FACTORS INFLUENCING THE MOTIVATION OF MEDICAL STUDENTS FOR MEDICAL PRACTICE IN RURAL AREAS: A REVIEW

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A thesis submitted in partial fulfilment of the requirement for the degree of Master of Public Health

By

Shyam Sundar Budhathoki

Nepal

Declaration:
Where other people's work has been used (either from a printed source, internet or any other source) this has been carefully acknowledged and referenced in accordance with departmental requirements.

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"I can no other answer but thanks, and thanks and ever thanks" - William Shakespeare, Twelfth Night, Act 3, Scene 3.

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Abstract

The choice of working in rural areas is influenced by a multitude of factors. The motivation developed as a medical student is important in making this choice. Medical students in Nepal showed low level of motivation for working in rural areas. This study explores the factors, which influence the motivation of medical students to work in rural areas following graduation in Nepal.

A literature search was conducted in Pubmed, Cochrane, Scopus, Embase, Eric and Google scholar from 2000 to July 2014. Papers reporting factors for motivation among medical students to work in rural areas were included.

Lack of infrastructures, high workload, poor hospital management and isolation are among the health facility factors that do not motivate medical practice in rural areas. Rural background, rural exposure, personal preferences for rural area are motivating factors for medical practice in rural areas. Selecting medical students from rural background, training in rural areas with community-based curriculum, early exposure to community during medical training and rural location of medical school are interventions to motivate medical students to work in rural areas.

Rural background, medical education, curriculum and medical school factors are more relevant to medical students than the health facility factors. In Nepal, recommended interventions are selections of medical students with rural backgrounds, regulating the scholarship schemes with obligatory service in rural areas following graduation reinforcing community-based curriculum, training in rural facilities, and rural location for new medical schools.

Key words: Medical Students, career choice, rural areas, medical education, Nepal

Word Count: 11,186 words excluding references and annexes

List of Abbreviations

BPKIHS	:	B P Koirala Institute of Health Sciences
CBE	:	Community-based Education
DOHS	:	Department of Health Services
FCHV	:	Female Community Health Volunteers
GDP	:	Gross Domestic Product
HIS	:	Health Information System
IOM	:	Institute of Medicine
KU	:	Kathmandu University
MOHP	:	Ministry of Health and Population
NMC	:	Nepal Medical Council
PAHS	:	Patan Academy of Health Sciences
RHD	:	Regional Health Directorate
TU	:	Tribhuwan University
UK	:	United Kingdom
USA	:	United States of America
VDC	:	Village Development Committee
WHO	:	World Health Organisation

Introduction

I am Shyam Sundar Budhathoki, from Kathmandu, Nepal. Born and raised in Kathmandu, I currently work in School of Public Health and Community Medicine (SPH&CM), at the B P Koirala Institute of Health Sciences (BPKIHS), Sunsari District located about 600 km east of Kathmandu. I am a medical doctor specialised in Community Medicine & Tropical Disease.

At SPH&CM, I have mainly three responsibilities; academics, service & research. As an academician, I teach sub-disciplines of community medicine & public health to undergraduate medical, dental, nursing & allied sciences students on family health, occupational health and disease control. I serve as a Community Physician to the rural villages of east Nepal with various family health programs, community based clinics, campaigns and outreach services through the Comprehensive Health Service Area (CoHSA), a Community Based Hospital in Duhabi village in Sunsari District. As a researcher, I assist in community-based researches for undergraduate & postgraduate students. I am in a team of researchers involved in researches in various aspects of Community Medicine & Public Health.

I have worked as a Primary Health Care Physician at the Bhutanese Refugee camps in Jhapa & Morang Districts of Nepal for 2 years. I have also worked as Health Information System (HIS) coordinator, as well as Training Coordinator of the Project to train the health workers in community health and case management at the Health Centre and ensure timely reporting through HIS.

I have always been curious about what drives someone to choose a career in rural areas. As I started my career as a doctor, I heard reports from rural areas about the lack of doctors in the health facilities for many years. With my involvement in community-based service, teaching & learning activities for more than 5 years and my current affiliation with an academic and research institute, I developed an interest to explore the motivations of a medical student to work for the underserved and rural community.

