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Factors influencing medical students' motivation to practice in rural areas: a literature review

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1 **TITLE PAGE**

2 **Factors influencing medical students’ motivation to practice in rural areas: a**
3 **literature review**

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26 Abstract

27 Objectives

28 The choice to practice medicine in a rural area is influenced by many factors.
29 Motivation developed as a medical student is one key determinant of this choice. This
30 study explores influences on medical students' motivation to practice in rural areas
31 following graduation.

32 Design

33 A literature review was conducted to identify influences on medical students'
34 motivation to work in rural areas around the world. Papers reporting influences on
35 motivation were included, and content analysis was conducted to select the articles.
36 Articles not published in English were excluded in this review.

37 Results

38 Motivators identified included rural background, exposure to the health needs of
39 people in rural areas, and a pre-existing personal preference for rural area work.
40 Perceived lack of infrastructure, high workload, poor hospital management and
41 isolation are among the health facility factors that demotivate medical students for
42 medical practice in rural areas. A rural background (i.e., being brought up in a rural
43 area), training in rural areas with community-based curriculum, early exposure to the
44 community during medical training and rural location of medical school motivate
45 medical students to work in rural areas.

46 Conclusions

47 The factors relevant for medical students' choosing rural areas for their practice are
48 rural background, medical training, curriculum and medical school factors. The
49 identification of these factors may assist the planners, medical educators and policy
50 makers in both high- and low-income countries country in designing relevant

51 interventions to increase rural choices where the shortage of rural physicians is an
52 ongoing and increasing concern.

53 **Key words:** Motivation, medical students, medical education, rural health

54
55 **Strengths and limitations of this study**

- 56 • This study focuses on the motivating factors among the medical students
57 unlike most studies which focus on medical doctors and specialists.
- 58 • There is a use of conceptual framework developed by problem tree approach
59 to structure the findings and discussion in the paper.
- 60 • This study is relevant for countries of all income groups that face challenges
61 for physicians to work in rural areas.
- 62 • The inclusion of English language articles only in this review may have
63 resulted in missing out of some possibly important papers published in other
64 languages.

65
66 **Introduction**

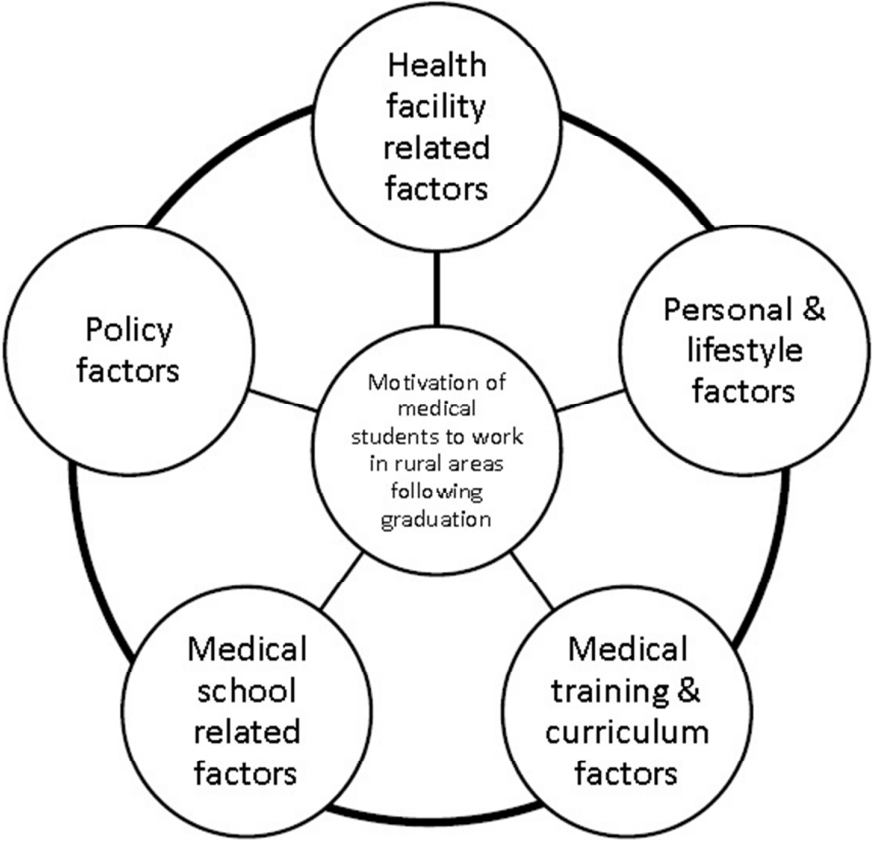
67 Approximately half of the world’s population resides in rural areas, while less than
68 25% of physicians provide services to rural communities (1). Poor access to health
69 workers impacts more than one billion people (1), with communities in Africa and
70 Southeast Asia experiencing the most significant disadvantage (2). Unequal
71 distribution of health care workers between urban and rural area leads to poorer health
72 among rural people (3,4).
73 In a cross-sectional study in 2012, nine out of ten students in Nepal intended to work
74 in Nepal after graduation from medical school, but only 1 out 10 were interested in
75 possibly working in rural areas (5). In similar studies since 2010 in other countries,

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3 76 career intentions in rural locations among medical students are reported very low in
4
5 77 Bangladesh (6) Sub Saharan Africa (7), and South Africa (8). Studies from India and
6
7 78 Ethiopia show slightly higher rates of about 1 out of 5 medical students showing
8
9 79 career interest in rural locations after graduation (9,10).
10
11 80 Decisions made by new doctors about where to establish their careers are influenced
12
13 81 by a range of personal, economic, familial, cultural and environmental factors (11).
14
15 82 Medical training, local and national policy, and factors related to the location of the
16
17 83 health facility also play a role in career decisions (12). Decisions about practice
18
19 84 location are made during medical training (13,14). Experiences during medical school
20
21 85 have a powerful influence over many students' choices (15).
22
23 86 Many determinants contribute to medical graduates' choices relating to career
24
25 87 locations (16). It is an important and difficult decision for many medical graduates
26
27 88 about where to commence their career. The choice influences future career choices
28
29 89 and opportunities, as well as family and social life (17). Understanding what
30
31 90 motivates the medical students at the time they are making this choice will assist
32
33 91 medical educators, researchers and policy makers to more effectively structure their
34
35 92 educational experiences and establish appropriate motivations that encourage more
36
37 93 medical graduates to practice in rural settings (18,19). Rural areas of high-income
38
39 94 countries are not comparable to the rural areas of low-income countries and differ by
40
41 95 income groups of countries, yet the motivation for working in rural areas is a
42
43 96 challenge faced by all countries. The current study sought to review the peer-reviewed
44
45 97 literature to identify factors influencing medical students' motivation to practice in
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47 98 rural areas following graduation.
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99 **Methods**

100 **Study Design:**

101 A literature review was conducted in PUBMED, COCHRANE library, SCOPUS,
102 EMBASE, ERIC, and Google Scholar databases during 2014 by two independent
103 researchers.
104 A problem tree approach was used to develop a conceptual framework for content
105 analysis, where motivation among the students is a dependent variable influenced by
106 these factors. Individual, work, social and environmental factors interact to influence
107 motivation. These factors guided the construction of the broad categories of a problem
108 tree for medical students' motivation (20,21). The Bland model illustrating the student
109 characteristics and school characteristics that play roles in making a choice of future
110 specialty was used as a reference to prepare the problem tree (22). (Figure 1).



111
112 **Figure 1: Conceptual Framework**

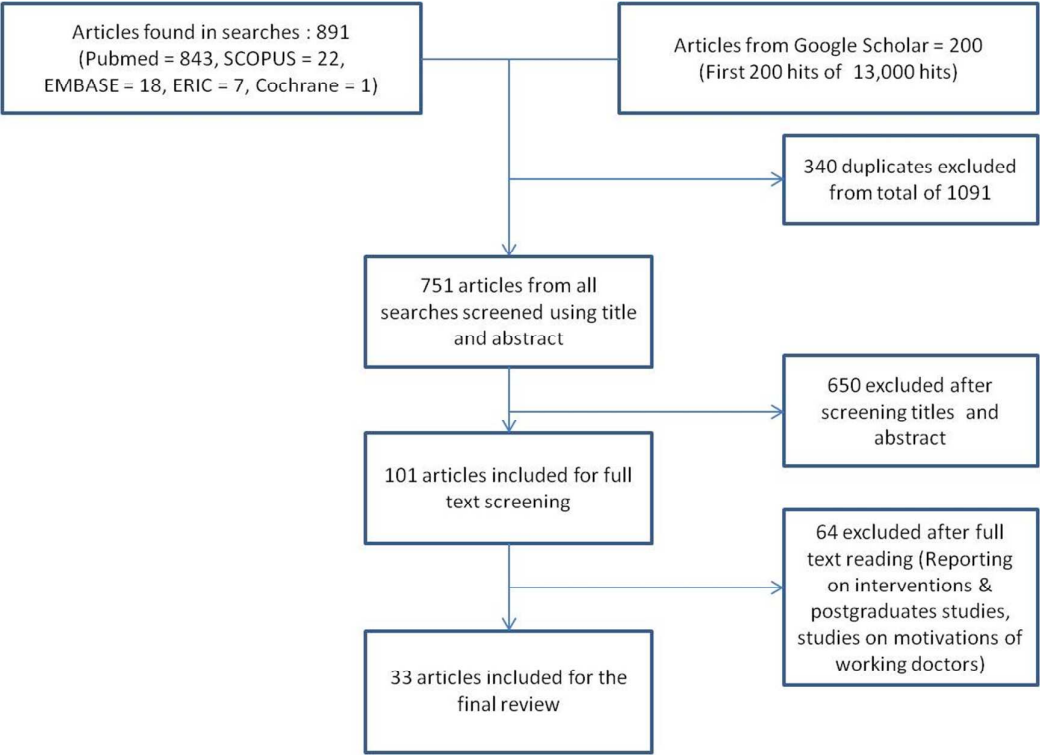
113 **Search Strategy:**

Keywords and Medical Subject Headings (MeSH) were used for each of the three concepts of interest. Medical students: 'medical students' OR 'undergraduate medical students' OR 'medical education'. Motivation: 'motivation' OR 'career choice' OR 'intention'. Location: 'rural areas' OR 'underserved area' OR 'remote area' OR 'community practice'.

The inclusion criteria were set to include all articles that were published between 2000 and July 2014 in peer reviewed journals and reported factors influencing medical students' motivation to work in rural areas. Definitions of 'rural area' differ from author to author and from country to country (23–25). For this study, author use of the terms 'rural area' or 'underserved area' were accepted. Studies reporting practice in low-, middle- and high-income countries were included. Articles not published in English were excluded.

Following extraction of articles from the databases and removal of duplicates, titles and abstracts were screened against the inclusion and exclusion criteria. A content analysis was then undertaken with the papers satisfying the inclusion criteria. Where the review of the full text revealed a paper that did not meet inclusion criteria, it was excluded from further analysis. The title and abstract screening and content analysis were performed by two independent reviewers (Figure 2).

Based on the conceptual framework (Figure 1), motivational factors were grouped into five categories: 1) Health facility related factors; 2) Personal and lifestyle factors; 3) Medical training and curriculum factors; 4) Medical school factors; and 5) Policy related factors.



136

137 **Figure 2: Articles selection process**

Results

The initial database search identified 891 articles, and following the removal of duplicates and a title and abstract scan, 101 articles were included in the full text review. A further 64 papers were excluded following full text review. Thirty-three studies were included in this review. The review included 19 cross-sectional studies, 5 qualitative studies, 4 systematic reviews, 2 reviews and one each of cohort, case control and mixed (qualitative and quantitative) studies. There were 22 articles from high-income countries, 2 each from upper middle-income and lower-middle income countries and 7 articles from low-income countries in this review (26). The characteristics of the 33 included articles can be seen in Table 1.

Table 1: Characteristics of articles reporting factors influencing motivation of medical students to work in rural areas following graduation

A summary of the factors influencing the motivation of medical students to work in rural areas after graduation is listed in Table 2 (See Additional File 1).

Factors influencing motivation of medical students to work in rural areas following graduation

Health facility related factors

Health facility related motivating factors and impediments for rural practice were found in 7 articles. Fourteen health facility related factors were identified from these articles.

