the population live in an urbanized area (*ie*, a densely settled territory with 50,000 or more people)	43% of PSAP graduates were currently practicing in a rural area (compared to 15.8% of non-PASP graduates, RR 2.7, CI: 2.1-3.5, p < .001). PSAP graduates were almost 10x more likely to combine family medicine with practice in a rural area (32.0% vs non-PSAP peers 3.2% (RR 9.9, CI 6.8-14.4; p < .001); > 1% of PSAP graduates were practicing in 18 of the state's 48 rural counties, whereas no rural county had even 0.3% of non-PSAP graduates	N/A	When applying the secondary definition of rural, the pattern of results were similar; but the absolute % were lower. Women PSAP graduates were >2x as likely as non-PSAP women graduates to practice in rural areas (RR, 2.6; CI, 1.6–4.2), similar to the PSAP impact on men	Despite major changes in healthcare in recent decades, Jefferson's PSAP continues to represent a successful model for substantially increasing the supply and distribution of rural family physicians. Especially with the forthcoming expansion in health insurance, access to care for rural residents will require an increased supply of providers. graduates.

Rabinowitz, 2013[108,109]	Jefferson Medical College, Philadelphia, PA N/A Capacity: 1937 graduates from 1978 to 1986	Jefferson medical school graduates N = 1937 graduates from 1978 to 1986 Jefferson Longitudinal Study	The Physician Shortage Area Program (PSAP), which began in 1974, recruits and selects medical school applicants that have grown up or lived in a rural area or small town for a substantial portion of their life after college and who were committed to practicing family medicine in a similar area. During medical school, PSAP students received faculty mentorship and career support and they completed their required 3rd-year, 6-week family medicine clerkship in a small town. During their 4th year, most PSAP students took a preceptorship in a rural location. Upon graduation, PSAP students were expected to take a family medicine residency and practice family medicine in a small town or rural area, although there is no mechanism to ensure compliance.	Post-only Rural: County not designated as a standard metropolitan statistical area	N/A	Of 37 PSAP graduates who originally practiced rural family medicine, 70% were still practicing family medicine in the same rural area (compared with 46% of non-PSAP graduates) (p = .02)	N/A	This study provides additional support for the substantial impact of medical school rural programs, suggesting that graduates of rural programs are not only likely to enter rural family medicine but to remain in rural practice for decades.

Ross, 2013[110]	Klamath Falls, Oregon Cascades East Family Medicine Residency Program; Sky Lakes Medical Center Capacity: 76 residents completed training from 1994 - 2009.	Family medicine residents N = 76 graduates sent survey. Response received from 62 (> 82% response rate) Survey	3-year family residency training program in Klamath Falls (population ~42,000) at 96-bed, nonprofit community hospital (only Oregon residency program outside metropolitan Portland area). AAFP notes this training site to be the most rural and remote training site in the nation and it is supported by the smallest community hospital. The program's main goal is to produce full scope of practice family physicians to enter rural practice	Post-only Rural: Rural practice = populations <25,000, >25 miles from major centers	60% of graduates initially enter practice in communities of <25,000 population and 45% practice in towns of <10,000; 63% of graduates first practiced in HPSAs	37% remained in very rural locales of <10,000 population; 50% of all graduates since 1994 remain in rural settings; 52% of graduates that first practiced in HPSAs remain in those areas, with 45% delivering care at FQHCs or RHCs	Of 25 graduates who practiced in >1 location since graduation, 18% moved to larger centers, 11% moved to towns of the same size, and the remaining 11% moved to smaller population centers	Family medicine residency programs of 3 years duration, located in small community hospitals, would seem to be ideal settings for training future rural physicians. The outcomes substantiate this conclusion and show that rural residency graduates tend to serve small communities, often the one where they first enter practice, for an extended period.

Whitacre, 2010[81]	Oklahoma Oklahoma State University Capacity: N/A	Medical students N = 190 Internal data	Osteopathic school program designed to promote rural location: Summer rural externship (optional) – observe local physician 30-35 hours per week during summer following 1st year of medical school. Early clinical experience (optional) – 5-day tour of different physician offices across the state. Community clinical clerkship (mandatory) – 1-month rotation during 3rd year in medical school. Rural clinic clerkship (mandatory) – 1 month rotation during 3rd year in medical school. Community hospital rotations (mandatory) – 2 months during 4th year of medical school.	Post-only Rural: Community with population <50,000	30% of graduates chose to practice in a rural location. In regression models, the optional summer program increased probability of locating in a rural area by about 24%	N/A	N/A	Programs implemented by osteopathic school can influence where graduates choose to practice. In particular, programs taking place in both the 1st and 4th year of training have an impact on rural practice location.

Zink, 2010[82,94,95]	University of Minnesota; Duluth and Twin Cities campuses Minnesota Capacity: Duluth average class size = 60 students; RPAP average class size = 33 students	Medical students N = 3365 RPAP and Duluth internal database matched to AMA Masterfile	Duluth Campus: During the 1st year of medical school, each student is assigned to a practicing family physician. Students meet with their preceptors 10x per year. Sessions expose students to the variety of activities (*eg*, hospital rounds, clinic practice, nursing home rounds). At the end of the 1st year and again for 3 sessions during the 2nd year, students live with a rural preceptor and his or her family for 3 days and are exposed to the physician's everyday working environment and lifestyle. These communities are located in Minnesota and western Wisconsin, and many are contiguous to or located in medically underserved areas. Faculty meet with students 3x/year to discuss the students' experiences. RPAP (Rural Physicians Associates Program) Students spend 9 months in a rural community under the mentorship of a primary care preceptor. RPAP developed its training model in the early 1970s. Students experience the full scope of primary care and	Comparative study Rural: Office of Management and Budget's definitions of metropolitan and nonmetropolitan populations. Communities that were not listed were considered metropolitan if within 50 miles of an urban center, otherwise designated as rural	43% of RPAP graduates are in rural settings and 28% of Duluth campus without RPAP. Logistic regression demonstrated that the RPAP (OR 4.62 (3.01-7.09, p<.001)) and UMN–Duluth (OR 4.09 (2.81-5.96, p<.001)) experiences are additive for the outcome of graduating students who chose rural practice	N/A	N/A	RPAP and UMN–Duluth provide significant, complementary educational programs that lead more graduates to choose rural and primary care practices. Efforts across the nation to address the crisis in rural primary care should build on these successful efforts. Both are achieving their missions, and the programs are complementary.

			become part of the small-town community. They follow patients over time, acquire hands-on experience, and complete specialty rotations. In recent years, online learning modules and class discussions fostering connectivity and learning across sites were incorporated.					
Evaluations across Multiple Training Institutions								
Baker, 2012[101]	West Virginia N/A Capacity: N/A	Medical school graduates practicing in Appalachia N = 44,894 2009 AMA Masterfile	US medical schools providing physicians for the Appalachian region of the US	Post-only Rural: rural or urban according to 1999 federal metropolitan and nonmetropolitan designations	10 schools produced 50.5% of all US medical school graduates from these years who practiced primary care in rural Appalachian counties. The West Virginia School of Osteopathic Medicine ranked 1st, followed by the University of Pikeville Kentucky College of Osteopathic Medicine and the University of Alabama School of Medicine. 6/10 are located not just in Appalachian states but actually in Appalachian counties	N/A	N/A	Physicians practicing in Appalachia are largely graduates of medical schools in or near the region. New schools being developed in the region may help reduce its continuing physician shortages.