1.0 Background information on Nepal

1.1 Country Introduction

Figure 1 Political and administrative map of Nepal

Source: (Nations Online Project 2014)

1.1.1 Geographic situation:

Nepal is a landlocked country with mountains. Nepal is bordered by China in the north and India in the east, west and the south. With a total area of 147,181 sq. Km, the east to west distance is 885 kilometres and the north to south distance is 193 kilometres. Well known for its natural beauty, Nepal has a wide geographical diversity. Nepal has three ecological zones extending from east to the west. The highland or the mountains in the north, the midland or the hills in the middle and the lowland or the terai plains in the south(Central Bureau of Statistics 2012).

Kathmandu city is the capital of Nepal. The country is divided into 5 developmental regions further divided into 14 zones and 75 districts.

Furthermore, at district level, there are municipalities (cities) and village development committees (VDCs). Mt Everest, the highest peak in the world (8,848 metres above sea level) is in Nepal. The Himalayan range in Nepal has eight of the 14 mountains above 8,000 metres in the world. The mountains and the hills comprise of about 83% of the land in Nepal, which comprise of rugged terrain and high hills. With poor road network coverage, 12 out of 75 districts in Nepal still have no access to roads. The absence of roads along with difficult geographical terrain poses challenge for access to health care (Central Bureau of Statistics 2012).

1.1.2 Population characteristics:

According to the census 2011, Nepal's population is 26.4 million and annual population growth rate is 1.35%. Under 15 years population comprise of 34% of the total population of Nepal. The sex ratio in Nepal is 94.2 males per 100 females. Population density is 180 per square kilometres. Nepal Demographic Health Survey reported the Total Fertility Rate as 2.6/woman aged 15-49 years in 2011. Rural population comprise of 83% of the people. Furthermore, half of the people in Nepal reside in the hills and mountains. As reported in 2012, about 2 million people are living out of country for employment. (Central Bureau of Statistics 2012; Ministry of Health and Population (MOHP) Nepal 2012). The refugees and asylum seekers in Nepal are mainly from Bhutan and Tibet. Currently there are 30,000 Bhutanese refugees estimated 20,000 Tibetan refugees and 231 asylum seekers residing in Nepal (United Nations High Commissioner for Refugees 2014).

1.1.3 Literacy:

Overall literacy rate is 65.9% in 2011. Literacy rate for males is 75.1% and for female is 57.4%. Highest literacy rate (86.3%) is in Kathmandu district and the lowest literacy rate (41.7%) is in Rautahat district. Almost 95% of households can reach primary school in 30 minutes (Central Bureau of Statistics 2012) .

1.1.4 Language and Culture:

As reported by census 2011, Nepal has 125 caste/ethnic groups. Nepalese society has a rich and diverse cultural heritage. Chhettri (16%) is the caste/ethnic largest group comprising of 16.6% of the population. Nepali is the national and the official language in Nepal. However, there are more than 123 spoken languages as mother tongue by the different caste/ethnic groups in Nepal.

1.1.5 Political situation:

Nepal has been a republic state since 2008. Nepal was a Kingdom for 240 years prior to 2008. Nepal had been in a situation of civil and political unrest before 2008 for almost 13 years. After the first constituent assembly, which dissolved in May 2012, failed to draft a new constitution, a second constituent assembly was re-elected. Currently Nepal is in a phase of drafting a new constitution. The Interim Constitution of 2008 guides the government system in Nepal at present.

1.1.6 Development situation:

Nepal is one of the low human development countries in the world. The human development report of 2014 ranks Nepal at 145 out of 187 countries (United Nations Development Programme 2014). Nepal is rich in water as a natural resource. Despite having a hydroelectricity potential of 42,000 megawatts of electricity, Nepal experiences up to 16 hours of power outage daily (Bergner 2013). People living under poverty line (with less than $1.25 daily income per person) comprise of about 25% of the population. Agriculture, tourism and remittance by migrant workers are the main sources of income in Nepal (Central Bureau of Statistics 2012).