Examples of motivating factors for rural practice included medical students from Uganda expecting that communication with patients in rural areas would be easier (27) than with those in urban areas. In Nepal, students perceived that financial

incentives offered by the government earmarked for certain rural locations acted to motivate their decision to work in rural areas (5). Findings from a cross-sectional study from Australia suggests that higher salaries for practicing in rural areas was a motivation for medical students (28). Examples of impediments for rural practice included studies from low-income countries with perceived lack of infrastructure, equipment, supplies and communication facilities within the rural health facility (27,29–31). In Malawi and Australia, expectations of a high after-hours work load in rural health facilities and high community expectations of physicians were the impediments for practising in rural areas (29,32). Poor hospital management in the rural areas was a perceived impediment to rural medical practice among the students in Uganda and Ghana (27,30). Limited professional development opportunities and support were perceived as impediments among students for future career in rural locations in Nepal and Australia (28,31).

Personal and lifestyle factors

Personal and lifestyle related motivating factors and impediments for rural practice were found in 22 articles, reporting 38 personal and lifestyle related factors. Examples of personal and lifestyle motivating factors include findings from Nepal, South Africa, Canada and United States, where male students are more likely than females to practice in rural areas (5,8,33–37). Rural background of the student, such as being born in a village, was a motivating factor reported from Ethiopia (9), Australia (38) (32,39,40), Canada, New Zealand and the UK (41–43). Completing their elementary school in rural area in Ghana, Nepal, United States (44) and Canada (44) (35) influenced medical students for future rural practice (5,33,45). Having lived in a rural community was a motivating factor for students to return to rural areas for

188 medical practice in Ghana (27,45). Having a spouse or parents from rural area (46)
189 was a motivating factor for students in the United States.
190 Students with a paramedical background prior to medical school, completing their
191 high school at an older age and lower grades in medical school were some
192 characteristics found linked with working in rural areas of Nepal (33). Two studies
193 from the United States and Canada have reported that future career intentions to
194 specialise in Family Practice or Primary Care is a positive, motivating factor towards
195 working in rural areas (14,42,47).
196 Students perceived diverse work experience, rewarding work and a sense of being
197 appreciated by the rural people as positive motivators for medical practice in rural
198 areas in Australia (28,32,40). Medical students from lower socioeconomic status in
199 Ghana are more motivated to work in rural areas following graduation. The reason for
200 this according to the study author is due to greater understanding of poverty that
201 motivates them to help the poor (45). In Malawi, medical students' personal values
202 motivate them to serve in rural areas, considering rural service as a part of their duty
203 as a citizen (29).
204 Examples of impediments include the needs of the spouse and families for better
205 education for children, perceived to be available in the cities and not rural areas, as
206 reported from Ghana (30) and Australia (28,32,48). The perceived lack of proper
207 housing in a Malawian study (29), perceived lack of recreation and entertainment
208 facilities for themselves and the families (27) and the perception of being isolated
209 from friends and family circles along with high travel costs associated with travel to
210 and from the rural areas and are impediments for medical practice in rural areas of
211 Ghana (27).

Another factor not favouring work intentions in rural area is the perception of difficulties in relocating to urban areas, if they choose to later on. (28).

Medical training and curriculum factors

Medical training and curriculum related motivating factors and impediments for rural practice were found in 7 articles. Seven health facility related factors were identified from the articles reviewed.

Examples of medical training and curriculum related motivating factors from a lower middle-income country, Ghana, shows that medical curriculum, including rural posting and training in rural areas motivates and prepares a medical student for future practice in rural areas (27). Students in Nepal perceive that training in resource constrained settings of rural areas as a medical student prepares them for medical practice in those areas (31). Studies from high-income countries, such as Canada, New Zealand, United Kingdom and United States also show that medical training and educational exposure in rural areas, have a positive influence on the student towards working in rural areas following graduation (35,41–43,49,50). In a cross-sectional study from the United States, students from urban medical school who participated in preclinical rural electives developed positive intentions towards working in rural areas (51). Community based education in Japan motivates students to work in rural areas following graduation (52,53). Reviews have concluded that the medical education curriculum that includes rural service, rural rotation, rural posting and early exposure of the medical student to the community, motivate students for future practice in rural areas in high income countries (14,40,42,43). Rural posting is reported by a cohort study from Australia to encourage medical students to practice in rural areas (39).

Medical school related factors

236 Medical school related motivating factors and impediments for rural practice were
237 found in 5 articles. Five medical school related factors were identified from the
238 articles reviewed.

239 Examples of medical school related motivating factors from Canada and New Zealand
240 show that medical school admission criteria prioritising students with a rural
241 background, students with a preference for rural areas and students with career
242 preference for family practice or primary care has resulted in increased motivation for
243 medical practice in rural areas (42,43). Medical students from rural medical schools
244 are likely to work in rural areas following graduation (43,54). Students are found to be
245 positively influenced by the training schools in rural areas in Canada (42).

246 Example of medical school related impediments includes high tuition fees paid for the
247 education in Nepal which is associated with no interest in working in rural areas (5)

249 ***Policy related factors***

250 In Nepal, government scholarship schemes provided to students with rural
251 background have been reported as a positive factor to influence their motivation.
252 Students who receive these scholarships are obliged to serve in a rural area for a
253 certain number of years (5).

254 **Discussion**

255 The health facility related factors (which are generally related to the development of
256 the national health system) identified in this study are impediments for medical
257 students to work in rural areas due to perceived shortcomings in the rural health
258 facilities. Lack of equipment and supplies, lack of peer support, poor hospital
259 management, and added burden of administration and high expectation from the
260 community is perceived to have a very strong repelling effect among the medical

261 students involved. The only motivating factor related to health facility was identified
262 to be the provision of extra financial incentive for working in rural areas (5,28).
263
264 Rural areas may differ from country to country; however, studies suggest that rural
265 background of a medical student in any country motivate them to work in the rural
266 area of that country. The choices of the individuals are influenced by the personal
267 circumstances of marriage, spouse's choice, family needs, and lifestyle choice for
268 living, housing and recreation. the personal factors identified in this review are mostly
269 impediments that drive individuals away from practicing in rural areas. Personal
270 experiences and exposure of rural areas is likely to motivate the individual to enjoy
271 rural lifestyles and thus work in rural areas. Interest in the rural lifestyle, perceived
272 friendly environment, expected less pressure or stress, expected opportunity to gain
273 administrative skills, perceived better patient relations, motivate students towards
274 working in rural areas.
275 Relevant factors for medical students are the medical training and curriculum factors.
276 Community-based education gives positive motivation to the student towards rural
277 communities. Rural trainings are expected to bring the student closer to the
278 community. The community based education curriculum builds on the personal factor
279 of rural experience, hence motivating the students for medical practice in rural area as
280 mentioned earlier.
281 Closely linked to the education and curriculum factor is the medical school factor. As
282 the medical school plays an important role from selection of the candidates to
283 implementing its curriculum to producing a doctor, the use of appropriate selection
284 criteria is very important. The findings suggest that schools with criteria to select
285 students with a rural background, experience and education motivate medical students

286 to serve in rural area after graduation. The location of the school being in a rural area
287 also adds to the motivation of the trained medical students towards rural areas. A
288 medical school related impediment to rural practice is high tuition fees paid at private
289 medical school.

290 Policy factors are more related with the health and educational system of the country.
291 The factors influence students to voluntarily opt for rural practices as a privilege they
292 have received in return of a scheme which provide them benefit as a student in terms
293 of education cost or opportunities. Students who opt for these schemes before the
294 start of their medical training are already aware about the obligation the scheme
295 entails. They voluntarily opt for the schemes in order to start their medical education.

296 **Relationship between the factors**

297 All the five categories of factors are linked with the income level of the country. The
298 health facility factors may play a more important role in low-income countries, where
299 the disparities between urban and rural facilities are greatest. Personal factors exert
300 influence in countries of all income groups. While studies are more available from
301 high-income countries regarding the medical education, curriculum and school
302 factors, the low- and lower-middle income countries also report factors related to
303 location of school and community based education. Policy factors have their own
304 motivations relevant for the citizens of their country. The factors are also linked with
305 each other. Rural background, education and exposure are closely linked to medical
306 school factors such as student intake criteria. While the rural background of the
307 student may not be modifiable at the level of medical school, the medical school
308 selection processes could be adjusted to allow entry of more students from rural
309 backgrounds. The medical school factors are linked across all the above-mentioned
310 categories of factors. Rurally located medical colleges with community-based

311 curriculum may develop student interest in rural areas, which is also considered a
312 personal factor.

313 **Limitations of the study**

314 The search strategy to include only English language could have resulted in missing
315 some relevant articles in other languages. The choice of key words and their
316 combinations may have limited the search results to the identified studies in this
317 review. However the list of articles found, include articles from high-income to low-
318 income countries across the globe.

319 **Conclusions**

320 Within high-income countries, there is recognition of the factors influencing medical
321 students' motivation to work in rural areas after graduation. Understanding of the
322 factors influencing medical graduates in low- and middle income-countries is,
323 however, limited. The current review suggests that amongst the powerful motivators
324 for rural practice following graduation is rural background. Other factors of influence
325 highlighted in the current review include rural location of medical schools. Providing
326 students with the opportunity to train in a rural area and be acquainted with the rural
327 lifestyle during the training may be one approach to enhancing motivation to practice
328 in rural areas following graduation. Together, rural background and community based
329 medical education, perhaps act to increase student exposure to the needs of rural
330 communities and the personal benefits of rural practice. Available interventions
331 around the world may be strengthened by considering one or more of these factors
332 targeting to increase motivations among the medical students. There is a need for
333 further research to identify country specific interventions taking the locally relevant
334 factors.

335 **Competing Interests**

336 There are no competing interests to be declared.

337 **Authors' information**

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349 **Authors' contributions**

350 SSB, PZ, PKP & AJS, all contributed to the conception of the study. SSB, PZ & AS
351 analyzed and interpreted the data of the work. Drafting of the manuscript and revising
352 it critically for the important intellectual content was done by SSB & PZ. Manuscript
353 preparation, editing and finalizing of the version to be published is the work of SSB,
354 PZ, PKP & AS. All authors agree to be accountable for all aspects of the work related
355 to the integrity of the work.

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360 **Data sharing statement**

361 No additional data are available.

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**Table 1: Characteristics of articles reporting factors influencing motivation of
medical students to work in rural areas following graduation**

Author (Year)	Country	Income Group of Country	Study type
Ahmed et al. 2011(6)	Bangladesh	Low income	Cross-sectional
Azer, Simmons & Elliot 2001(32)	Australia	High income	Cross-sectional
Bailey at al. 2012(29)	Malawi	Low income	Qualitative
Barrett, Lipsky & Lutfiyya 2011(49)	North America	High income	Review
Bazargan et al. 2006(47)	United States	High income	Cross-sectional
Brooks et al. 2002(14)	United States	High income	Review
Clark et al. 2013(39)	Australia	High income	Cohort
Crampton, McLachlan & Illing 2013(41)	United Kingdom	High income	Review

Crump, Fricker & Ziegler 2009(51)	Unites States	High income	Cross-sectional
Curran & Rourke 2004(42)	Canada	High income	Review
Deaville & Grant 2011(50)	United Kingdom	High income	Qualitative
Deressa & Azazh 2012(9)	Ethiopia	Low Income	Cross-sectional
Eley et al. 2012(40)	Australia	High income	Mix Method
Hsueh, Wilkinson & Bills 2004(43)	New Zealand	High income	Review
Huntington et al. 2012(5)	Nepal	Low Income	Cross-sectional
Kaye et al. 2010(27)	Uganda	Low Income	Qualitative
Kotha et al. 2012(45)	Ghana	Lower-middle Income	Cross-sectional
Kruk et al. 2010(30)	Ghana	Lower-middle Income	Cross-sectional
Okayama & Kajii 2011(52)	Japan	High income	Cross-sectional
Orpin & Gabriel 2005(28)	Australia	High income	Cross-sectional
Pretorius, Milling & Mcguigan 2008(44)	United States	High income	Case Control
Ranmuthugala et al. 2007(54)	Australia	High income	Review
Roberts et al. 2012(48)	Australia	High income	Qualitative
Rosenblatt & Andrilla 2005(36)	United States	High income	Cross-sectional
Ross 2007(37)	South Africa	Upper-middle Income	Qualitative
Royston et al. 2012(46)	United States	High income	Cross-sectional