Deutchman, 2013[98]	35 US medical schools with established rural tracks or rural tracks in development, 38 rural track Capacity: The number of students participating in each RT ranges from 4-60, with the majority representing 5% to 10% of each class at that institution.	MD and DO students N = N/A Information collected and provided by each Rural Track program	Rural tracks (RT) commonly employ curriculum elements across all years of training. These elements serve to expose students to rural-related healthcare topics in years 1 and 2, provide early and lengthy rural clinical experience, and form a social network with other like-minded students and faculty. Clinical clerkships in rural communities take a variety of forms within each RT. Some students go for a year or more to a rural site that serves as a branch campus. More commonly, students spend several months in 1 rural location either rotating among physicians or with one main clinical faculty member or group. These longer experiences integrate the learning objectives of several formerly separate clerkship topics in a longitudinal model.	Post-only Rural: Defined by presence of Rural Track site	The 18 programs that have been able to track students' practice locations report that an average of 44% of their graduates practice in a rural area (range: 20-73%)	N/A		Based on the findings and lessons learned in this report it would be helpful for RTs to track and report standardized parameters. This, in combination with knowledge of admissions and curriculum information, will help define and refine best practices for education of the future rural physician workforce.

Patterson, 2013[99]	Multiple family medicine residencies with Rural Training Tracks supported by the RTT Technical Assistance Program Multiple Capacity: The 18 RTTs in this study each graduated an average of 1.5 physicians per year.	Family Medicine residents N = 123 Survey of RTT Programs, AMA Masterfile, American Board of Family Medicine, and Centers for Medicare and Medicaid Services.	The "1-2" family medicine rural training track (RTT) model combines 1 year of urban training with 2 years of rural training	Comparative study Rural: ZIP codes	72% of graduates began clinical practice in rural areas (2-3x the proportion of family medicine residency graduates overall)	3 years after graduation: some migration away from rural (60.6% of graduates in rural areas)	N/A	RTT programs continue to succeed in recruiting and preparing family physicians for practice with rural and underserved populations.

Phillips, 2009[60]	US Allopathic Medical Schools US Capacity: N/A	Medical students N = 322,131 Medicare outpatient institutional claims filed from Rural Health Centers (RHC), and rural primary care hospitals.	Since 1976, DHHS Title VII funding has provided substantial support for Family Medicine educational programs at medical schools in many states. These curricula focus on development of primary care physicians who would care for urban and rural underserved populations	Post-only Rural: RUCA Code	Title VII-funded school experience increases likelihood of rural practice (OR 1.11, sign.) but not Title VII-funded residency (OR 0.90, sign.) Relative likelihood of association between Title VII funding and practice in rural area (RR 1.31, sign.) and practice in rural health center (RR 1.20, sign.). Practice in rural area associated with predoc Title VII training funding (RR 1.39, sign.) and matriculated in Title VII funded school (RR 1.31, sign.).	N/A	N/A	Title VII funding has languished over the last decade and is due for reauthorization. There is overwhelming evidence, confirmed in this study, of the beneficial effects associated with this small federal program.

Phillips, 2013[89]	American Board of Family Medicine, Washington D.C. N/A Capacity: N/A	Residents who trained in Critical Access Hospital (CAH), RHC, or FQHC between 2001-2005 and compared to practice location in 2009 N = 3,430 Medicare claims 2001-2005, 2009, 2011 AMA Masterfile	RHC: nonurbanized area, MUA, HPSA, or GDSA, NPs, CNMs, or PAs at least 50% of the time the clinic is open, nonprofit or for profit, sliding fee schedule optional, provider productivity standard, cost-based Medicare, Medicaid prospective payment system. FQHC: MUA or MUP, tax-exempt nonprofit or public, Board of Directors, majority from community served, sliding fee schedule (must), provider productivity standard, FTCA malpractice coverage, Comprehensive Services requirement, cost-based Medicare, Medicaid, eligible for federal grant support. CAH: rural area, more than 35 miles from nearest hospital (15 in mountainous areas), 24-hour emergency care, 25 or fewer beds, average stay 96 hours or less, cost-based Medicare. [MUA: medically underserved area; GDSA: governor-designated shortage area; MUP: medically underserved population; FTCA: Federal Tort	Post-only Rural: N/A	52.6% of the residents who trained in a CAH, 38.1% who trained in an RHC, and 31.2% who trained in an FQHC practiced in a safety net setting in 2009. Of CAH trainees, 40.9% remained in CAH, of RHC trainees, 10.4%, and, of FQHC trainees, 12.5%	N/A	N/A	Using Medicare claims data, the authors identified residents who trained in safety net settings and demonstrated that many went on to practice in these settings. They recommend that graduate medical education policy support or expand training in these settings to meet the surge in healthcare demand that will occur with the enactment of the Affordable Care Act insurance provision in 2014.

			Claims Act]					
Rabinowitz, 2012[91]	Jefferson Medical College; Pennsylvania Jefferson Medical College, Pennsylvania; University of Minnesota-Duluth campus; University of Illinois Rockford campus Capacity: Jefferson PSAP average 12.1 grads per year; Duluth average 42.9 grads per year; RMED average 14.7 per year	Graduates of 3 rural-specific training programs N = 1,757 RP graduates versus 6,474 IMGs 2010 AMA Masterfile information on graduates from 3 rural programs and compared to practicing IMGs	3 long-standing and successful rural programs (RPs) that include preferential admission of students likely to practice in rural areas as well as having a required rural curriculum: the Physician Shortage Area Program (PSAP) of Jefferson Medical College of Thomas Jefferson University; the University of Minnesota Medical School Duluth (UMD, a 2-year program where students take their final 2 years at the University of Minnesota Minneapolis); and the Rural Medical Education Program (RMED) at the University of Illinois College of Medicine at Rockford	Comparative study Rural: RUDT, practicing in a nonmetropolitan county according RUCC	63% of graduates practicing in a rural area (IMGs: 26.5% were in rural areas)	N/A	Although there were almost 7x as many IMGs as RP graduates, the absolute number of RP graduates practicing rural family medicine was 1.5x greater than IMGs	Despite their relatively small size, RPs had a significant impact on rural family physician and primary care supply compared with the much larger cohort of IMGs. Wider adoption of the RP model would substantially increase access to care in rural areas compared with increasing reliance on IMGs or unfocused expansion of traditional medical schools.

Shipman, 2013[100]	N/A N/A Capacity: N/A	US medical school graduates N = 1999-2001: 48,862, 2009-2011: 56,276 American Medical College Application Service for 2 time periods	Comparison of US medical school graduates prior to expansion (1999-2001) to a period 10 years after expansion (2009-2011); in 2006, AAMC had called for a 30% increase in MD-granting medical school enrollment by 2015	Pre-post RUCC to classify the county as nonrural (codes 0-5) or rural (codes 6-9)	Schools with higher growth rates were more likely than schools with lower or no growth to produce graduates practicing in rural areas, range between 5.6 and 8.6% (p<.001)	N/A	Despite expansion, number of matriculants born in rural areas decreased	Despite expansion, the characteristics of matriculating medical students changed little, except at new schools. Further expansion may benefit from targeted consideration of workforce needs.
Talley, 2011[87]	US Rural rotation site Capacity: N/A	Emergency medicine (EM) residents N = 197 residents completed a rural rotation 111/126 programs responded for 88% response rate	Comparison of different programs. Rural rotations as 1) required, 2) elective at predesignated site, 3) elective, but resident must create own rotation (no predesignated site), or 4) not available	Post-only Rural: N/A	7% of residents who completed a rural rotation selected their initial job in a rural area. EM residency graduates were more likely to select a rural job when rural rotations were required (22%), compared to other options: predesignated (7%) or not predesignated (6%), elective or not available (7%; p < 0.001)	N/A	N/A	Elective rural rotations at predesignated sites increase resident exposure to rural areas compared to programs without, but neither was associated with rural practice after graduation. EM residency programs that required a rural rotation had increased resident selection of rural jobs, but only 5% of programs had this requirement.