1.1.7 Situation of Health:

The Life Expectancy at birth in Nepal is 68 years for both sexes while it is 67 for males and 69 for females. The under five mortality rate is 42/1000 live births has a maternal mortality ratio of 170/100,000 live births. Nepal has shown progress in these two indicators over the years. For these progresses, Nepal has received awards for improving indicators of UN MDG4 and MDG 5. However, the neonatal mortality rate has remained unchanged since 2006 at 24/1000 live births. Immunisation coverage in Nepal is at 90% and 36% of all births are attended by skilled health workers. The total expenditure on health in Nepal as a percentage of Gross Domestic Product (GDP) is 5.4%. General government expenditure on health as a percentage of total government expenditure is 9.6% while the private expenditure on health for the same is 60.7%. Eighty eight percent of the population use improved drinking water source while 35 % of the population use improved sanitation facilities. Nepal has increasing burden of non-communicable diseases while it continues to fight communicable disease. Nepal reports natural disaster like flood, landslides and drought, which cause damages to the health facility infrastructures every year (World Health Organisation 2014a).

Health facilities in rural Nepal, have limited resources and infrastructure including medical and diagnostic facilities. It is an issue that has influence in motivation for health workers as well as affects the quality of care for the patients in Nepal (Simkhada et al. 2006).

1.1.8 Health System:

The Department of Health services under the Ministry of Health and Population (MoHP) is responsible for all the preventive, promotive and curative health services in Nepal. Organisation chart can be found in Figure 5 in Annex 1. It is one of the three departments of MoHP. The other two are Department of Drug Administration and Department of Ayurveda. It has 5 centres, 7 divisions and 8 central hospitals. There are 5 regional directorates, 3 regional hospitals, 2 sub-regional hospitals and 10 zonal hospitals. At district level, there are 72 district hospitals, 2097 PHCCs, 1679 HPs and 2,127 SHPs (Department of Health Services 2014).

Regional Health Directorates (RHDs) situated in each developmental region, provides technical as well as administrative for health programs in the districts. Local Self Governance Act 1999, provides decentralised authority to regional, sub-regional and zonal hospitals via the formation of Hospital Development Boards. There are also training centres, laboratories, and medical stores in each region (Department of Health Services 2014). At the district level, District Health Office (DHO) or District Public Health Office (DPHO) are responsible for implementing essential health care services (EHCS) and monitor activities and outputs of District Hospitals, Primary Health Care Centres (PHCCs), Health Posts (HPs) and Sub Health Posts (SHPs) (Department of Health Services 2014).
Nepal has more than 50,000 Female Community Health Volunteers (FCHV) who link community people to the health system. FCHV program is a successful program that contributes more in the Maternal and Child health program (Department of Health Services 2014).

Department of Drug Administration (DDA) under MoHP is regulatory body for all functions related to drugs making available safe, efficacious and good quality drugs to the people (Department of Drug Administration 2014). Nepal has alternative traditional medical system of Ayurveda for which MoHP has a separate Department of Ayurveda. The ancient medical system of Ayurveda uses herbs, minerals and animal products for treatment of illnesses. There are several health facilities in the country using this medicine system under the department (Department of Health Services 2014).

1.2 Medical Education in Nepal

Modern medical education in Nepal commenced in 1934 when the Civil Medical School for the training of compounders and dressers started. Subsequently nursing education along with trainings for different auxiliary health workers began with the New Education System Plan of the government of Nepal. Undergraduate medical education was started in Nepal in 1978 at Institute of Medicine (IoM), affiliated to Tribhuwan University (TU) (Dixit & Marahatta 2008).

There are four universities to which all the undergraduate medical colleges are affiliated. Ministry of Education has two universities; Tribhuwan University and Kathmandu University. The other two, B P Koirala Institute of Health Sciences (BPKIHS) and Patan Academy of Health Sciences (PAHS) are deemed universities owned by Ministry of Health and Population. As of 1993, there were two medical colleges, the Institute of Medicine and BP Koirala Institute of Health Sciences. As of 2014, there are 19 medical colleges in Nepal, of which one publicly owned medical college only offers postgraduate courses. Out of the 18 medical colleges that run under graduate medical courses, 15 are privately owned and 2 are publicly owned and 1 owned by Nepal Army (Magar 2013; Ministry of Health & Population 2014).