Shankar & Thapa 2012(31)	Nepal	Low Income	Cross-sectional
Tani et al. 2014(53)	Japan	High income	Cross-sectional
Tate & Aoki 2012(35)	Canada	High income	Cross-sectional
Van Wyk, Naidoo & Esterhuizen 2010(8)	South Africa	Upper-middle Income	Cross-sectional
Walker et al. 2012(38)	Australia	High income	Cross-sectional
Wayne et al. 2010(55)	United States	High income	Cross-sectional
Zimmerman, Shakya & Pokhrel 2012(33)	Nepal	Low Income	Cross-sectional

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ADDITIONAL FILE 1

Table 2: Summary of articles reporting factors influencing motivation of medical students to work in rural areas following graduation

Author/Year	Country	Study	Key Findings
Ahmed 2011(6)	Bangladesh	Cross-sectional	<ul style="list-style-type: none"> Four percent of medical students interested to practice in rural areas
Azer 2001(32)	Australia	Cross-sectional	<ul style="list-style-type: none"> Students from rural background more willing to practice in rural areas. Rural students stated spouse/partner needs and school availability as influencing factors for rural job Urban students stated personal factors, higher education opportunities, socio/cultural facilities and the need for frequent travelling as key influencing factors for rural job. Advantages of rural jobs stated were: doctors better appreciated by rural people, friendly environment, higher salaries, less pressure and stress Disadvantages of rural jobs stated were: lack of facilities, isolation from families, afterhours workload, less opportunities for postgraduate studies, lack of peer support and consultation and high expectations from community
Bailey 2012(29)	Malawi	Qualitative	<ul style="list-style-type: none"> Postgraduate specialisation as the most important factor for career choice Motivators for rural practice were to get associated to district people, see cases that do not reach central hospitals, to work for the people from home district, to get management skills of administration of hospital and performing duty as a loyal citizen to the community. De-motivators for rural practice were: huge workload, high expectation from the community, trade off to administrative work over clinical work, lack of resources, lack of proper housing, poor living conditions, and lack of good opportunities for private practice, lack of equipments and lack of good schools for the children.
Barrett 2011(49)	North America	Review	<ul style="list-style-type: none"> Rural Training experience influence career choice and practice location Rural training is valued by the medical students as positive learning experience for rural practice.

Bazargan 2006(47)	United States	Cross-sectional	<ul style="list-style-type: none">Concerns on finances played important role in career choice.Interest in primary care specialty showed higher likelihood of working in underserved areas
Brooks 2002(14)	United States	Review	<ul style="list-style-type: none">Rural upbringing, family physician as specialty preference, medical curriculum committed to rural service and rural rotation strongly influenced medical practice in rural area.
Clark 2013(39)	Australia	Cohort	<ul style="list-style-type: none">Rural background was associated with uptake of medical practice in rural areasExtended placement in rural areas motivated students to take up medical practice in rural area more than rural background.
Crampton 2013(41)	United Kingdom	Review	<ul style="list-style-type: none">Rural exposure during undergraduate training and rural background increased the likelihood of medical practice in rural areas.
Crump 2009(51)	United States	Cross-sectional	<ul style="list-style-type: none">Rural Medical Elective from urban medical school increased the likelihood of medical practice in rural areas.
Curran 2004(42)	Canada	Review	<ul style="list-style-type: none">Students are attracted to rural practice location by rural training curriculum, rural training environments and rural background of students.Medical school admission criteria selecting students with rural preference, primary care specialty preference, Community oriented medical curriculums and rural practice experience are medical education factors influencing medical practice at rural areas.
Deaville 2011(50)	United Kingdom	Qualitative	<ul style="list-style-type: none">Anxiety and expectation associated with rural area, distance from friends, isolation while living, limited communication facilities and expensive travel to and from rural area were associated with impediments for rural practice.
Deressa 2012(9)	Ethiopia	Cross-sectional	<ul style="list-style-type: none">Thirty percent student expressed interest to practice medicine in rural area.Students from rural background had better odds of medical practice in rural areas.
Eley 2012(40)	Australia	Mix Method	<ul style="list-style-type: none">Interest for rural lifestyle, rural background, and time spent at the rural clinical posting motivated for medical practice at rural areas.

			<ul style="list-style-type: none"> • Personal and family reasons such as marriage, starting family had strong influence in career choices.
Hsueh 2004(43)	New Zealand	Review	<ul style="list-style-type: none"> • Students from rural origin showed more positive attitude towards medical practice in rural areas. • An admission criterion for selecting rurally oriented students is strong factor for choosing a rural practice career. • Medical Education in rural area, community based teaching are important motivators for students to choose rural area for practice. • Preceptors have been seen as role models for influencing rural practice among students.
Huntington 2012(5)	Nepal	Cross-sectional	<ul style="list-style-type: none"> • Male students, government secondary school graduate before joining medical school, born in a village, sense of duty for the country and financial incentives for rural careers and scholarship for medical schooling from government were associated with career intentions at a rural place. • High-income family, self-paying private medical school students and feeling of isolation were associated with no intentions for working at rural areas.
Kaye 2010(27)	Uganda	Qualitative	<ul style="list-style-type: none"> • Prior exposure to the community, Community based education, role of family and friends, career development opportunities, teamwork and friendly environment of co-workers are positive motivators for career choice in rural areas. • Security concerns as political stability of the area and personal safety, workload, communication, transport, family, language, ease of communication with patients, cost of living, benefits, local people culture, opportunity for recreation, school for children, possibility of extra income, equipment, facility infrastructure, and continuing education facilities. • Serious de-motivators for rural factors were insufficient salary, high workload with understaffing, poor hospital management, poor accommodation, lacking equipments, isolation from friends, lack of entertainment and inadequate opportunities for continuing professional development.

Kotha 2012(45)	Ghana	Cross-sectional	<ul style="list-style-type: none">• Fifty seven percent of students are willing to work in rural areas.• Rural practice willingness was seen among male, those who completed high school in rural area, rural living experience and lower socioeconomic class medical students.
Kruk 2010(30)	Ghana	Cross-sectional	<ul style="list-style-type: none">• Job preference in rural area was strongly associated with improving the equipment and supportive management.• Other factors: shorter contracts, increment in salaries, facilities for children education, transport utility and improving housing were also influential.• Male were more influenced by improved housing while females were more influenced by supportive management.
Okayama 2011(52)	Japan	Cross-sectional	<ul style="list-style-type: none">• Community based education motivates the medical student for community health care.
Orpin 2005(28)	Australia	Cross-sectional	<ul style="list-style-type: none">• Over a third of the first year students and more than half of the third years students are willing to practice in rural areas after graduation.• Factors important to influence career choices are professional and peer support, rural working conditions, variety of work, flexibility at work, need of the partner, good income, further study opportunities and children needs.• Students perceived rural practice motivations are better patient relations, diverse work experiences and rewarding work.• Impediments are less financial incentives, professional isolation, and fewer opportunities for further studies, limiting future practice options, difficult for partner, difficulty in moving back to urban area and difficulties for children needs.• Rural course work was not reported as an influence in career choice in rural area.
Pretorius 2008(44)	United States	Case Control	<ul style="list-style-type: none">• Medical students from rural high school background are more likely to practice in rural area.
Ranmuthugala 2007(54)	Australia	Review	<ul style="list-style-type: none">• Rural clinical schools and curriculum focusing on rural health motivate practice in rural area.

Roberts 2012(48)	Australia	Qualitative	<ul style="list-style-type: none"> Geographic isolation from friends and family, limited career options for partners, limited education opportunities for children, heavy workload were reported as barriers for rural practice intentions among students.
Rosenblatt 2005(36)	United States	Cross-sectional	<ul style="list-style-type: none"> Males more motivated to work in rural areas. Student debt was not seen as influencing career decision for rural area.
Ross 2007(37)	South Africa	Qualitative	<ul style="list-style-type: none"> Students from rural background return to practice in rural areas.
Royston 2012(46)	United States	Cross-sectional	<ul style="list-style-type: none"> Intentions to practice in rural area were associated with rural upbringing of students and having spouse or parents from rural area. Extraversion personality type students were more likely to intend for rural practice. Students reported financial incentives as possible motivator for rural practice.
Shankar 2012(31)	Nepal	Cross-sectional	<ul style="list-style-type: none"> Students reported lack of adequate facilities, inadequate salaries, less security, fewer opportunities for further education, less medical equipments, isolation from family and less literacy of rural people as de-motivators for rural practice. Spending more learning in rural area, training in resource constraint settings could motivate the students. High tuition fees at medical school influences the career location choice of student.
Tani 2014(53)	Japan	Cross-sectional	<ul style="list-style-type: none"> Community based medical education and early exposure to community increases motivation among students to work for rural community
Tate 2012(35)	Canada	Cross-sectional	<ul style="list-style-type: none"> Male students, rural living experience, attended rural school and rural medical education experiences are related to influencing practice at rural area.
Van Wyk 2010(8)	South Africa	Cross-sectional	<ul style="list-style-type: none"> Eight percent of students intended for rural practice. Female students were less likely to go for rural careers. Students from rural origin not likely to opt for rural practice.
Walker 2012(38)	Australia	Cross-	<ul style="list-style-type: none"> Rural origin of the student, Rural Clinical School motivates medical students for rural practice.

		sectional	
Wayne 2010(55)	United States	Cross-sectional	<ul style="list-style-type: none">Rural background, older age (>25 years) at matriculation and member of underrepresented minority
Zimmerman 2012(33)	Nepal	Cross-sectional	<ul style="list-style-type: none">Male students, rural background, rural birthplace, attended high school in rural area, older age at matriculation, prior medical background before medical school and lower grades in medical school are associated with rural practice in Nepal.



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2&3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3 & 4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	No
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	6
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	N/A
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	N/A

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PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	N/A
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	7 & 8
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	8
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	N/A
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	N/A
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	N/A
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	12-14
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	14
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	15
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	N/A

41 From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097.
42 doi:10.1371/journal.pmed1000097

43 For more information, visit: www.prisma-statement.org.

BMJ Open

Factors influencing medical students' motivation to practice in rural areas in Low and Middle Income Countries: a systematic review

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TITLE PAGE

Factors influencing medical students’ motivation to practice in rural areas of low and middle income countries: a systematic review

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Abstract

Objectives

The choice to practice medicine in a rural area is influenced by many factors. Motivation developed as a medical student is one key determinant of this choice. This study explores influences on medical students' motivation to practice in rural areas of low and middle income countries following graduation.

Design

A systematic review was conducted to identify influences on medical students' motivation to work in rural areas in low and middle income countries. Papers reporting influences on motivation were included, and content analysis was conducted to select the articles. Articles not published in English were excluded in this review.

Results

Motivators identified included rural background, exposure to the health needs of people in rural areas, and a pre-existing personal preference for rural area work. Perceived lack of infrastructure, high workload, poor hospital management and isolation are among the health facility factors that demotivate medical students for medical practice in rural areas. A rural background (i.e., being brought up in a rural area), training in rural areas with community-based curriculum, early exposure to the community during medical training and rural location of medical school motivate medical students to work in rural areas.

Conclusions

The factors relevant for medical students' choosing rural areas for their practice are rural background, medical training, curriculum and medical school factors. The identification of these factors may assist the planners, medical educators and policy makers in low and middle income countries in designing relevant interventions to

51 positively influence rural choices where the shortage of rural physicians is an ongoing
52 and increasing concern.

53 **Key words:** Motivation, medical students, medical education, rural health

54
55 **Strengths and limitations of this study**

- 56 • This study focuses on the motivating factors among medical students unlike
57 most studies which focus on medical doctors and specialists.
- 58 • Using a conceptual framework based on a problem tree approach structured
59 the findings and discussion.
- 60 • This study is relevant for all low and middle income countries that face
61 challenges for recruiting medical doctors to work in rural areas.
- 62 • The inclusion of English language articles only in this review may have
63 resulted in missing out of some possibly important papers published in other
64 languages.
- 65 • The conclusion is based on low quality evidence only, as studies with
66 moderate and high evidence was not found in literature search.