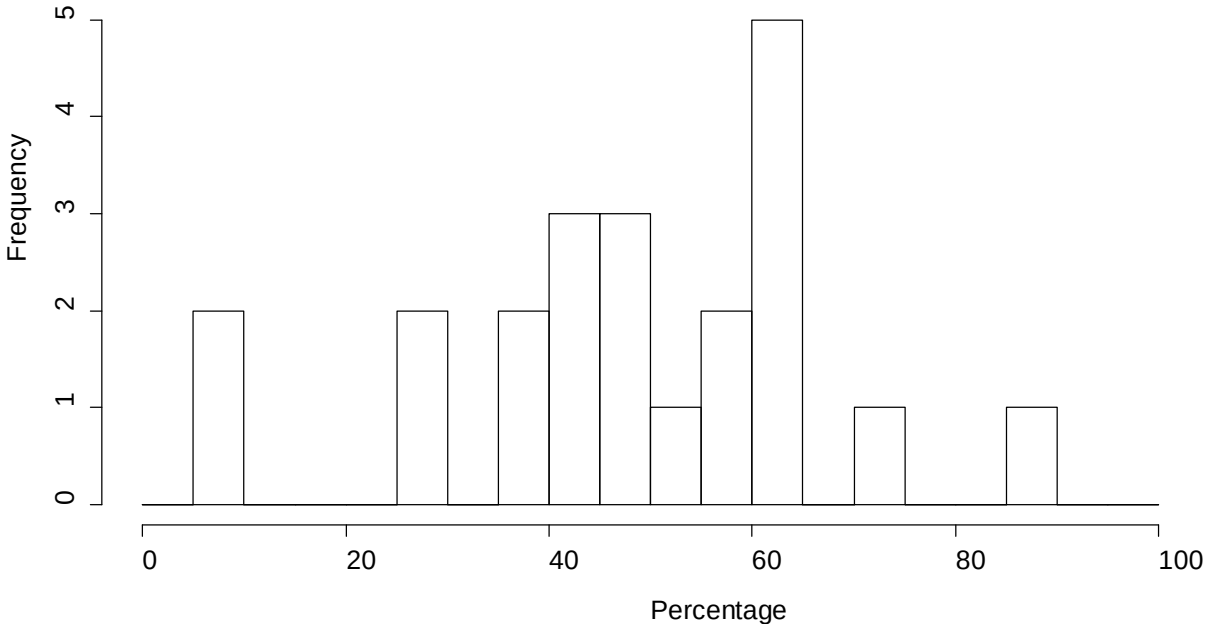
AAFP = American Academy of Family Physicians, ACGME = Accreditation Council for Graduate Medical Education, min = minutes, FQHC = Federally Qualified Health Center, HPSA = Health Professional Shortage Areas, PY = program year, RHC = Rural Health Centers, RUCC = Rural-Urban Continuum Codes, RUDT = Rural-Urban Density Typology, RR = relative risk, OR = odds ratio

Summary of Findings and Quality of Evidence for Key Question 5

This section summarizes the effectiveness of interventions aimed at healthcare providers in training with the goal of recruiting and retaining them in rural practice after graduation or completion of training. The primary outcome is recruitment success for rural healthcare.

The figure documents the percentage of students entering rural care across all studies reporting on 22 samples to provide a general overview.

Figure 2: Effect of Student Interventions on Recruitment to Rural Healthcare



Note: The histogram shows the relative frequency of reported recruitment success expressed as the percentage of trainees practicing in rural healthcare.

Across all identified approaches for healthcare providers in training, the percentage of choosing rural healthcare at least as the first site of practice varied widely. However, most estimates were in the range of 35 to 65%. The mean across all studies was 49%, the median 53%.

Restricting to the studies reporting on programs of a single institution, the mean recruitment success was 53% (median 55%). This included programs for medicine students as well as programs specifically aimed at residents in general surgery, psychiatry, and family medicine.

The 5 rural track programs exclusively aimed at medical residents[88,93,96,102,110] reported a mean of providers successfully recruited into rural healthcare of 59% (median 60%). The largest success rate (86%) was reported for a small Texas rural training track program for family medicine residents, but the study included only 7 participants.[93]

Stratifying programs by intensity we found that training programs with greater than 6 months cumulative time spent in rural training had a median success rate of 51%, versus 53% for those comprising less than 6 months of rural experience.

Some of the identified studies reported on data across multiple training institutions. A study evaluating whether the 2006 AAMC request for a 30% increase in US MD-granting medical school enrollment by 2015 was successful in producing more physicians practicing in rural care showed that in schools with high growth, 8.6% of graduates practice in rural healthcare, compared to 5.6, 7.4, and 7.3% for no-, low-, and moderate-growth schools.[100] A survey of program directors of emergency medicine residency programs reported that of all residents who had completed a rural rotation, 7% selected their initial job in a rural area.[87] The percentage was 22% when restricting to students in programs where the rural rotation was a required element.

An evaluation of 35 medical schools with 18 rural track programs that were able to identify students' practice location reported an average of 44% of their graduates practice in rural areas (range 20-73%).[98] A study accessing data from 3 rural programs that include preferential admission of students likely to practice in rural areas as well as having a required rural curriculum (Physician Shortage Area Program, Jefferson Medical College; University of Minnesota Medical School Duluth campus; and Rural Medical Education Program, University of Illinois) reported that 63% of the graduates practice in a rural area.[91]

A study found that of residents having trained in a critical access hospital, 48% practiced in a critical access hospital or a rural health clinic and 36% who trained in a rural health clinic practiced in a critical access hospital or a rural health clinic.[89] Family medicine residencies with rural training tracks supported by the Rural Training Track Technical Assistance Program reported that 72% of graduates began clinical practice in rural areas.[99]

Among the studies that reported on retention of trainees in rural areas, between 37% and 82% of trainees stayed and practiced in the rural areas in which they were trained[105,110] but data on duration of retention was lacking.

We did not identify any data specific to VA providers.

SUMMARY AND DISCUSSION

The review demonstrates rural healthcare workforce needs, determinants of providers' geographic choices, the lack of intervention studies aimed at US providers, and a multitude of recent provider in training efforts.

We identified a small number of studies quantifying current healthcare provider needs (8 studies). Estimates were for specific regions and specific years, and studies operationalized provider need differently. Hence it is difficult to make concrete or generalizable evidence statements regarding the number of healthcare providers needed. However, all included studies reported current unmet healthcare provider needs that worsen with increasing rurality. There is in particular a healthcare provider shortage for primary care providers, mental health professionals, and general surgeons.

We identified 3 published studies estimating future provider need (KQ1). Studies made predictions for primary care physicians, emergency physicians, and surgeons. We did not identify 2 or more studies reporting on the same provider group. We also did not find studies addressing other provider groups of interest for this review. All studies concluded that the supply is not likely to meet demand.

A large number of studies exploring the determinants of practicing in rural care (KQ2) has been published. Growing up in a rural community was the most consistent factor associated with practice location choice. Education efforts for physicians, such as rural tracks, also seem to increase the likelihood of practicing in a rural community. Positive associations were also shown for family, exposure to rural communities, a primary care and family medicine orientation, osteopathic degree, recreation activities, and rural lifestyle; however, the evidence base is very limited. Although a large number of studies explored potential factors, further studies are needed to determine the relative importance of the predictor variables.

For KQ3, we identified only 5 evaluations that were aimed at practicing providers, J-1 visa waiver, and loan forgiveness program evaluations. A J-1 visa program evaluation reported that 53% of physicians did not complete their obligations but of the respondents who had completed commitments, 84% remained longer than required.[83] A state-wide evaluation of various recruiting programs reported that 80% of placed providers have remained at their initial placement site upon completion of their obligation.[86] The loan repayment programs reported on different outcomes. One reported 86% continued medical practice at their sponsoring facility after completing their obligation. One reported that of those recipients whose obligated practice location was rural, 84% were practicing in rural areas and 28% of program completers were practicing in rural areas. One evaluation highlighted that 74% of recipients were already working in or intended to work in an eligible community when they were made aware of the program but the program was important to retention in rural healthcare for 38%.