Nepal Medical Council (NMC) is an autonomous government under the Ministry of Health and Population, which is responsible for regulations medical practitioners and accreditation body for private health institutions and both public and private medical colleges. The minimum numbers of teachers and hospital beds required by each medical college are regulated by NMC. NMC has the aim to produce doctors according to the need of the country and allow multiple modalities for delivering medical education. It ranges from Student centred Problem-based Integrated Community-based Electives and Systematic model, Problem Based Learning (PBL) and Clinical Presentation Curriculum models (Dixit 2003).

Although, each university develops its own curriculum based on the accreditation guidelines of the Nepal Medical Council, all medical colleges in Nepal, have their curriculum focusing in Community Based Education. The affiliated colleges under an university is obliged to follow the curriculum of the university it is affiliated to (Dixit & Marahatta 2008).

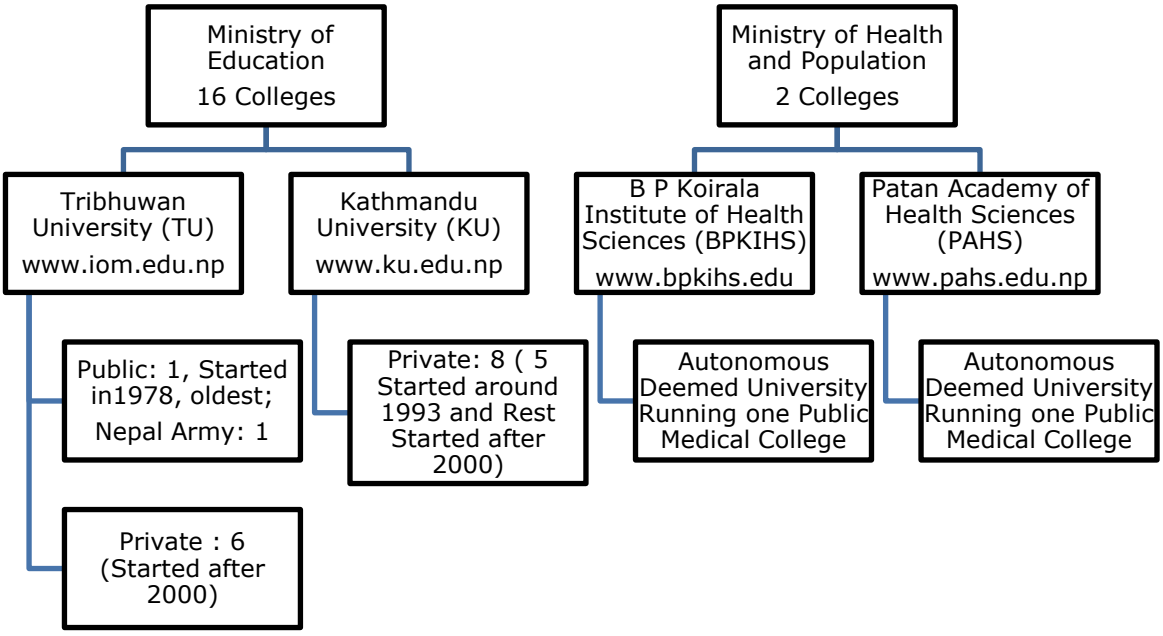

Figure 2 : Organisation of undergraduate medical colleges in Nepal

The medical curriculum is spread over four and half years followed by one year of compulsory rotational internship in various sub disciplines of medicine. The spread of the subjects over these years vary in all four medical curriculum of Nepal. (Institute of Medicine, the oldest public owned medical college requires medical student to gain experience in community services within the first three years of medical schooling.) The curriculum from Kathmandu University has community posting spread over four years of medical schooling. BPKIHS has adopted a Teaching district Concept, where the medical students visit various district health systems during their learning and internship. They must spend a total of one year of their learning period with the district health system. The fourth model of curriculum at PAHS sends students to the community during the first six months of medical schooling (Jha et al. 2002; Marahatta et al. 2009).