67
68 **Introduction**

69 Approximately half of the world’s population resides in rural areas, while less than
70 25% of physicians provide services to rural communities (1). Poor access to health
71 workers impacts more than one billion people (1), with communities in Africa and
72 Southeast Asia experiencing the most significant disadvantage (2). Unequal
73 distribution of health care workers between urban and rural area leads to poorer health
74 among rural people (3,4). Inadequate qualified health workers in rural areas affects

the access to health services for a large proportion of people living in rural areas. This in turn affects the health and development related indicators of the countries(5). In a cross-sectional study in 2012, nine out of ten students in Nepal intended to work in Nepal after graduation from medical school, but only 1 out 10 were interested in possibly working in rural areas (6). In similar studies since 2010 in other countries, career intentions in rural locations among medical students are reported very low in Bangladesh (7) Sub Saharan Africa (8), and South Africa (9). Studies from India and Ethiopia show slightly higher rates of about 1 out of 5 medical students showing career interest in rural locations after graduation (10,11). Decisions made by new doctors about where to establish their careers are influenced by a range of personal, economic, familial, cultural and environmental factors (12). Medical training, local and national policy, and factors related to the location of the health facility also play a role in career decisions (13). Decisions about practice location are made during medical training (14,15). Experiences during medical school have a powerful influence over many students' choices (16). Many determinants contribute to medical graduates' choices relating to career locations (17). It is an important and difficult decision for many medical graduates about where to commence their career. The choice influences future career choices and opportunities, as well as family and social life (18). Understanding what motivates the medical students at the time they are making this choice will assist medical educators, researchers and policy makers to more effectively structure their educational experiences and establish appropriate motivations that encourage more medical graduates to practice in rural settings (19,20). The World Health Organization has recommended a set of interventions to increase the access of health workers in rural areas globally(5). Relevant reviews can be found regarding medical students'

motivation to work in rural areas of high income countries. The factors identified in reviews from high income countries include rural background of the medical student and the medical school selection criteria to select the students with rural background as motivators for future rural practice(15,21–25). Rural areas of high-income countries are not comparable to the rural areas of low and middle income countries (LMICs) and differ by income groups of countries, yet the motivation for working in rural areas is a challenge faced by all countries. Reviews focusing on medical students’ motivation to work in rural areas in low and middle income countries was not found in literature search. The current study sought to review the literature to identify factors influencing medical students’ motivation to practice in rural areas following graduation.

Methods

Study Design:

A literature review was conducted in PUBMED, COCHRANE library, SCOPUS, EMBASE, ERIC, and Google Scholar databases in 2016 by two independent researchers.

Conceptual framework

The Bland model (26), illustrating the student characteristics and school characteristics that play roles in making a choice of future specialty was used as a reference to prepare a problem tree, which was used to develop a conceptual framework for content analysis, where motivation among the students is a dependent variable influenced by these factors. Individual, work, social and environmental factors interact to influence motivation. These factors guided the construction of the broad categories of a problem tree for medical students' motivation (27,28). (Figure 1).

Figure 1: Conceptual Framework

Search Strategy:

Keywords and Medical Subject Headings (MeSH) were used for each of the three concepts of interest.

Medical students: 'medical students' OR 'undergraduate medical students'.

Motivation: 'motivation' OR 'career choice' OR 'intention'.

Location: 'rural areas' OR 'underserved area' OR 'remote area' OR 'rural practice'.

We used the search strategy, (((((((("undergraduate medical student") OR "medical student") AND motivation) OR "career choice") OR intention) AND "rural area") OR "remote area") OR "Rural practice") for Pubmed search.

Inclusion and exclusion criteria:

The inclusion criteria were set to include all articles that were published between 2000 and July 2016 in peer reviewed journals and reported factors influencing medical students' motivation to work in rural areas. Definitions of 'rural area' differ from author to author and from country to country (29–31). For this study, the author's use of the terms 'rural area' or 'underserved area' were accepted. Studies reporting practice in low and middle income countries were included. Articles from high income countries and articles not published in English were excluded.

Outcome measurement

The outcome of interest in this review is the motivation of medical students to work in rural areas following graduation.

Data collection:

Following extraction of articles from the databases and removal of duplicates, titles and abstracts were screened against the inclusion and exclusion criteria. A content analysis was then undertaken with the papers satisfying the inclusion criteria. Where

the review of the full text revealed a paper that did not meet inclusion criteria, it was excluded from further analysis. The title and abstract screening and content analysis were performed by two independent reviewers. The complete article selection process is reported using the PRISMA flowchart (Figure 2). The PRISMA checklist was used to guide the report writing of the systematic review(32).

Synthesis of results

Based on the conceptual framework (Figure 1), motivational factors extracted from the papers in this review, were grouped into five categories: 1) Health facility related factors; 2) Personal and lifestyle factors; 3) Medical training and curriculum factors; 4) Medical school factors; and 5) Policy related factors.

Figure 2: Articles selection process

Quality assessment

The quality of evidence was assessed using the Grading of Recommendations: Assessment, Development and Evaluation (GRADE) approach for Observational studies(33). The articles in this review were independently assessed for quality by two reviewers and then agreement was reached on the final quality.

Results

The initial database search identified 1,862 articles, and following the removal of duplicates and a title and abstract scan, 109 articles were included in the full text review. A further 97 papers were excluded following full text review (24 papers from high income countries study & 72 papers not fitting the inclusion criteria). Thirteen studies were included in this review. The review included 8 cross-sectional studies, 2 qualitative studies, and 2 mixed (qualitative and quantitative) studies and 1 discrete choice experiment. There were 2 articles from upper middle-income, 3 articles from lower-middle income countries, 7 articles from low-income countries

and 1 article covering lower middle- and upper middle- income countries in this review (34). The characteristics of the 13 included articles can be found in Table 1.

Table 1: Characteristics of articles reporting factors influencing motivation of medical students to work in rural areas following graduation

A summary of the factors influencing the motivation of medical students to work in rural areas after graduation is listed in Table 2 (See Additional File 1).

Factors influencing motivation of medical students to work in rural areas following graduation

Health facility related factors

Health facility related motivating factors and impediments for rural practice were found in 7 articles. Motivating factors for rural practice included medical students from Uganda expecting that communication with patients in rural areas would be easier, better teamwork, friendly environment(35), staff would be more supportive(36) and more career development opportunities(35) than in urban areas. The students perceived that financial incentives(6) in Nepal or higher salaries(36,37) in Botswana and India and provision of good housing(37,38) in Ghana and India for rural locations acted to motivate their decision to work in rural areas. Impediments for rural practice included studies from low-income countries with perceived lack of infrastructure, equipment, supplies and communication facilities within the rural health facility (35–40). In Botswana, the expected weak referral system in health and poorly functioning health facility were reported as impediments for future rural practice(36). In Malawi, expectations of a high after-hours work load in rural health facilities, trade off to administrative works over clinical work, lack of opportunities for private practice and high community expectations of physicians were the impediments for practising in rural areas (39). Poor hospital management in the rural

200 areas was a perceived impediment to rural medical practice among the students in
201 Uganda and Ghana (35,38). Limited professional development
202 opportunities(36,37,40), professional career stagnation(36) and lack of opportunities
203 for higher education and support(37,40) were perceived as impediments among
204 students for future career in rural locations in Botswana, India and Nepal(40). Rurally
205 located health facilities are considered unsafe during political instability by medical
206 students in Nepal and Uganda(35,40).

207 ***Personal and lifestyle factors***

208 Personal and lifestyle related motivating factors and impediments for rural practice
209 were found in 11 articles. Personal and lifestyle motivating factors include findings
210 from Nepal, South Africa, where male students are more likely than females to
211 practice in rural areas (6,9,41,42). Rural background of the student, such as being
212 born in a village, was a motivating factor reported from Botswana and Ethiopia
213 (10,36). Completing their elementary school in rural area in Ghana, Nepal, influenced
214 medical students for future rural practice (6,41,43). Having lived in a rural community
215 was a motivating factor for students to return to rural areas for medical practice in
216 Ghana (35,43). Perceived proximity to family when working in rural area was a
217 motivating factor for practice in rural areas by students in Botswana(36).
218 Students with a paramedical background prior to medical school, completing their
219 high school at an older age and lower grades in medical school were some
220 characteristics found linked with working in rural areas of Nepal (41). Students
221 perceived diverse work experience as positive motivators for medical practice in rural
222 areas in Botswana(36). Medical students from lower socioeconomic status in Ghana
223 are more motivated to work in rural areas following graduation. The reason for this
224 according to the author of the study is due to greater understanding of poverty that

225 motivates them to help the poor (43). In Malawi, medical students' personal values
226 motivate them to serve in rural areas, considering rural service as a part of their duty
227 as a citizen (39).

228 Impediments include the needs of the spouse and families for better education for
229 children, perceived to be available in the cities and not rural areas, as reported from
230 Ghana (38). The perceived lack of proper housing in a Malawian study (39),
231 perceived lack of recreation and entertainment facilities for themselves and the
232 families and the perception of being isolated from friends and family circles in
233 Botswana and Uganda (35,36) along with high travel costs associated with travel to
234 and from the rural areas are impediments for medical practice in rural areas of Ghana
235 and Uganda (35,38). Students from families with high income was found as a
236 negative predictor for future career location as rural areas in Nepal(6).

237 ***Medical training and curriculum factors***

238 Medical training and curriculum related motivating factors and impediments for rural
239 practice were found in 2 articles. Medical training and curriculum related motivating
240 factors from a low income country, Uganda, shows that community based medical
241 curriculum, including rural posting and training in rural areas motivates and prepares
242 a medical student for future practice in rural areas (35). Students in Nepal perceive
243 that training in resource constrained settings of rural areas as a medical student
244 prepares them for medical practice in those areas (40).

245 ***Medical school related factors***

246 Medical school related motivating factors and impediments for rural practice were
247 found in 3 articles. Medical school selection criteria to select students from rural
248 background was a positive influence to motivate students to rural practice in the
249 future in Philippines, South Africa and Sudan(44).

250 Medical school related impediments includes high tuition fees paid for the education
251 in Nepal which is associated with no interest in working in rural areas (6,40)

252 ***Policy related factors***

253 Policy related factors are reported in 2 articles in this review. In Nepal, government
254 scholarship schemes provided to students with rural background have been reported
255 as a positive factor to influence their motivation. Students who receive these
256 scholarships are obliged to serve in a rural area for a certain number of years (6).
257 Shorter contracts in rural areas was also considered as a potential motivator to opt for
258 rural areas by medical students after graduation in Ghana(38).

259 **Discussion**

260 The conceptual framework provides illustration on how the 5 categories of factors
261 individually to influence the motivation of the medical students to practice in rural
262 areas after graduation (figure 1). The health facility related factors (which are
263 generally related to the development of the national health system) identified in this
264 study are acting mostly as impediments for medical students to work in rural areas
265 due to perceived shortcomings in the rural health facilities. Lack of equipment and
266 supplies, lack of peer support, poor hospital management, and added burden of
267 administration and high expectation from the community is perceived to have a very
268 strong repelling effect among the medical students involved. These are found in
269 studies from all low income countries and in one out of 5 studies from middle income
270 countries.