We did not identify any study specifically aimed at improving retention of fully trained healthcare providers practicing in rural healthcare facilities (KQ4).

We identified a large number of program evaluations focusing on providers in training. However, all were programs aimed at medical students and residents (KQ5). Across individual approaches, studies reported a median success rate for recruitment into rural healthcare of 53%.

DISCUSSION BY KEY QUESTION

The included studies quantify shortages for rural areas, for specific provider groups (primary care providers, mental health professionals, and general surgeons) and for a defined period of time. The specific estimates of unmet needs underpin the perceived shortage of healthcare providers, in particular for rural areas, as highlighted in numerous publications on the topic.[7,9-11,111-118] HRSA provides annually updated, online access to all designated Health Professional Shortage Areas (HPSAs) stratified by primary medical care, mental health, and dental health.[119] The variability in the metrics used to define unmet need illustrate the difficulty of quantifying provider needs and comparing unmet needs across geographic regions and provider disciplines.

Although this review only targeted research describing practicing healthcare providers relevant to the current healthcare system, we identified a large number of studies contributing to key question 2. We identified growing up in a rural community as the most consistent factor associated with practice location choice. This factor has also been identified in earlier datasets[120] and it appears that this aspect continues to play an important role in determining the choice of location. The recent literature also includes multivariate analyses that were able to confirm the effect without obvious confounders.[72,78] Despite this association, the evidence suggests that most rural physicians did not grow up in a small town. Among physicians moving to a rural setting, factors such as feeling established in practice with a close connection to patients and location were noted to be of importance. [65,80] A second key predictor that emerged in the literature is education efforts such as rural tracks for physicians. These seem to increase the likelihood of practicing in a rural community, and although the choice of selecting a rural track may be in part determined by a personal affinity preceding the choice of school, multivariate analyses showed that the effect cannot be entirely explained by the variable of growing up in a rural community.[72] However, there is a lack of studies differentiating the relative importance of a personal affinity for rural communities, motivation through rural training, and effects of interventions attracting trained healthcare providers into rural care settings.[61]

For KQ3, we only identified a very small number of studies aimed at the recruitment of healthcare providers for rural communities. This is consistent with a recent Cochrane review on interventions to increase the proportion of health professionals practicing in rural and other underserved areas; the review includes only one study.[121] The included study reported on an international setting (Taiwan). The Cochrane review concluded that there is currently limited reliable evidence regarding the effects of interventions aimed at addressing the inequitable distribution of health professionals. A 2010 review for the World Health Organization on interventions to increase attraction and retention of health workers in remote areas included 3 studies directed at healthcare providers (rather than providers in training): studies addressed community service for doctors in South Africa, financial incentives in the Niger, and bundled interventions for rural areas in Mali.[27] Studies reported a 25% proportion of participants placed in rural areas, an increase of 44% in the number of doctors practicing outside the capital city, and the total number of physicians installed in rural areas over a 10-year period (100) but the review cautioned that there is a need for more thorough evaluations to support policy-makers in developing, implementing, and evaluating effective interventions to increase the availability of health workers in underserved areas.

One of the identified evaluations in our systematic review was a J-1 visa waiver program evaluation at state level and it highlighted that programs need to be evaluated carefully. The

study reported that half of physicians did not complete their obligation. However, of the respondents who had completed their commitments, over 80% remained longer than required. [83] This is mirrored by earlier evaluations of the program; an evaluation for rural Wisconsin concluded that to keep physicians practicing in communities, successful integration into the community is important.[122] Research on loan forgiveness programs is sparse and the identified evaluations assessed different outcomes and results. Careful evaluation is needed given that one included study highlighted that a large proportion of participants were working in or intended to work in an eligible community when they were made aware of the program. Hence, the program may influence their retention in rural healthcare but was not key to entering rural healthcare.[62] A critical review of interventions to redress the inequitable distribution of healthcare professionals to rural and remote areas summarized the reviewed literature published to 2008, as many service-lined scholarships, loans, and loan repayment programs have been described, but the effect of these on the rural or remote workforce are not clear.[123]

We did not identify any recent study specifically aimed at improving retention for healthcare providers in rural healthcare facilities (KQ4). This finding is consistent with a recent review on physician recruitment and retention in rural and underserved areas. The review highlighted that several authors have suggested recruitment and retention techniques; however, there is a need for a research agenda that includes valid, reliable, and rigorous analyses regarding formulating and implementing these strategies.[124] Review articles have frequently pointed to models of telehealth and their expected influence on rural care,[21,36] but there is a lack of studies providing empirical data of the effects of these innovations. There was a similar lack of evidence to evaluate whether there is a critical duration of rural practice after which providers are more likely to remain in that setting for an extended time or the duration of their career. Furthermore, we did not identify any study assessing the effect of education and continuous professional development on rural healthcare providers. Our review concentrated on specific healthcare provider groups; however, a review of reviews on interventions for supporting nurse retention in rural and remote areas also concluded that more knowledge is needed regarding the effectiveness of specific strategies to address the factors known to contribute to nurse retention,[125] suggesting that the absence of systematic evaluations is not necessarily provider group-specific. While our review concentrated on the US setting, a 2010 systematic review on the international literature on retention incentives for health workers in rural and remote areas reported that little evidence demonstrated the effectiveness of any specific strategy, with the possible exception of health worker obligation.[126] The review suggested a framework of 6 components (staffing, infrastructure, remuneration, workplace organization, professional environment, and social, family, and community support) and concluded that retention strategies should be rigorously evaluated.

In the last 10 years a large number of studies have been published that evaluate programs for healthcare providers in training (KQ5). However, the literature is dominated by studies focusing on medical students and residents. Across all approaches, studies reported a median success rate for recruiting healthcare providers to rural care of 53%, meaning that about half the students trained for rural healthcare enter rural settings. The success rate varied across datasets and programs but most estimates ranged between 35 and 65%. This included a study that combined data from 3 identified programs that give preference to students with a rural background and a rural track approach ensuring exposure to rural healthcare; the reported success rate was 63%.[91] Individual training programs varied widely in format and duration but we did not identify factors that systematically affected success rates. For example, training programs with greater than 6 months' time spent in rural training had a median success rate of 51%, versus 53% for those

comprising less than 6 months of rural experience. Our identified data are comparable to the estimate of a prior systematic review with data to 2006 that reported a weighted average 53 to 64%.[127]

While the data contained in the included studies suggest that it is difficult to recruit, retain, and train rural providers, the studies provide little exploration of the specific challenges of rural practice. These challenges are illustrated well in the results of a 2011 survey performed by Chipp et al.[32] Rural providers were asked, simply, "What are the 3 things you wish someone would have told you about delivering healthcare in rural areas?" Responses relating to challenges of rural healthcare provision frequently touched on challenges in community relationship-building, personal and professional boundaries, and rural lifestyle challenges and self-care practices. One respondent, for example, replied, "Self care is one of the primary things, because of isolation; you have to be a person who knows how to nurture yourself, to replenish yourself." Although an in-depth discussion of these challenges and difficulties lies outside the scope of this review, these results offer some understanding of the forces shaping the rural provider workforce and the results of the included studies.