1.3 Medical Doctors in Nepal

In 2013, there were 1014 medical graduates from the 18 medical colleges of Nepal (Gupta et al. 2013). Based on the available data from Nepal Medical Council, there are 12,194 doctors registered in Nepal. Out of them, 68% (8335) were working in Nepal. Of those working in Nepal, 12% (1,447) doctors were working in public sector while 88% (6,888) were working in private sectors. Two-thirds of these doctors working in Nepal are working in the capital city and other urban areas. Almost 90%

of the doctors in Nepal work in private health facilities, which are located in urban areas. While we know that 83% of the population of Nepal reside in rural areas, these rural areas only have public health facilities where about a tenth of the doctors are working (Nepal Health Sector Support Program 2012). As reported in 2012, 1/4th of the position sanctioned for the doctors are vacant in the public sector (Nepal Public Health Foundation 2012).

The doctor population ratio of Nepal in 2010 was 0.37 doctors per 1,000 people. This ratio is 1.5 doctors per 1000 people in Kathmandu, while it is 0.008 doctors per 1000 people in remote district of Bhojpur (Department of Health Services 2010). While the country statistics shows a lower doctor population ratio compared to 1 doctor per 1000 people by World Health Organisation (WHO), the rural districts have even lower ratio (World Health Organisation 2014b). The doctor at rural facilities also has to bear administrative responsibilities for which they are not trained. This responsibility at rural health facility becomes a burden for the physician (Hamal et al. 2011; Mishra 2008).

2.0 Problem Statement, Justification, Objectives, Research Questions and Methodology

2.1 Problem statement

A cross-sectional study based on future career intent of 469 fourth year and final year medical students showed 88% of the student wanted to stay in Nepal after graduation. Of those who wished to stay in Nepal, only 12% of the students intended to work in the rural areas (Huntington et al. 2012). This study used convenience sampling by selecting only four medical colleges in and around the capital city, Kathmandu. However, this study does not represent all medical students but is the only study that I found on rural career intentions of medical students in Nepal. Findings from other regions are similar with a slight variation of percentages around the figure from Nepal. Similarly, a study in Bangladesh among 129 students of 1st, 3rd and final year medical students revealed only 4% of the medical students intending to practice in rural areas (Ahmed et al. 2011). A study among 984 final year medical students from six Sub Saharan African country reports only 4.8% of the medical students intend to go for rural practice (Burch et al. 2011). Study from South Africa among 194 final year students report 8.0% students showing interest for working in rural area (Van Wyk, Naidoo & Esterhuizen 2010). India and Ethiopia report slightly higher figures of 21.2% and 29.5% respectively.

In India, the study conducted was among 792 first year students while the Ethiopian study was done among 660 medical students in different years of their medical schooling (Deressa & Azazh 2012; Diwan et al. 2013). The study involves four colleges in Nepalese study, 2 colleges from Bangladeshi study, 9 colleges in six Sub Saharan Countries study, 1 college in South African study, 9 colleges in India and 1 college in Ethiopian study. Given these differences, the similarity still comes out to be that these cross-sectional studies conducted on medical students from different countries still show that the motivation for career in rural areas following graduation is low in all these countries.

A study in 2012, by Zimmerman showed that only 27% of the graduates from Nepal's oldest public medical college were serving in the rural areas of Nepal. This cross-sectional study discusses that recent medical graduates travelling abroad for work may increase in the future (Zimmerman, Shakya & Pokhrel 2012). A Canadian study in 2005, reports 9.4% of physicians practised in rural areas though 21% of population of Canada resided in rural areas (Pong, Pitblado & J Roger 2005). A study reports that in 2010, when doctor jobs were announced for 54 positions in rural clinics of Nepal, only 22 applicants actually applied to work (Courneya 2010). This is an example showing less motivation to work in rural areas.