271 Rural areas may differ from country to country; however, studies suggest that rural
272 background of a medical student in any country motivate them to work in the rural
273 area of that country. The choices of the individuals are influenced by the personal
274 circumstances of marriage, spouse's choice, family needs, and lifestyle choice for

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2
3 275 living, housing and recreation. The personal factors identified in this review are
4
5 276 mostly impediments that drive individuals away from practicing in rural areas.
6
7 277 Personal experiences and exposure of rural areas is likely to motivate the individual to
8
9 278 enjoy rural lifestyles and thus work in rural areas. Perceived friendly environment,
10
11 279 and perceived better patient relations, motivate students towards working in rural
12
13 280 areas.
14
15 281 Relevant factors for medical students are the medical training and curriculum factors.
16
17 282 Community-based education gives positive motivation to the student towards rural
18
19 283 communities. Rural trainings are expected to bring the student closer to the
20
21 284 community. The community based education curriculum builds on the personal factor
22
23 285 of rural experience, hence motivating the students for medical practice in rural area as
24
25 286 mentioned earlier. There is a need for more studies in low and middle income
26
27 287 countries on how the community based medical education and rural based medical
28
29 288 training can motivate medical students to motivate future medical practice in rural
30
31 289 areas.
32
33 290 Closely linked to the education and curriculum factor is the medical school factor. As
34
35 291 the medical school plays an important role from selection of the candidates to
36
37 292 implementing its curriculum to producing a doctor, the use of appropriate selection
38
39 293 criteria is very important. The schools with criteria to select students with a rural
40
41 294 background, experience and education could motivate medical students to serve in
42
43 295 rural area after graduation. The criteria ensuring inclusion of underserved
44
45 296 communities are seen as potential solution to increase the even distribution of doctors
46
47 297 in rural areas(44). This can be seen as an important and a feasible factor to build upon
48
49 298 for intervention to increase medical doctors in rural areas of LMICs. As rural
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51 299 background is a common factor reported in most papers and selection criteria of
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300 selecting students from rural background is also reported as positive influencer for
301 motivation students for rural practice, this needs to be taken as an important area to
302 build upon to address the rural shortage of physicians. Training the students in rural
303 settings adds to the rural interest of the student. Availability of training locations in
304 low income countries is an issue that also may need to be explored. While factors like
305 community based education and rural training is being discussed, it is important that
306 we also pay attention that the health facility in rural areas of low income countries
307 lack even the basic infrastructure, it may be not be justifiable to pursue the rural
308 training as a factor of relevance to increase the rural motivation of medical students.
309 While training in rural health facilities may motivate the students to pursue career in
310 rural location, countries may also need to pay attention to invest in development of
311 rural health facilities.
312 A medical school related impediment to rural practice is high tuition fees paid at
313 private medical school. Policy factors are more related with the health and educational
314 system of the country. Policy factors influence students to voluntarily opt for rural
315 practices, as the students receive financial support in return of a scheme in terms of
316 education cost or opportunities. Students who opt for these schemes before the start
317 of their medical training are already aware about the obligation the scheme entails.
318 They voluntarily opt for the schemes in order to start their medical education. Shorter
319 contracts could also work in favour of motivating rural practice. Taking into account
320 relevant factors, regulations may be needed as recommended by WHO(5), for
321 developing country specific interventions to increase medical doctors in rural areas
322 through motivation of the medical students.
323 It seems evident that the lower the income group a country belongs, the basic factors
324 linked with physical development like infrastructure, health facilities are more

reported as important impediments in possible rural practice in future compared to the medical school and curriculum factors.

Relationship between the factors

All the five categories of factors are linked with the income level of the country. The health facility factors may play a more important role in low-income countries, where the disparities between urban and rural facilities are greatest. Personal factors exert influence in countries of all low and middle income groups. There are lesser studies regarding the medical training & curriculum factors and medical school factors from the low and middle income countries report. These studies report medical school factors related to medical school selection criteria focusing on rural background, training location and community based education. Policy factors have their own motivations relevant for the citizens of their country. The factors are also linked with each other. Rural background, education and exposure are closely linked to medical school factors such as student intake criteria. While the rural background of the student may not be modifiable at the level of medical school, the medical school selection processes could be adjusted to allow entry of more students from rural backgrounds. The medical school factors are linked across all the above-mentioned categories of factors. Training in rural locations along with community-based curriculum may develop student's interest in rural areas, which is also considered a personal factor.

Quality of included studies

All studies included in this systematic review are of low quality and very low quality as classified by the GRADE approach(33) for observational studies.

Limitations of the study

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2
3 349 The search strategy to include only English language could have resulted in missing
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5 350 some relevant articles in other languages. The choice of key words and their
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7 351 combinations may have limited the search results to the identified studies in this
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10 352 review. As only observational studies were found, there were no studies that were of
11
12 353 moderate or high quality of evidence according to the GRADE approach.
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14 **Conclusions**

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16 355 Understanding of the factors influencing medical graduates in low- and middle
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18 356 income-countries is, however, limited. The current review suggests that amongst the
19
20
21 357 powerful motivators for rural practice following graduation is rural background.
22
23 358 Selecting medical students from rural backgrounds seems an important area for low
24
25 359 income countries. Together, rural background and community based medical
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27 360 education, perhaps act to increase student exposure to the needs of rural communities
28
29 361 and the personal benefits of rural practice. Low income countries could also consider
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31 362 ensuring minimum infrastructure of health facilities in rural areas in addition to
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33 363 addressing other important factors. Possible interventions as recommended by
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35 364 WHO(5) could be considered paying attention to one or more of these factors
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37 365 targeting to increase motivations among the medical students for rural areas. There is
38
39 366 a need for further research to identify country specific interventions taking the locally
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41
42 367 relevant factors.
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44
45 **Competing Interests**

46
47 369 There are no competing interests to be declared.
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Authors' contributions

SSB, PZ, PKP & AJS, all contributed to the conception of the study. SSB, PZ & AS analyzed and interpreted the data of the work. Drafting of the manuscript and revising it critically for the important intellectual content was done by SSB & PZ. Manuscript preparation, editing and finalizing of the version to be published is the work of SSB, PZ, PKP & AS. All authors agree to be accountable for all aspects of the work related to the integrity of the work.

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Data sharing statement

No additional data are available.

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Table 1: Characteristics of articles reporting factors influencing motivation of medical students to work in rural areas following graduation

Author (Year)	Country	Income Group of Country	Study type	Quality of Evidence(33)
Arscott-Mills 2016(36)	Botswana	Upper-middle Income	Mix Methods	Low quality
Bailey 2012(39)	Malawi	Low income	Qualitative	Very low quality
Deressa 2012(10)	Ethiopia	Low Income	Cross-sectional	Low quality
Huntington 2012(6)	Nepal	Low Income	Cross-sectional	Low quality
Kaye 2010(35)	Uganda	Low Income	Qualitative	Very low quality
Kotha 2012(43)	Ghana	Lower-middle Income	Cross-sectional	Low quality
Kruk 2010(38)	Ghana	Lower-middle Income	Discrete choice experiment	Low quality
Larkins 2015(44)	Philippines Sudan South Africa	Lower- & Upper- middle income	Cross-sectional	Low quality
Nallala 2015(37)	India	Lower-middle income	Cross-sectional	Low quality
Ross 2007(42)	South Africa	Upper-middle Income	Mix Methods	Low quality
Shankar 2012(40)	Nepal	Low Income	Cross-sectional	Low quality
van Wyk 2010(9)	South Africa	Upper-middle Income	Cross-sectional	Low quality
Zimmerman 2012(41)	Nepal	Low Income	Cross-sectional	Low quality

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Table 2: Summary of articles reporting factors influencing motivation of medical students to work in rural areas following graduation

Author/Year	Country	Key Findings	Factors
Arscott-Mills 2016(36)	Botswana	<ul style="list-style-type: none">Interests to practice in rural area was expressed by 9% students.Rural training of medical students was not found to influence preferred future practice locations rural or urban. <i>Motivators</i> <ul style="list-style-type: none">Monetary compensation, diversity of practice and supportive staff were potential motivators.Medical students with a rural background perceived proximity to their family as a motivator for rural practice. <i>Impediments</i> <ul style="list-style-type: none">Impediments to working in rural areas as mentioned by students are perceived lack of learning opportunities, professional stagnation, isolation, dysfunctional referral systems, poorly functioning health facilities, lack of recreation and poor infrastructure in rural areas.	HF PLS
Bailey 2012(39)	Malawi	<ul style="list-style-type: none">Postgraduate specialisation is the most important factor for career choice <i>Motivators</i> <ul style="list-style-type: none">Motivators for rural practice were to get associated to district people, see cases that do not reach central hospitals, to work for the people from home district, to get management skills of administration of hospital and performing duty as a loyal citizen to the community. <i>Impediments</i> <ul style="list-style-type: none">Impediments for rural practice were: huge workload, high expectation from the community, trade off to administrative work over clinical work, lack of resources, lack of proper housing, poor living conditions, and lack of good opportunities for private practice, lack of equipments and lack of good schools for the children.	HF PLS
Deressa 2012(10)	Ethiopia	<ul style="list-style-type: none">Thirty percent student expressed interest to practice medicine in rural area. <i>Motivators</i> <ul style="list-style-type: none">Students from rural background had better odds of medical practice in rural areas.	PLS
Huntington 2012(6)	Nepal	<ul style="list-style-type: none">Twelve percent of the medical students intended to work in rural areas. <i>Motivators</i> <ul style="list-style-type: none">Male students, government secondary school graduate before joining medical school, born in a village, sense of duty for the country and financial incentives for rural careers and scholarship for medical schooling from government were associated with career intentions at a rural place. <i>Impediments</i> <ul style="list-style-type: none">High-income family, self-paying private medical school students and feeling of isolation were associated with	HF PLS MS P

		no intentions for working at rural areas.	
Kaye 2010(35)	Uganda	<ul style="list-style-type: none"> Medical students have limited exposure to health facilities in the rural areas. <p><i>Motivators</i></p> <ul style="list-style-type: none"> Prior exposure to the community, community based education, role of family and friends, career development opportunities, teamwork and friendly environment of co-workers are positive motivators for career choice in rural areas. <p><i>Impediments</i></p> <ul style="list-style-type: none"> Sense of personal safety, workload, communication, transport, family, language, ease of communication with patients, cost of living, benefits, local people culture, opportunity for recreation, school for children, possibility of extra income, equipment, facility infrastructure, and continuing education facilities. Serious impediments for rural factors were insufficient salary, high workload with understaffing, poor hospital management, poor accommodation, lack of equipment, isolation from friends, lack of entertainment and inadequate opportunities for continuing professional development. 	HF PLS MTC
Kotha 2012(43)	Ghana	<ul style="list-style-type: none"> Fifty seven percent of students are willing to work in rural areas. <p><i>Motivators</i></p> <ul style="list-style-type: none"> Rural practice willingness was seen among male, those who completed high school in rural area, rural living experience and lower socioeconomic class medical students. 	PLS
Kruk 2010(38)	Ghana	<p><i>Motivators</i></p> <ul style="list-style-type: none"> Job preference in rural area was strongly associated with improving the equipment and supportive management. Other factors: shorter contracts, increment in salaries, facilities for children education, transport utility and improving housing were also influential. Male were more influenced by improved housing while females were more influenced by supportive management. 	HF PLS
Larkins 2015(44)	Philippines Sudan South Africa	<ul style="list-style-type: none"> Interest to work with rural and remote population was expressed by 65.9% students in Philippines, 33.5% students in Sudan and 62.8% students in South Africa. <p><i>Motivators</i></p> <ul style="list-style-type: none"> Medical school selection criteria to select students with prior education in rural area expressed intention to serve in rural areas after graduation. 	MS
Nallala 2015(37)	India	<ul style="list-style-type: none"> Willingness to work in rural areas was expressed by 17% of government medical school and 9% of private medical school students. <p><i>Motivators</i></p>	HF PLS

		<ul style="list-style-type: none">• Good housing, high salaries, and adequate infrastructure are perceived as factors that attract medical students toward future rural service. <i>Impediments</i> <ul style="list-style-type: none">• Lack of professional career growth opportunities and opportunities for higher education in rural location are potential impediments towards rural practice.	
Ross 2007(42)	South Africa	<i>Motivators</i> <ul style="list-style-type: none">• Students from rural background return to practice in rural areas.	PLS
Shankar 2012(40)	Nepal	<ul style="list-style-type: none">• High tuition fees at medical school influences the career location choice of student. <i>Motivators</i> <ul style="list-style-type: none">• Spending more learning in rural area, training in resource constraint settings could motivate the students. <i>Impediments</i> <ul style="list-style-type: none">• Students reported lack of adequate facilities, inadequate salaries, less security, fewer opportunities for further education, high tuition fees, isolation from family and less literacy of rural people as impediments for rural practice.	HF PLS MTC MS
van Wyk 2010(9)	South Africa	<ul style="list-style-type: none">• Eight percent of students intended for rural practice. <i>Motivators</i> <ul style="list-style-type: none">• Male students were likely to go for rural careers. <i>Impediments</i> <ul style="list-style-type: none">• Students from rural origin not likely to opt for rural practice.	PLS
Zimmerman 2012(41)	Nepal	<ul style="list-style-type: none">• Twenty seven percent of the medical students are working in rural areas after graduation. <i>Motivators</i> <ul style="list-style-type: none">• Male students, rural background, rural birthplace, attended high school in rural area, older age at matriculation, prior medical background before medical school and lower grades in medical school are associated with rural practice in Nepal.	PLS

HF= Health Facility; PLS= Personal and Life Style; MTC= Medical Training and Curriculum; MS= Medical School; P = Policy