LIMITATIONS

Workforce supply and demand is part of a complex and dynamic system. While our review targeted only recent research, that is within the last 10 years, the effects of newer developments such as the Affordable Care Act will add new components.[128] Our systematic review captures research published to February 2015 but publications continue to address this complex topic.[129,130]

We restricted the review to a specific range of healthcare disciplines, chosen by consensus as those most frequently appearing in the literature pertinent to Community-Based Outpatient Clinics, Rural Health Clinics, and Critical Access Hospitals. Additional providers, whose role in providing rural care may be relevant, fell outside the scope of the study. HRSA provides information on health workforce projections for various other healthcare providers such as psychologists and pharmacists.[131]

Our review focused on specific empirical evidence, for example provider demand estimates, and program evaluations for healthcare practitioners had to report on recruitment or retention measures to be eligible. This left out studies assessing supply, rather than demand,[132,133] or evaluations assessing provider satisfaction with programs.[134-136]

Finally, as shown in the evidence tables throughout the report, "rural" was operationalized differently across identified studies which introduced heterogeneity across studies.

RESEARCH GAPS/FUTURE RESEARCH

Supply information is now widely available. However, few studies exist that have quantified provider needs for rural areas. HRSA provides a model for estimating provider demand that can be used for estimates. Predictive models are very complex and need to be continuously updated due to developments such as the Affordable Care Act. Although the shortage of healthcare providers is often cited, specific estimates are needed, in particular for healthcare providers other than physicians. Furthermore, there is a need to identify and assess the skills and competencies needed by current and future rural healthcare providers, in order to optimize the impact of these

providers, to predict the supply and demand according to geographic region, to shape new models of care, and to effectively utilize technology to ameliorate issues physician shortage and patient access. The impact of federal and state policies on supply and demand warrants investigation. In particular, research considering the context above and focusing on VA-specific care in rural settings is needed.

Although we have identified many studies addressing providers' geographic choices for practice, few were designed to determine the relative importance of contributing factors. For physicians in particular, studies should focus on the context of rural upbringing, academic preparation, and competitive medical school admissions processes to understand individual decisions of where providers choose to practice. In addition, there is a need for further, multivariate analyses, simultaneously exploring the effects of personal background, training, time spent in rural placements, and interventions aimed to recruit healthcare provider groups for rural care.

We identified only very few intervention evaluations that targeted providers, rather than students and residents. In particular, empirical evidence of strategies to improve provider retention in rural areas is missing. There is a lack of intervention studies evaluating organizational interventions (*eg*, estimating the effect of implemented continuous education, clinical support, and inter-professional collaboration). We also did not did not identify evaluations that reported on the current effect of a federal program, the National Health Service Corps. Earlier evaluations were positive[137,138] but effect estimates should be intermittently updated to assess effects of the American Recovery and Reinvestment Act and the Patient Protection and Affordable Care Act.[19] In recent years, additional approaches to recruiting and retaining US healthcare providers have been suggested that should be evaluated in future research studies.[139-142] Data is currently lacking on the effects of improved access to Continuing Medical Education, availability of e-consults with specialists, expanded consult networks, and other interventions aimed at improving ease of practice in rural areas.

Studies of training interventions for students and residents varied widely in duration, intensity, balance of acute care to rural or primary care exposure, geographic regions, program elements, and other factors making impacts difficult to compare across studies. Analyses are needed that parse out the specific aspects of the training experience that influenced success. To date it is, for example, unknown whether the rural-specific skills training is crucial, or if simply spending time in the rural setting is sufficient. There is a lack of studies evaluating the comparative effectiveness of different training programs. Moreover, effects of training programs for healthcare providers other than medical students and residents are needed, at least to demonstrate that effects are comparable to medical school training efforts.

CONCLUSIONS

All included studies reported current unmet healthcare provider needs that worsen with increasing rurality. The small number of studies estimating future need also predicted unmet provider needs for rural healthcare.

Growing up in a rural community is the most consistent factor associated with practice location. Education efforts for physicians, such as rural tracks, also seem to increase the likelihood of practicing in a rural community. More research on the relative importance of factors is needed.

More research is needed to evaluate existing healthcare provider recruitment interventions for rural healthcare.

There is a lack of evidence regarding interventions to support healthcare provider retention in rural healthcare.

Current evaluations of rural training programs for medical students and residents suggest a median success rate of 53%.

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128. US Department of Health and Human Services. The Affordable Care Act- What it Means for Rural America. 2013; http://www.hhs.gov/healthcare/facts/factsheets/2013/09/rural09202013.html.

129. Patterson DG, Keppel G, Skillman SM, Berry C, Daniel C, Doescher MP. *Recruitment of Non-U.S. Citizen Physicians to Rural and Underserved Areas through Conrad State 30 J-1 Visa Waiver Programs. Final Report #148, April 2015.* Seattle, WA: WWAMI Rural Health Research Center, University of Washington;2015.

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135. Suter E, Deutschlander S, Mickelson G, et al. Can interprofessional collaboration provide health human resources solutions? A knowledge synthesis. *Journal of interprofessional care.* Jul 2012;26(4):261-268.

136. Tumosa N, Horvath KJ, Huh T, et al. Health care workforce development in rural america: when geriatrics expertise is 100 miles away. *Gerontology & geriatrics education.* 2012;33(2):133-151.

137. Holmes GM. Increasing physician supply in medically underserved areas. *Labour Econ.* Oct 2005;12(5):697-725.

138. Pathman DE, Fryer GE, Jr., Phillips RL, Smucny J, Miyoshi T, Green LA. National Health Service Corps staffing and the growth of the local rural non-NHSC primary care physician workforce. *The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association.* Fall 2006;22(4):285-293.

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140. Primm D. Tennessee Rural Partnership. 2014; https://www.raconline.org/success/project-examples/777. Accessed 09/02/2015.

141. Stempniak M. The hiring headache. Rural hospitals band together to lure physicians. *Hospitals & health networks / AHA.* Dec 2012;86(12):18-19.

142. Schmitz DF, Baker E, Nukui A, Epperly T. Idaho rural family physician workforce study: the Community Apgar Questionnaire. *Rural and remote health.* 2011;11(3):1769.

APPENDIX 1. SEARCH STRATEGY

KQ1 – RURAL HEALTH PROVIDER NEEDS

DATABASE SEARCHED & TIME PERIOD COVERED:
PubMed – 1/1/2005-2/11/2015

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"[Mesh] OR physician*[tiab] OR nurses[tiab] OR nursing[tiab] OR hospitalist*[tiab] OR hospital staff*[tiab] OR healthcare professional*[tiab] OR health care professional*[tiab] OR doctor[tiab] OR doctors[tiab] OR health manpower[mh] OR manpower[tiab] OR workforce OR medical staff, hospital
AND
need[tiab] OR needs[tiab] OR needed[tiab] OR needing[tiab] OR supply[tiab] OR demand[tiab] OR "supply and distribution" [Subheading]
AND
predict* OR projected OR future OR trend*

DATABASE SEARCHED & TIME PERIOD COVERED:
CIN/AHL – 1/1/2005-2/11/2015

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
need OR needs OR needed OR needing OR supply OR demand

Narrow by SubjectGeographic: - usa

KQ2 – DECISION FACTORS

DATABASE SEARCHED & TIME PERIOD COVERED:

PubMed – 1/1/2005-2/13/2015

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"[Mesh] OR physician*[tiab] OR nurses[tiab] OR nursing[tiab] OR hospitalist*[tiab] OR hospital staff*[tiab] OR healthcare professional*[tiab] OR health care professional*[tiab] OR doctor[tiab] OR doctors[tiab] OR health manpower[mh] OR manpower[tiab] OR workforce OR medical staff, hospital
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

LANGUAGE:
English

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

incentive* OR attract* OR pecuniary OR non-pecuniary OR income OR monetary OR economic* OR financial OR opportunit* OR incentive*