Choices in careers for medical practice are influenced by personal factors, home or environmental factors and experiences or events (Harris, Gavel & Young 2005), factors of medical education, policy factors and factors related to health facility location (Dussault & Franceschini 2006). Factors related to medical education are important in influencing career choices in medical students (Reid, Couper & Volmink 2011). Decisions about career choices are based on factors before, during and after the medical schooling (Morrison 2004). Motivation contributes directly to the performance of the health sector along with other aspects of service quality, equity, efficiency. There are many determinants that contribute to the motivation including finance based incentives (Franco, Bennett & Kanfer 2002). Multiple studies explain the motivation for careers locations in health to different geographic locations. Motivation are influenced by health sector reforms (Franco, Bennett & Kanfer 2002), multitude of factors from individual, work, local environment, national and international environments (Lehmann, Dieleman & Martineau 2008). Explaining in terms of role of nature and nurture, a review has explored the recruitment of physician in rural area as premedical, medical and residency factors (Brooks et al. 2002).

2.2 Justification

The global data shows that half of the population reside in rural area, where less than 25% of the available physicians worldwide provide their services. Data estimates that, one billion people around the world do not have access to any health workers. There are 57 countries with a shortage of health workers and doctors mostly from Africa and Southeast Asia including Nepal (WHO 2012). The shortage of doctors and low availability of doctors willing to work in rural areas, where a major proportion of the population resides, leads to reduced numbers of doctors available for this population. The motivation for career choice for physician starts even before one becomes a qualified physician (Morrison 2004). Medical Graduates are in dilemma regarding future career, family, social life and profession and has been linked with medical education (Lamichhane 2010). Medical education is an important basis for preparing the medical graduate to work in rural and underserved areas. Despite, having community-based approach as the main teaching approach in curriculum and about 1,000 medical graduates every year in Nepal, there is still low motivation for medical students to work in rural areas following graduation. Thus, I chose to perform a comprehensive analysis of the factors motivating medical practice in rural areas was in this study.

2.3 Objectives

General Objective(s):

- To explore the factors influencing motivation of medical students for choosing to work in rural areas following graduation in Nepal in order to provide suggestions for influencing medical student's choice to serve as a physician in the rural areas.

Specific Objectives:

- To identify and analyse the factors that influence the motivation of medical students to work in rural areas following graduation.
- To assess and discuss interventions from around the world to improve the motivation for medical practice in rural areas following graduation.
- To provide recommendations based on the findings of this study in order to promote evidence-based interventions to increase the motivation of medical students to work in rural areas following graduation.

2.4 Methodology

2.4.1 Study Design:

This review was conducted using existing literatures to find answers to the broad question of exploring factors influencing motivation to choose a rural area as a medical practice location. The method is chosen, as there are many available studies from around the world that have explored this problem in different countries and context. The study follows a formal method of literature search, selection of articles, abstraction of data and synthesis of the findings using a conceptual framework (Figure 4).

The literature was searched in (1) PUBMED, (2) COCHRANE library, (3) SCOPUS, (4) EMBASE, (5) ERIC, and (6) Google Scholar databases through the Free University Library. The searches also included Google scholar for literatures. Full texts of the selected articles were retrieved from Free University library links and Google Scholar.

2.4.2 Search Strategy:

The following text words and Medical Subject Headings (MeSH) were used for each concept.

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 that reported on the motivation or career choice or intentions of the medical student to work in rural areas, from low, middle and high-income countries.

At first, the duplicates from all searches were removed. After screening titles and abstracts, the studies satisfying the inclusion criteria were taken for further review. Then the full text of the remaining articles was retrieved and reviewed thoroughly. After reviewing the full text of the retrieved articles, some studies were discarded on the basis of not being relevant to the research questions (Fig. 3 shows Flow diagram of the search strategy depicting the article selection process)