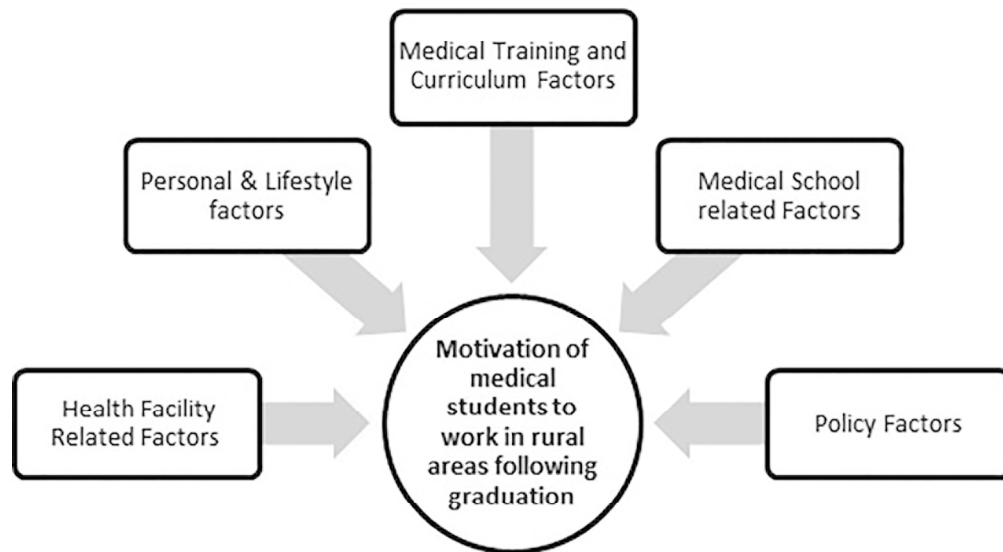


Figure 1: Conceptual Framework
(Figure 1)
184x119mm (300 x 300 DPI)

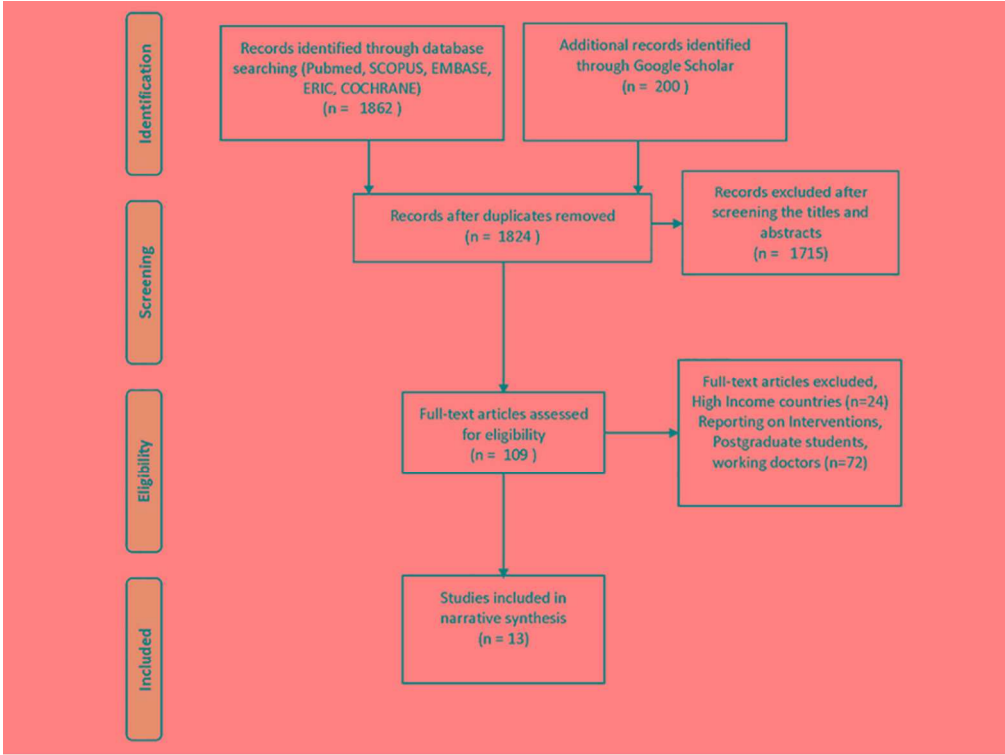


Figure 2: Articles selection process
(Figure 2)
101x76mm (300 x 300 DPI)

((((((("undergraduate medical student") OR "medical student") AND motivation) OR "career choice")
OR intention) AND "rural area") OR "remote area") OR "Rural practice")

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PRISMA 2009 Checklist

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Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2&3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3 &4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	No
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5 & 6
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I ² for each meta-analysis).	N/A

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PRISMA 2009 Checklist

Page 1 of 2

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	7 & 8
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	8, Table 1/2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Table 1 (quality Assessment)
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	N/A
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	N/A
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	12-15
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	16
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	16
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	N/A

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Factors influencing medical students' motivation to practice in rural areas in Low and Middle Income Countries: a systematic review

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TITLE PAGE

Factors influencing medical students’ motivation to practice in rural areas in low and middle income countries: a systematic review

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26 Abstract

27 Objectives

28 There is a shortage of doctors working in rural areas all over the world, especially in
29 low and middle income countries. The choice to practice medicine in a rural area is
30 influenced by many factors. Motivation developed as a medical student is one key
31 determinant of this choice. This study explores influences on medical students'
32 motivation to practice in rural areas of low and middle income countries following
33 graduation.

34 Design

35 A systematic review was conducted to identify influences on medical students'
36 motivation to work in rural areas in low and middle income countries. Papers
37 reporting influences on motivation were included, and content analysis was conducted
38 to select the articles. Articles not published in English were excluded from this
39 review.

40 Results

41 A rural background (i.e., being brought up in a rural area), training in rural areas with
42 community-based curriculum, early exposure to the community during medical
43 training and rural location of medical school motivate medical students to work in
44 rural areas. Perceived lack of infrastructure, high workload, poor hospital
45 management and isolation are among the health facility factors that demotivate
46 medical students for medical practice in rural areas.

47 Conclusions

48 Medical school selection criteria focusing on rural background factor and medical
49 education curriculum focusing on rural area are more relevant factors in low and
50 middle income countries. The factors identified in this review may assist the planners,

51 medical educators and policy makers in low and middle income countries in designing
52 relevant interventions to positively influence rural choices where the shortage of rural
53 physicians is an ongoing and increasing concern.

54 **Key words:** Motivation, medical students, medical education, rural health, low and
55 middle income countries.

56
57 **Strengths and limitations of this study**

58 Strengths

- 59 • This study focuses on the motivating factors among medical students, unlike
60 most studies, which focus on medical doctors and specialists.
- 61 • Using a conceptual framework based on a problem tree approach structured
62 the findings and discussion.
- 63 • This study is relevant for all low and middle income countries that face
64 challenges in recruiting medical doctors to work in rural areas.

65 Limitations

- 66 • The inclusion of English language articles only in this review may have
67 resulted in missing some possibly important papers published in other
68 languages.
- 69 • The conclusion is based on low quality evidence only, as studies with
70 moderate and high evidence was not found in the literature search.

71
72 **Introduction**

73 Approximately half of the world’s population resides in rural areas, while less than
74 25% of physicians provide services to rural communities (1). Poor access to health
75 workers impacts more than one billion people (1), with communities in Africa and

1
2
3 76 Southeast Asia experiencing the most significant disadvantage (2). Unequal
4
5 77 distribution of health care workers between urban and rural area leads to poorer health
6
7 78 among rural people (3,4). This in turn affects the health and development related
8
9 79 indicators of the countries (5).
10
11 80 In a cross-sectional study in 2012, nine out of ten students in Nepal intended to work
12
13 81 in Nepal after graduation from medical school, but only 1 out 10 were interested in
14
15 82 possibly working in rural areas (6). In similar studies since 2010 in other countries,
16
17 83 career intentions in rural locations among medical students are reported very low in
18
19 84 Bangladesh (7), Sub Saharan Africa (8), and South Africa (9). Studies from India and
20
21 85 Ethiopia show slightly higher rates of about 1 out of 5 medical students showing
22
23 86 career interest in rural locations after graduation (10,11).
24
25 87 Decisions made by new doctors about where to establish their careers are influenced
26
27 88 by a range of personal, economic, familial, cultural and environmental factors (12).
28
29 89 Medical training, local and national policy, and factors related to the location of the
30
31 90 health facility also play a role in career decisions (13). Decisions about practice
32
33 91 location are made during medical training (14,15). Experiences during medical school
34
35 92 have a powerful influence over many students' choices (16).
36
37 93 Many determinants contribute to medical graduates' choices relating to career
38
39 94 locations (17). It is an important and difficult decision for many medical graduates
40
41 95 about where to commence their career. The choice influences future career choices
42
43 96 and opportunities, as well as family and social life (18). Understanding what
44
45 97 motivates the medical students at the time they are making this choice will assist
46
47 98 medical educators, researchers and policy makers to more effectively structure their
48
49 99 educational experiences and establish appropriate motivations that encourage more
50
51 100 medical graduates to practice in rural settings (19,20). The World Health Organization
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101 has recommended a set of interventions to increase the access of health workers in
102 rural areas globally (5).
103 Relevant reviews can be found regarding the medical students' motivation to work in
104 rural areas of high income countries. The factors identified in reviews from high
105 income countries include rural background of the medical student and the medical
106 school selection criteria to select the students with rural background as motivators for
107 future rural practice (15,21–27). Rural areas of high-income countries are different
108 from rural areas of low and middle income countries (LMICs) and differ by income
109 groups of countries, yet the motivation for working in rural areas is a challenge faced
110 by all countries.
111 No review focusing on medical students' motivation to work in rural areas in low and
112 middle income countries was found in a thorough literature search. The current study
113 sought to review the literature to identify factors influencing medical students'
114 motivation to practice in rural areas following graduation.

115 **Methods**

116 **Study Design:**

117 A literature review was conducted in PUBMED, COCHRANE library, SCOPUS,
118 EMBASE, ERIC, and Google Scholar databases in 2016 by two independent
119 researchers.

120 **Conceptual framework**

121 The Bland model (28), illustrating the student characteristics and school
122 characteristics that influence the choice of medical specialty was used as a reference
123 to prepare a problem tree, which was used to develop a conceptual framework for
124 content analysis, where motivation among the students is a dependent variable
125 influenced by these factors. Individual, work, social and environmental factors

126 interact to influence motivation. These factors guided the construction of the broad
127 categories of a problem tree for medical students' motivation (29,30). (Figure 1).

128

129

130 **Figure 1: Conceptual Framework**

131 **Search Strategy:**

132 Keywords and Medical Subject Headings (MeSH) were used for each of the three
133 concepts of interest.

134 Medical students: 'medical students' OR 'undergraduate medical students'.

135 Motivation: 'motivation' OR 'career choice' OR 'intention'.

136 Location: 'rural areas' OR 'underserved area' OR 'remote area' OR 'rural practice'.

137 We used the search strategy, ("undergraduate medical student") OR "medical
138 student") AND motivation) OR "career choice") OR intention) AND "rural area") OR
139 "remote area") OR "Rural practice") for Pubmed search.

140 **Inclusion and exclusion criteria:**

141 The inclusion criteria were set to include all articles that were published between
142 2000 and July 2016 in peer reviewed journals and reported factors influencing
143 medical students' motivation to work in rural areas. Definitions of 'rural area' differ
144 from author to author and from country to country (31–33). For this study, the
145 author's use of the terms 'rural area' or 'underserved area' were accepted. Studies
146 reporting practice in low and middle income countries were included. Articles from
147 high income countries and articles not published in English were excluded.

148 **Outcome measurement**

149 The outcome of interest in this review is the motivation of medical students to work in
150 rural areas following graduation.

Data extraction

Following identification of articles from the databases and removal of duplicates, titles and abstracts were screened against the inclusion and exclusion criteria. A content analysis was then undertaken with the papers satisfying the inclusion criteria. Where the review of the full text revealed a paper that did not meet inclusion criteria, it was excluded from further analysis. The title and abstract screening and content analysis were performed by two independent reviewers. The complete article selection process is reported using the PRISMA flowchart (Figure 2). The PRISMA checklist was used to guide the report writing of the systematic review (34). The reported factors influencing medical students to practice in rural areas were extracted using data extraction forms.

Synthesis of results

Based on the conceptual framework (Figure 1), motivational factors extracted from the papers in this review were grouped into five categories: 1) Health facility related factors; 2) Personal and lifestyle factors; 3) Medical training and curriculum factors; 4) Medical school factors; and 5) Policy related factors.