KQ3 & 4 – RECRUITMENT & RETENTION

DATABASE SEARCHED & TIME PERIOD COVERED:
PubMed – 1/1/2005-2/23/2015

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"[Mesh] OR physician*[tiab] OR nurses[tiab] OR nursing[tiab] OR hospitalist*[tiab] OR hospital staff*[tiab] OR healthcare professional*[tiab] OR health care professional*[tiab] OR doctor[tiab] OR doctors[tiab] OR health manpower[mh] OR manpower[tiab] OR workforce OR medical staff, hospital
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

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DATABASE SEARCHED & TIME PERIOD COVERED:
CIN/AHL – 1/1/2005-2/23/2015

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
recruit* OR retention OR retain* OR personnel selection OR turnover OR turn over* OR burnout OR burn* out

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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
"Schools, Health Occupations"[Mesh]) OR "Students, Health Occupations"[Mesh] OR internship and residency[mh] OR graduate[tiab] OR post-graduate[tiab] OR postgraduate[tiab] OR college[tiab]
AND
training OR train[ti] OR educat*[tiab] OR medical education OR education, professional
AND
program OR programs[tiab] OR programme*[tiab] OR project[tiab] OR projects[tiab] OR effort[tiab] OR efforts[tiab] OR evaluat*[tiab] OR improv*[tiab] OR success*[tiab] OR efficacy OR survey* OR questionnaire*

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

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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] Challenges, solutions & opportunities : affordable housing, workforce training, recruitment & retention of health care professionals. Northern Arizona University, the W.A. Franke College of Business; 2007: http://www.franke.nau.edu/RPI/projects/ARPF2007FinalReport.pdf

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

[no author] Young physicians not keen on rural areas. Managed care (Langhorne, Pa.). 2012;21(10):16.

Aseltine RH, Jr., Katz MC, Geragosian AH. Connecticut 2009 Primary Care Survey: physician satisfaction, physician supply and patient access to medical care. Connecticut medicine. 2010;74(5):281-291.

Avery DM, Jr., Wheat JR, Leeper JD, McKnight JT, Ballard BG, Chen J. Admission factors predicting family medicine specialty choice: a literature review and exploratory study among students in the Rural Medical Scholars Program. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association. 2012;28(2):128-136.

Baker E, Schmitz D, Epperly T, Nukui A, Miller CM. Rural Idaho Family Physicians' Scope of Practice. Journal of Rural Health. 2010;26(1):85-89.

Ballance D, Kornegay D, Evans P. Factors that influence physicians to practice in rural locations: a review and commentary. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association. 2009;25(3):276-281.

Balshem H, Helfand M, Schunemann HJ, et al. GRADE guidelines: 3. Rating the quality of evidence. Journal of clinical epidemiology. 2011;64(4):401-406.

Barnighausen T, Bloom DE. Financial incentives for return of service in underserved areas: a systematic review. BMC health services research. 2009;9:86.

Barrett FA, Lipsky MS, Lutfiyya MN. The impact of rural training experiences on medical students: a critical review. Academic medicine : journal of the Association of American Medical Colleges. 2011;86(2):259-263.

Bowman RC. Measuring primary care: the standard primary care year. Rural Remote Health. 2008;8(3).

Bridgham RG. Final report : HB 1615, (Chapter 367:3, Laws of 2008), establishing a Commission to Recommend Policies and Programs to Increase the Number of New Hampshire Individuals in Health Professions Servicing New Hampshire's Rural and Underserved Areas with a Focus on Primary Care. Concord, N.H.: N.H. General Court; 2009.

Broughan TA. SAGES 2007 rural surgery panel. Surgical endoscopy. 2008;22(7):1579-1581.

Carlton EL, Simmons LA. Health decision-making among rural women: physician access and prescription adherence. Rural Remote Health. 2011;11(1).

Chen C, Xierali I, Piwnica-Worms K, Phillips R. The redistribution of graduate medical education positions in 2005 failed to boost primary care or rural training. Health affairs (Project Hope). 2013;32(1):102-110.

Chipp C, Dewane S, Brems C, Johnson ME, Warner TD, Roberts LW. "If only someone had told me...": lessons from rural providers. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association. 2011;27(1):122-130.

Cogbill TH, Cofer JB, Jarman BT. Contemporary issues in rural surgery. Current problems in surgery. 2012;49(5):263-318.

Collier D. Rural Michigan physician retention study reveals motivators. Michigan medicine. 2010;109(5):21.

Cook AF, Hoas H. Hide and seek: The elusive rural psychiatrist. Academic Psychiatry. 2007;31(6):419-422.

Corbett CD. Recruitment and retention of physicians in rural North Dakota : testing for congruency between current policies and physician motivation. 2012:ii, 37 leaves ; 29 cm. Dissertation: Paper (M.S.)--Minnesota State University Moorhead, 2012.

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.

Curran V, Rourke L, Snow P. A framework for enhancing continuing medical education for rural physicians: A summary of the literature. Medical teacher. 2010;32(11):e501-508.

Deveney K, Deatherage M, Oehling D, Hunter J. Association between dedicated rural training year and the likelihood of becoming a general surgeon in a small town. JAMA surgery. 2013;148(9):817-821.

Dill MJ, Salsberg ES. The Complexities of Physician Supply and Demand: Projections Through 2025. November 2008. Washington, DC: Association of American Medical Colleges, Center for Workforce Studies.;2008.

Doescher MP, Andrilla CH, Skillman SM, Morgan P, Kaplan L. The contribution of physicians, physician assistants, and nurse practitioners toward rural primary care: findings from a 13-state survey. Medical care. 2014;52(6):549-556.

Dolea C, Stormont L, Braichet JM. Evaluated strategies to increase attraction and retention of health workers in remote and rural areas. Bull World Health Organ. 2010;88(5):379-385.

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Dorsey ER, Nicholson S, Frist WH. Commentary: improving the supply and distribution of primary care physicians. Academic Medicine: Journal of the Association of American Medical Colleges. 2011;86(5):541-543.

Doty B, Andres M, Zuckerman R, Borgstrom D. Use of Locum Tenens Surgeons to Provide Surgical Care in Small Rural Hospitals. World J. Surg. 2009;33(2):228-232.

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Escarce JJ, Kapur K. Do patients bypass rural hospitals? Determinants of inpatient hospital choice in rural California. J. Health Care Poor Underserved. 2009;20(3):625-644.

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.

Filipova AA. Factors influencing the satisfaction of rural physician assistants: a cross-sectional study. Journal of allied health. 2014;43(1):22-31.

Fordyce MA, Chen FM, Doescher MP, Hart LG. 2005 physician supply and distribution in rural areas of the United States [Internet]. Seattle, WA: Rural Health Research and Policy Centers;2007.

Fournier GM, Henderson C. Incentives and physician specialty choice: a case study of Florida's Program in Medical Sciences. Inquiry : a journal of medical care organization, provision and financing. 2005;42(2):160-170.

Fraher EP, Knapton A, Sheldon GF, Meyer A, Ricketts TC. Projecting surgeon supply using a dynamic model. Annals of surgery. 2013;257(5):867-872.

Gagnon MP, Pollender H, Trepanier A, Duplaa E, Ly BA. Supporting health professionals through information and communication technologies: a systematic review of the effects of information and communication technologies on recruitment and retention. Telemedicine journal and e-health : the official journal of the American Telemedicine Association. 2011;17(4):269-274.

Garrison-Jakel J. Patching the rural workforce pipeline--why don't we do more? The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association. 2011;27(2):239-240.

Getson DS. Rural practice realities. The West Virginia medical journal. 2013;109(4):34-37.

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.

Haggerty TS, Fields SA, Selby-Nelson EM, Foley KP, Shrader CD. Physician Wellness in Rural America: A Review. International journal of psychiatry in medicine. 2013;46(3):303-313.

Halaas GW. The Rural Physician Associate Program: successful outcomes in primary care and rural practice. Rural and remote health. 2005;5(2):453.

Henry LR, Hooker RS, Yates KL. The role of physician assistants in rural health care: a systematic review of the literature. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association. 2011;27(2):220-229.

Hilty DM, Yellowlees PM, Cobb HC, Bourgeois JA, Neufeld JD, Nesbitt TS. Models of telepsychiatric consultation-liaison service to rural primary care. Psychosomatics. 2006;47(2):152-157.

Hirsh D, Walters L, Poncelet AN. Better learning, better doctors, better delivery system: possibilities from a case study of longitudinal integrated clerkships. Medical teacher. 2012;34(7):548-554.

Holmes GM. Increasing physician supply in medically underserved areas. Labour Econ. 2005;12(5):697-725.

Huff C. Where are the specialists? Hospitals & health networks / AHA. 2011;85(12):26-28, 31, 21.

Huff C. Please doc, stay. Give docs a reason to set up shop. Hospitals & health networks / AHA. 2012;86(2):20.

Huff C. Done recruiting? Start retaining. Trustee : the journal for hospital governing boards. 2014;67(1):8-12, 11.

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.

Larson EH, Hart LG. Growth and change in the physician assistant workforce in the United States, 1967-2000. Journal of allied health. 2007;36(3):121-130.

Lee DM, Nichols T. Physician recruitment and retention in rural and underserved areas. International journal of health care quality assurance. 2014;27(7):642-652.

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.

Lynch S. Hospice and palliative care access issues in rural areas. The American journal of hospice & palliative care. 2013;30(2):172-177.

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Mareck DG. Federal and state initiatives to recruit physicians to rural areas. The virtual mentor : VM. 2011;13(5):304-309.

Mbemba G, Gagnon MP, Pare G, Cote J. Interventions for supporting nurse retention in rural and remote areas: an umbrella review. Human resources for health. 2013;11:44.

Meyer D. Technology, job satisfaction, and retention: rural mental health practitioners. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association. 2006;22(2):158-163.

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Murphy KL. Alaska health care workforce shortages : impact of state legislation. 2011:ix, 74 leaves ; 28 cm. Dissertation: Thesis (M.Public Health)--University of Alaska Anchorage, 2011.

Nakayama DK, Hughes TG. Issues That Face Rural Surgery in the United States. Journal of the American College of Surgeons. 2014;219(4):814-818.

Nance ML, Carr BG, Branas CC. Access to pediatric trauma care in the United States. Archives of pediatrics & adolescent medicine. 2009;163(6):512-518.

Ortiz J, Bushy A, Zhou Y, Zhang H. Accountable care organizations: benefits and barriers as perceived by Rural Health Clinic management. Rural and remote health. 2013;13(2):2417.

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.

Pathman DE, Fryer GE, Jr., Phillips RL, Smucny J, Miyoshi T, Green LA. National Health Service Corps staffing and the growth of the local rural non-NHSC primary care physician workforce. The Journal of rural health : official journal of the American Rural Health Association and the National Rural Health Care Association. 2006;22(4):285-293.

Patterson DG, Keppel G, Skillman SM, Berry C, Daniel C, Doescher MP. Recruitment of Non-U.S. Citizen Physicians to Rural and Underserved Areas through Conrad State 30 J-1 Visa Waiver Programs. Final Report #148, April 2015. Seattle, WA: WWAMI Rural Health Research Center, University of Washington;2015.

Patterson DG, Longenecker R, Schmitz D, Skillman SM, Doescher MP. January 2011 Policy Brief: Training Physicians for Rural Practice: Capitalizing on Local Expertise to Strengthen Rural Primary Care. 2011; https://www.raconline.org/rtt/pdf/policybrief_jan11.pdf. Accessed 8/20/2015.

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Peterson LE, Bazemore A, Bragg EJ, Xierali I, Warshaw GA. Rural-urban distribution of the U.S. Geriatrics physician workforce. Journal of the American Geriatrics Society. 2011;59(4):699-703.

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Price J. The National Health Service Corps--a critical component of provider recruitment in North Carolina's rural and underserved communities. North Carolina medical journal. 2010;71(3):251.

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Rabinowitz HK, Diamond JJ, Markham FW, Rabinowitz C. Long-term retention of graduates from a program to increase the supply of rural family physicians. Academic medicine : journal of the Association of American Medical Colleges. 2005;80(8):728-732.

Rabinowitz HK, Diamond JJ, Markham FW, Santana AJ. Increasing the supply of women physicians in rural areas: outcomes of a medical school rural program. Journal of the American Board of Family Medicine : JABFM. 2011;24(6):740-744.

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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.

Ricketts TC. Workforce issues in rural areas: A focus on policy equity. Am. J. Public Health. 2005;95(1):42-48.

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APPENDIX 3. RISK OF BIAS ASSESSMENT

KQ1 STUDIES

ID	Data source reporting	External validity
Branch, 2014[47]	Low risk	Low risk
Camargo, 2008[56]	Low risk	Low risk
Ghosh, 2011[51]	Low risk	Low risk
Hendryx, 2008[54]	Low risk	Low risk
Maizel, 2009[48]	Low risk	Unclear
Rayburn, 2012[52]	Low risk	Unclear
Rosenblatt, 2010[1]	Low risk	Low risk
Stewart, 2013[49]	Low risk	Low risk
Thomas, 2009[50]	Low risk	Unclear
Williams, 2011[53]	Low risk	Low risk
Wilson, 2011[55]	Low risk	Low risk

KQ2 STUDIES

ID	Response rate	Confounding variables	Other limitations
Chen, 2010[57]	Unclear	High risk	
DHHS, 2006[66]	Unclear	High risk	
Duffrin, 2014[67]	High risk	High risk	
Fordyce, 2012[58]	Unclear	High risk	
Glasser, 2010[68]	Low risk	High risk	
Hancock, 2009[69]	High risk	High risk	Recall bias and small sample size with likely selection bias
Helland, 2010[70]	Low risk	High risk	
Heneghan, 2005[71]	High risk	High risk	Selection bias, response bias, did not address non-responders
Henry, 2007[65]	High risk	High risk	Qualitative results only
Hughes, 2005[72]	Unclear	High risk	
Jarman, 2009[73]	High risk	High risk	
Kimball, 2007[74]	Low risk	High risk	Qualitative study with selection bias
MacDowell, 2013[105]	Unclear	High risk	
Mason, 2012[63]	Unclear	Unclear	
Pepper, 2010[75]	Low risk	High risk	
Phillips,2009[60]	Unclear	Low risk	

Phillips, 2013[89]	Low risk	High risk	
Rabinowitz, 2012[61]	Low risk	High risk	
Renner, 2010[62]	Low risk	Unclear	
Schiff, 2012[77]	Low risk	High risk	
Shannon, 2011[78]	Unclear	Low risk	Use of self-reported data, limited sample size, and limited external validity
Smith, 2012[64]	High risk	High risk	
Snyder, 2014[79]	High risk	High risk	
Stenger, 2008[80]	Low risk	Unclear	Self-reported data, selection bias
Whitacre, 2010[81]	Unclear	Low risk	
Zink, 2010[82]	Unclear	Unclear	

KQ3 AND KQ4 STUDIES

ID	Selection bias	Performance bias	Attrition bias	Detection bias	Other bias
Kahn, 2010[83]	High risk	Low risk	Low risk	Low risk	N/A
No Author, 2007[85]	High risk	Low risk	Low risk	Low risk	N/A
Renner, 2010[62]	High risk	Unclear	Low risk	Low risk	N/A
Wheeler, 2009[84]	High risk	Low risk	Low risk	Low risk	N/A
Wheeler, 2013[86]	High risk	Unclear	Unclear	Unclear	Recruitment data no denominator, retention data not stratified by program