Figure 2: Articles selection process

Quality assessment

The quality of evidence was assessed using the Grading of Recommendations: Assessment, Development and Evaluation (GRADE) approach for Observational studies (35). The articles in this review were independently assessed for quality by two reviewers and then an agreement was reached on the final quality category.

174 Results

175 The initial database search identified 1,862 articles, and following the removal of
176 duplicates and a title and abstract scan, 109 articles were included in the full text
177 review. A further 96 papers were excluded following full text review (24 papers from
178 high income countries study and 72 papers not fitting the inclusion criteria).
179 Thirteen studies were included in this review. The review included 8 cross-sectional
180 studies, 2 qualitative studies, 2 mixed (qualitative and quantitative) studies and 1
181 discrete choice experiment. There were 2 articles from upper middle-income, 3
182 articles from lower-middle income countries, 7 articles from low-income countries
183 and 1 article covering lower middle- and upper middle- income countries (36). The
184 characteristics of the 13 included articles can be found in Table 1.

185 **Table 1: Characteristics of articles reporting factors influencing motivation of** 186 **medical students to work in rural areas following graduation**

187 A summary of the factors influencing the motivation of medical students to work in
188 rural areas after graduation is listed in Table 2.

189 **Table 2: Factors influencing motivation of medical students to work in rural** 190 **areas following graduation**

191 *Health facility related factors*

192 Health facility related motivating factors and impediments for rural practice were
193 found in 7 articles. Motivating factors for rural practice included medical students
194 from Uganda expecting that communication with patients in rural areas would be
195 easier, better teamwork, friendly environment (37). They also expected that staff
196 would be more supportive (38) and that there would be more career development
197 opportunities (37) in rural areas than in urban areas. The students perceived that
198 financial incentives (6) in Nepal or higher salaries (38,39) in Botswana and India and

199 provision of good housing (39,40) in Ghana and India for rural locations acted to
200 motivate their decision to work in rural areas. Impediments for rural practice are
201 reported from studies in low-income countries, as perceived lack of infrastructure,
202 equipment, supplies and communication facilities within the rural health facility (37–
203 42). In Botswana, the expected weak referral system in health and poorly functioning
204 health facility were reported as impediments for future rural practice (38). In Malawi,
205 expectations of a high after-hours work load in rural health facilities, trade off to
206 administrative works over clinical work, lack of opportunities for private practice and
207 high community expectations of physicians were the impediments for practising in
208 rural areas (41). Poor hospital management in the rural areas was a perceived
209 impediment to rural medical practice among the students in Uganda and Ghana
210 (37,40). Limited professional development opportunities (38,39,42), professional
211 career stagnation (38) and lack of opportunities for higher education and support
212 (39,42) were perceived as impediments among students for future career in rural
213 locations in Botswana, India and Nepal (42). Rurally located health facilities are
214 considered unsafe during political instability by medical students in Nepal and
215 Uganda (37,42).

216 ***Personal and lifestyle factors***

217 Personal and lifestyle related motivating factors and impediments for rural practice
218 were found in 11 articles. Personal and lifestyle motivating factors include findings
219 from Nepal, South Africa, where male students are more likely than females to
220 practice in rural areas (6,9,43,44). Rural background of the student, such as being
221 born in a village, was a motivating factor reported from Botswana and Ethiopia
222 (10,38). Completing their elementary school in rural area in Ghana, Nepal, influenced
223 medical students for future rural practice (6,43,45). Having lived in a rural community

was a motivating factor for students to return to rural areas for medical practice in Ghana (37,45). Perceived proximity to family when working in a rural area was a motivating factor for practice in rural areas by students in Botswana (38). Students with a paramedical background prior to medical school, completing their high school at an older age and lower grades in medical school were some characteristics found linked with working in rural areas of Nepal (43). Students perceived diverse work experience as positive motivators for medical practice in rural areas in Botswana (38). Medical students from lower socioeconomic status in Ghana are more motivated to work in rural areas following graduation. The reason for this according to the author of the study is due to greater understanding of poverty that motivates them to help the poor (45). In Malawi, medical students' personal values motivate them to serve in rural areas, considering rural service as a part of their duty as a citizen (41). Impediments include the needs of the spouse and families for better education for children, perceived to be available in the cities and not rural areas, as reported from Ghana (40). The perceived lack of proper housing in a Malawian study (41), perceived lack of recreation and entertainment facilities for themselves and the families and the perception of being isolated from friends and family circles in Botswana and Uganda (37,38) along with high travel costs associated with travel to and from the rural areas are impediments for medical practice in rural areas of Ghana and Uganda (37,40). Students from families with high income was found as a negative predictor for future career location as rural areas in Nepal (6).

Medical training and curriculum factors

Medical training and curriculum related motivating factors and impediments for rural practice were found in 2 articles. Medical training and curriculum related factors from

249 a low income country, Uganda, shows that community based medical curriculum,
250 motivates and prepares a medical student for future practice in rural areas. These
251 factors include rural posting and training in rural areas (37). Students in Nepal
252 perceive that training in resource constrained settings of rural areas as a medical
253 student prepares them for medical practice in those areas (42).

254 ***Medical school related factors***

255 Medical school related motivating factors and impediments for rural practice were
256 found in 3 articles. Medical school selection criteria to select students from rural
257 background was a positive influence to motivate students to rural practice in the
258 future in the Philippines, South Africa and Sudan (46).

259 Medical school related impediments includes high tuition fees paid for the education
260 in Nepal which is associated with no interest in working in rural areas (6,42).

261 ***Policy related factors***

262 Policy related factors are reported in 2 articles in this review. In Nepal, government
263 scholarship schemes provided to students with rural background have been reported
264 as a positive factor to influence their motivation. Students who receive these
265 scholarships are obliged to serve in a rural area for a certain number of years (6).

266 Shorter contracts in rural areas were also considered as a potential motivator for rural
267 areas by medical students after graduation in Ghana (40).

268 **Discussion**

269 The conceptual framework illustrates the influence of each of the 5 categories of
270 factors on the motivation of the medical students to practice in rural areas after
271 graduation (figure 1). The health facility related factors (which are generally related to
272 the development of the national health system) identified in this study are acting
273 mostly as impediments for medical students to work in rural areas due to perceived

shortcomings in the rural health facilities. Lack of equipment and supplies, lack of peer support, poor hospital management, and added burden of administration and high expectation from the community is perceived to have a very strong discouraging effect among the medical students involved. These are found in studies from all low income countries and in one out of 5 studies from middle income countries.

Rural areas may differ from country to country; however, studies suggest that rural background of a medical student in any country motivate them to work in the rural area of that country. The choices of the individuals are influenced by the personal circumstances of one's marriage, spouse's choice, family needs, and lifestyle choice for living, housing and recreation. The personal factors identified in this review are mostly impediments that drive individuals away from practicing in rural areas.

Personal experiences and exposure of rural areas is likely to motivate the individual to enjoy rural lifestyles and thus work in rural areas. Perceived friendly environment, and perceived better patient relations, motivate students towards working in rural areas.

Relevant factors for medical students are the medical training and curriculum factors. Community-based education gives positive motivation to the student towards rural communities. Rural trainings are expected to bring the student closer to the community. The community based education curriculum builds on the personal factor of rural experience, hence motivate medical students to undertake future medical practice in rural area as mentioned earlier. There is a need for more research in low and middle income countries on how the community based medical education and rural based medical training can motivate medical students to further their medical practice in rural areas.

298 Closely linked to the education and curriculum factor is the medical school factor. As
299 the medical school plays an important role from selection of the candidates to
300 implementing its curriculum to producing a doctor, the use of appropriate selection
301 criteria is very important. The schools with criteria to select students with a rural
302 background, experience and education could motivate medical students to serve in
303 rural area after graduation. The criterion ensuring inclusion of underserved
304 communities is seen as a potential solution to increase a more even distribution of
305 doctors in rural areas (46). This can be seen as an important and a feasible factor to
306 consider when designing any interventions to increase the number of medical doctors
307 in rural areas of LMICs. Training the students in rural settings adds to the rural
308 interest of the student. Availability of training locations in low income countries is an
309 issue that also may need to be explored. While factors like community based
310 education and rural training are being discussed, attention should also be paid to the
311 reality that the health facility in rural areas of low income countries lacks even the
312 basic infrastructure. Training in rural health facilities may motivate the students to
313 pursue careers in rural locations. However, countries may also need to invest in the
314 development of rural health facilities.

315 A medical school related impediment to rural practice is high tuition fees paid at
316 private medical schools. National policies that provide financial support for medical
317 education in return for service in rural areas can influence students' choices toward
318 rural practices. They voluntarily opt for the schemes in order to start their medical
319 education. Short contracts could also work in favour of motivating rural practice.

320 Taking into account country specific relevant factors, policy interventions may be
321 designed as outlined by WHO (5), to increase medical doctors in rural areas through
322 the motivation of the medical students.

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3 323 The basic factors linked with physical development like infrastructure and health
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5 324 facilities are more reported as impediments for rural practice in the future from low
6
7 325 income countries compared to middle income countries.
8

9
10 326 **Relationship between the factors**

11 327 All five categories of factors are linked with the income level of the country. There is
12
13 328 likely an interplay between the factors that contribute to the overall shortage of health
14
15 329 workforce in rural areas of low and middle income countries. Addressing factors
16
17 330 individually as well as looking across the factors is important. Strategies that address
18
19 331 multiple influences would be useful. Rural background is the most commonly
20
21 332 reported factor in this review and in some high income countries, some preference has
22
23 333 been given to rural students for medical school admission (47–49). Medical school
24
25 334 factors that include consideration of student admission, curriculum geared towards
26
27 335 rural areas and rural exposure during placement have been reported in the literature
28
29 336 for high income countries as important (23,26,50–54). Although the literature we
30
31 337 found on low and middle income countries had only a limited focus on medical school
32
33 338 factors, potentially developing strategies to create graduates who are more confident
34
35 339 and committed to working in resource-limited rural areas could be helpful. A
36
37 340 sequence of interventions from selective admission for students with a rural
38
39 341 background, community based medical education and clinical training in rural areas
40
41 342 during undergraduate medical education are seen to increase rural practice motivation
42
43 343 among medical students (26). Establishing medical schools in rural areas could be
44
45 344 adopted by governments to potentially increase rural motivation among the medical
46
47 345 students (55). The health facility factors appear to be an important influence in low-
48
49 346 income countries, where the disparities between urban and rural facilities are greatest.
50
51 347 Communities, medical schools and governments all need to work together to develop
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the health infrastructure and staffing of facilities in rural areas. High tuition fees in medical schools reported from low income countries could be linked with the policy intervention of providing scholarships to medical students. This may address the obstacle of high tuition fees to support students from rural areas to attend medical school. Policy of financial aid to students during medical education has been used as a successful strategy in high income countries (56,57). These factors may need further investigation in terms of motivation to work in rural areas following graduation.

Quality of included studies

As the available studies are either cross-sectional, mix-methods or qualitative, the studies included in this systematic review are of either low quality or very low quality as classified by the GRADE approach (35) for observational studies. This affects the quality of evidence generated by this review. However, as these are the only studies that are found for review, the findings may still be valid to summarize the factors influencing medical students’ motivation to practice in rural areas of low and middle income countries. Intervention studies, cohort and case control studies may have generated higher quality of evidence in this subject matter.

Limitations of the study

The search strategy to include only English language could have resulted in missing some relevant articles in other languages. The choice of key words and their combinations may have limited the search results to the identified studies in this review. As only observational studies were found, there were no studies that were of moderate or high quality of evidence according to the GRADE approach.

Conclusions

The current review suggests that amongst the powerful motivators for rural practice following graduation is rural background. Selecting medical students from rural

backgrounds seems an important area for low income countries. Together, rural background and community based medical education, perhaps act to increase student exposure to the needs of rural communities and the personal benefits of rural practice. Low income countries could also consider ensuring minimum infrastructure of health facilities in rural areas in addition to addressing other important factors. Understanding of the factors influencing medical graduates in low- and middle income-countries are, however, limited. Further identification of locally relevant factors may be useful to design country specific interventions.

Competing Interests

There are no competing interests to be declared.

Authors' information

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Authors' contributions

SSB, PZ, PKP & AJS, all contributed to the conception of the study. SSB, PZ & AS analyzed and interpreted the data of the work. Drafting of the manuscript and revising

398 it critically for the important intellectual content was done by SSB & PZ. Manuscript
399 preparation, editing and finalizing of the version to be published is the work of SSB,
400 PZ, PKP & AS. All authors agree to be accountable for all aspects of the work related
401 to the integrity of the work.

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407 **Data sharing statement**

408 No additional data are available.

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570 **Table 1: Characteristics of articles reporting factors influencing motivation of**
571 **medical students to work in rural areas following graduation**

Author (Year)	Country	Income Group of Country	Study type	Quality of Evidence(35)
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Arcscott-Mills 2016(38)	Botswana	Upper-middle Income	Mix Methods	Low quality
Bailey 2012(41)	Malawi	Low income	Qualitative	Very low quality
Deressa 2012(10)	Ethiopia	Low Income	Cross-sectional	Low quality
Huntington 2012(6)	Nepal	Low Income	Cross-sectional	Low quality
Kaye 2010(37)	Uganda	Low Income	Qualitative	Very low quality
Kotha 2012(45)	Ghana	Lower-middle Income	Cross-sectional	Low quality
Kruk 2010(40)	Ghana	Lower-middle Income	Discrete choice experiment	Low quality
Larkins 2015(46)	Philippines Sudan South Africa	Lower- & Upper- middle income	Cross-sectional	Low quality
Nallala 2015(39)	India	Lower-middle income	Cross-sectional	Low quality
Ross 2007(44)	South Africa	Upper-middle Income	Mix Methods	Low quality
Shankar 2012(42)	Nepal	Low Income	Cross-sectional	Low quality
van Wyk 2010(9)	South Africa	Upper-middle Income	Cross-sectional	Low quality
Zimmerman 2012(43)	Nepal	Low Income	Cross-sectional	Low quality

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Table 2: Summary of articles reporting factors influencing motivation of medical students to work in rural areas following graduation

Author/Year	Country	Key Findings	Factors
Arscott-Mills 2016(38)	Botswana	<ul style="list-style-type: none">Interests to practice in rural area was expressed by 9% students.Rural training of medical students was not found to influence preferred future practice locations rural or urban. <i>Motivators</i> <ul style="list-style-type: none">Monetary compensation, diversity of practice and supportive staff were potential motivators.Medical students with a rural background perceived proximity to their family as a motivator for rural practice. <i>Impediments</i> <ul style="list-style-type: none">Impediments to working in rural areas as mentioned by students are perceived lack of learning opportunities, professional stagnation, isolation, dysfunctional referral systems, poorly functioning health facilities, lack of recreation and poor infrastructure in rural areas.	HF PLS
Bailey 2012(41)	Malawi	<ul style="list-style-type: none">Postgraduate specialisation is the most important factor for career choice <i>Motivators</i> <ul style="list-style-type: none">Motivators for rural practice were to get associated to district people, see cases that do not reach central hospitals, to work for the people from home district, to get management skills of administration of hospital and performing duty as a loyal citizen to the community. <i>Impediments</i> <ul style="list-style-type: none">Impediments for rural practice were: huge workload, high expectation from the community, trade off to administrative work over clinical work, lack of resources, lack of proper housing, poor living conditions, and lack of good opportunities for private practice, lack of equipments and lack of good schools for the children.	HF PLS
Deressa 2012(10)	Ethiopia	<ul style="list-style-type: none">Thirty percent student expressed interest to practice medicine in rural area. <i>Motivators</i> <ul style="list-style-type: none">Students from rural background had better odds of medical practice in rural areas.	PLS
Huntington 2012(6)	Nepal	<ul style="list-style-type: none">Twelve percent of the medical students intended to work in rural areas. <i>Motivators</i> <ul style="list-style-type: none">Male students, government secondary school graduate before joining medical school, born in a village, sense of duty for the country and financial incentives for rural careers and scholarship for medical schooling from government were associated with career intentions at a rural place. <i>Impediments</i> <ul style="list-style-type: none">High-income family, self-paying private medical school students and feeling of isolation were associated with	HF PLS MS P

		no intentions for working at rural areas.	
Kaye 2010(37)	Uganda	<ul style="list-style-type: none"> Medical students have limited exposure to health facilities in the rural areas. <p><i>Motivators</i></p> <ul style="list-style-type: none"> Prior exposure to the community, community based education, role of family and friends, career development opportunities, teamwork and friendly environment of co-workers are positive motivators for career choice in rural areas. <p><i>Impediments</i></p> <ul style="list-style-type: none"> Sense of personal safety, workload, communication, transport, family, language, ease of communication with patients, cost of living, benefits, local people culture, opportunity for recreation, school for children, possibility of extra income, equipment, facility infrastructure, and continuing education facilities. Serious impediments for rural factors were insufficient salary, high workload with understaffing, poor hospital management, poor accommodation, lack of equipment, isolation from friends, lack of entertainment and inadequate opportunities for continuing professional development. 	HF PLS MTC
Kotha 2012(45)	Ghana	<ul style="list-style-type: none"> Fifty seven percent of students are willing to work in rural areas. <p><i>Motivators</i></p> <ul style="list-style-type: none"> Rural practice willingness was seen among male, those who completed high school in rural area, rural living experience and lower socioeconomic class medical students. 	PLS
Kruk 2010(40)	Ghana	<p><i>Motivators</i></p> <ul style="list-style-type: none"> Job preference in rural area was strongly associated with improving the equipment and supportive management. Other factors: shorter contracts, increment in salaries, facilities for children education, transport utility and improving housing were also influential. Male were more influenced by improved housing while females were more influenced by supportive management. 	HF PLS
Larkins 2015(46)	Philippines Sudan South Africa	<ul style="list-style-type: none"> Interest to work with rural and remote population was expressed by 65.9% students in Philippines, 33.5% students in Sudan and 62.8% students in South Africa. <p><i>Motivators</i></p> <ul style="list-style-type: none"> Medical school selection criteria to select students with prior education in rural area expressed intention to serve in rural areas after graduation. 	MS
Nallala 2015(39)	India	<ul style="list-style-type: none"> Willingness to work in rural areas was expressed by 17% of government medical school and 9% of private medical school students. <p><i>Motivators</i></p>	HF PLS

		<ul style="list-style-type: none">• Good housing, high salaries, and adequate infrastructure are perceived as factors that attract medical students toward future rural service. <i>Impediments</i> <ul style="list-style-type: none">• Lack of professional career growth opportunities and opportunities for higher education in rural location are potential impediments towards rural practice.	
Ross 2007(44)	South Africa	<i>Motivators</i> <ul style="list-style-type: none">• Students from rural background return to practice in rural areas.	PLS
Shankar 2012(42)	Nepal	<ul style="list-style-type: none">• High tuition fees at medical school influences the career location choice of student. <i>Motivators</i> <ul style="list-style-type: none">• Spending more learning in rural area, training in resource constraint settings could motivate the students. <i>Impediments</i> <ul style="list-style-type: none">• Students reported lack of adequate facilities, inadequate salaries, less security, fewer opportunities for further education, high tuition fees, isolation from family and less literacy of rural people as impediments for rural practice.	HF PLS MTC MS
van Wyk 2010(9)	South Africa	<ul style="list-style-type: none">• Eight percent of students intended for rural practice. <i>Motivators</i> <ul style="list-style-type: none">• Male students were likely to go for rural careers. <i>Impediments</i> <ul style="list-style-type: none">• Students from rural origin not likely to opt for rural practice.	PLS
Zimmerman 2012(43)	Nepal	<ul style="list-style-type: none">• Twenty seven percent of the medical students are working in rural areas after graduation. <i>Motivators</i> <ul style="list-style-type: none">• Male students, rural background, rural birthplace, attended high school in rural area, older age at matriculation, prior medical background before medical school and lower grades in medical school are associated with rural practice in Nepal.	PLS

HF= Health Facility; PLS= Personal and Life Style; MTC= Medical Training and Curriculum; MS= Medical School; P = Policy

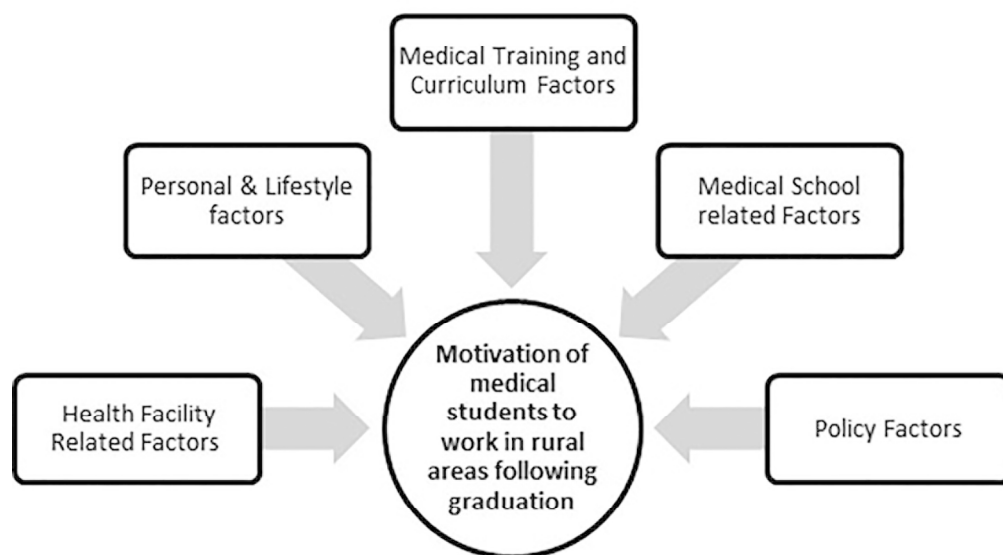
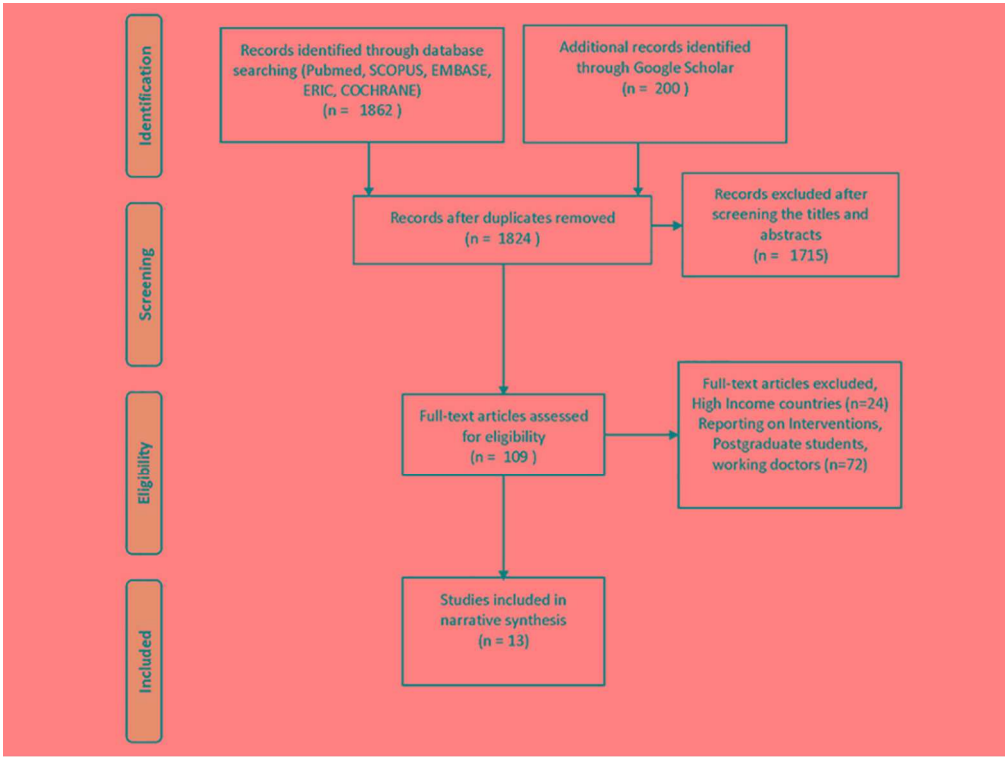


Figure 1: Conceptual Framework
(Figure 1)
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Caption : Figure 2: Articles selection process
(Figure 2)
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PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2&3
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3 & 4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	No
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	4
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5 & 6
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	8
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	N/A
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2 for each meta-analysis).	N/A

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Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	8
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	N/A
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	7 & 8
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	8, Table 1/2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	Table 1 (quality Assessment)
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	N/A
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	N/A
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	N/A
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	N/A
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	12-15
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	16
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	16
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	N/A

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