KQ5 STUDIES

ID	Selection bias
Antonenko, 2009[96]	High risk
Baker, 2012[101]	Unclear
Bonham, 2014[88]	High risk
Crane, 2014[102]	High risk
Crump, 2013[103]	Unclear
Deutchman, 2013[98]	High risk
Deveney, 2009[29,97]	High risk
Glasser, 2008[68,104]	High risk
Kallail, 2010[106]	High risk
Mason, 2012[63]	High risk
Nash, 2008[93]	High risk
Patterson, 2013[99]	Unclear

Phillips,2009[60]	Low risk
Phillips, 2013[89]	Unclear
Quinn, 2011[92]	Low risk
Rabinowitz, 2011[90]	Low risk
Rabinowitz, 2012[91]	Low risk
Rabinowitz, 2013[108]	Low risk
Ross, 2013[110]	High risk
Shipman, 2013[100]	Low risk
Talley, 2011[87]	Low risk
Whitacre, 2010[81]	High risk
Zink, 2010[82]	Unclear

APPENDIX 4. PEER REVIEW COMMENTS/AUTHOR RESPONSES

Comments	Response
Appears comprehensive and very useful.	Thank you
Very thorough and complete.	Thank you
Missing studies: Phillips RL; Dodoo MS; Petterson S; et al. Specialty and Geographic Distribution of the Physician Workforce: What Influences Medical Student and Resident Choices? Robert Graham Center: Policy Studies in Family Medicine and Primary Care, Washington, DC, 2009.	The study is included in the final report.
It appears VA studies on Workforce were not including in this synthesis. Was this by design?	We have limited this systematic review to studies in the public domain and applied this inclusion criterion consistently.
Aren't there unpublished data on VA health care workforce supply and demand?	Please see above
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.	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.
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 "Study Selection" - I would recommend that the authors provide more detail on how disagreements were resolved (e.g., consensus, third reviewer, etc.).	Added as suggested
- Page 13, line 28 "Technical Expert Panel". Please change Bureau of Health Professions to Bureau of Health Workforce. We had a merger last year and with it came the name change.	Revised as suggested
- Page 70, line 51 - "Limitations" The HRSA workforce projections covered many more specialties than psychologists and pharmacists. Would suggest changing to various health providers or health professions.	We have revised the sentence slightly to address this point.
- Page 71, line 10-11 "Research Gaps/Future Research" 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.	Thank you for this suggestion, we have added this point.

- Page 71, line 26/27 - "Research Gaps/Future Research" 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.	We have revised the paragraph to avoid misinterpretation of the sentence.
- Page 71, line 32 - "Research Gaps/Future Research" 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.	Added as suggested
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?	We have addressed this point in the limitation section and added more detail on the decision.
Comments regarding the key study questions: KQ1: What are the current versus projected healthcare provider needs by numbers and disciplines in the next 20 years in rural areas? 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.	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.
KQ2: What factors influence healthcare providers' geographic choices for practice? Macy Foundation Graham Center Report 2009, not peer-reviewed in the usual sense, but a well- done research study and report, vetted by experts: Phillips et all, 2009.	Please see above
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 [61,76], 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 <u>both</u> 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.	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.
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?"	We have added this interesting point to the future research section.
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 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: M. Pacheco, D. Weiss, K. Vaillant, S. Bachofer, B. Garrett, W. H. Dodson, 3rd, C. Urbina, B. Umland, D. Derksen, W. Heffron and A. Kaufman. The impact on rural New Mexico of a family medicine residency. Acad Med. 2005; 80:739-44	The study was outside the scope of the intervention because it reported on data before 2005.
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.	To address this comment we have highlighted this in the future research section.
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)	We have expanded the conclusion section and provided more detail to address this comment.
•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.	To address this point we have added an analysis stratified by intensity operationalized as more than 6 months cumulative time spent in rural locations.
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 is 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.	Thank you, very insightful comments.
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.	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.
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.	We have added some more detail to the introduction and the discussion to highlight the challenges faced by rural practitioners.
Specific comments: P. 2, line 42: the tense needs to be changed from future to past tense	Corrected
P. 3, line 6: perhaps there should be a bit of background on the GRADE approach for readers unfamiliar with this method	We have expanded the description and added a reference
P. 6, line 40: please define "contemporary context"	Added as suggested
P. 7, Topic Development: Who determined the synthesis' key questions?	Added as suggested
Title of report should be ' Rural Healthcare Workforce: A Systematic Review'.	Thank you so this suggestion, we agree and have added the term
Page 1, line 13 change to " increase rural provider";	Changed
Page 4 line 3 can you elaborate on type of sponsoring facility?	We have added more information but the information in the original article was very limited.

page 11, line 7 "what qualifies as a training site?";	We have added a definition to the methods section
page 23 page 8 why did you not included unpublished VA data on workforce?	Please see above
page 68 line 6 "what constitutes small?" provide number of studies;	Added
page 68 line 59 - spell out HRSA;	Revised
page 6 lines 6-8 can this point be elaborated in discussion?	Added as suggested
Page 5 lines 51 -53 can the international literature be elaborated on further? Those approaches could work in VA.	The existing studies are described in detail in the discussion (page 69-70)
Page 6 lines 26-28 can the new research recently published be further elaborated?	These are the studies included in our report. They are described under key question 5, evidence table 6.
Page 71 - Future research - gaps - 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;	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
Page 71 line 32, 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	Without empirical evidence it is difficult to speculate; to address this point w have added the topics to the future research section.
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.	We have expanded the discussion as suggested
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.	The discussion section places the identified research in context of the international literature.
(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.	The studies have been added to the final report.
ES, KQ1: It seems reasonable that this is the main finding, yet the lead sentence defines a limitation	Duly noted but given the scope of KQ1 this seems justified
Again, it seems that the important finding of the literature review is that ALL reports state that supply is not met, and that with increasing rurality the demand increases. It would also seem reasonable to choose a metric to compare current or anticipated need, e.g. physicians/population or providers/county, etc.	We have added information on the variability of the reported metrics to address this comment.

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."	We have added a discussion of the study limitations to the discussion section to address this point
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.	Added
Can you define the difference between recipients and program completers?	Added as suggested
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?	Thank you for this interesting comment.
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.	We have revised the wording and expanded the introduction to address this point
Conclusion KQ1: I think you mean population needs	We have reworded the sentence to make it clearer that studies reported unmet healthcare provider needs
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.	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.
Would be helpful to compare/contrast what the literature shows for these 3 interventions, e.g. in a table format.	To address this point we have highlighted that Table 5 provides an overview of studies and evaluated programs
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.	The small number of provider interventions unfortunately did not allow meaningful stratification
Intro, Evidence syntheses are sparse and care environment has changed: Not sure what this means	Reworded for clarification
Intro, AAMC call for 30% increase:-Is there evidence that increased production of medical graduates has focused on increasing rural education?	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.
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.	Thank you.
KQ1, we did not identify studies reporting on the same provider group: Please clarify. Unclear what this means.	Revised to clarify
Evidence tables: These tables are very helpful to understand the content of the literature as well as the review process. Table 4: This table is very useful in understanding and synthesizing the strength of the literature.	Thank you

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.	Added as suggested
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.	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.
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.	We have added a note section to the figure to address this point
Would be helpful to cite comparison percentage from slow/low growth schools.	Added as suggested
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?	We have clarified the wording to address this point
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.	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 sa strong as the evidence will support.
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.	Nurse practitioners and physician assistants were also included but not pharmacist or psychologists; we have added this point to the limitation section
p. 10, line 18: Acronym should be spelled out when first mentioned as opposed to later in the document.	Revised
p.24, line 55: Is there not more data or information to include here to support this statement?	No, abstracted as reported