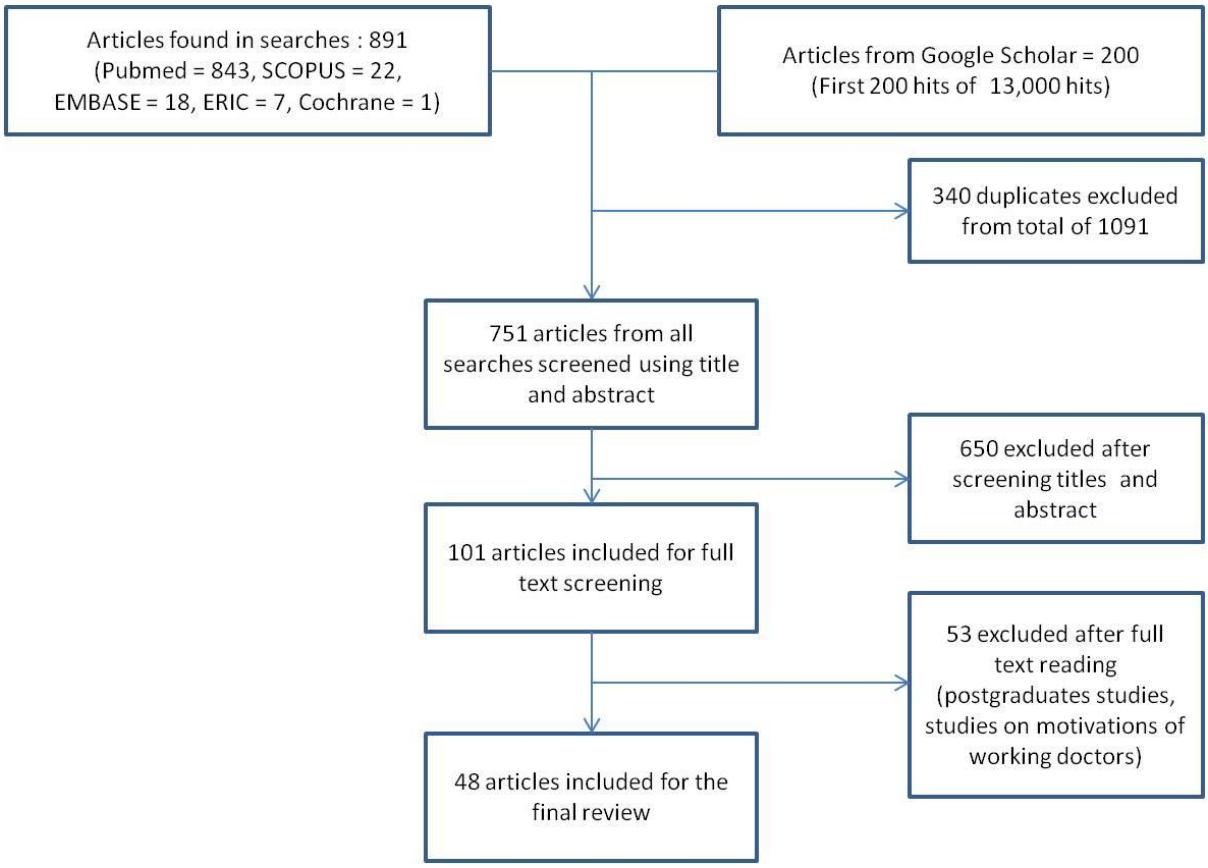

Figure 3 : Articles selection process for the current review

2.4.3 Conceptual Framework for the review

A framework to explore motivation for location for work in rural area, which is influenced by multiple factors, needed to be developed. A problem tree approach was used to develop a framework for problem analysis (AusAID 2003). The framework was constructed considering the broad categories of factors that influence the motivation of the medical students for medical practice in rural areas following graduation. Career choices have been illustrated to be influenced by many factors and a model on student choice for specialities can be found in the literature (Bland, Meurer & Maldonado 1995). This model focuses on future specialty as a career choice. Medical students motivation has been explored for primary care speciality choice as a multitude of factors from demographics, education, prior exposure along with lifestyle and specialty selection domains (Clinite et al. 2013). This is adapted from the Bland et al model.

While these models focus on motivation for future specialty, my paper focuses on motivation for medical practice in rural areas. Therefore, both these models do not fit my purpose completely. Even though both models

did not fit my purpose completely I chose bland et al for its original concept on motivation. I extracted the concept of medical school factors and medical education factors in the problem tree from the study by Bland et al 1995. The factors, income and values were also added from this framework into the definition of personal and lifestyle factors.

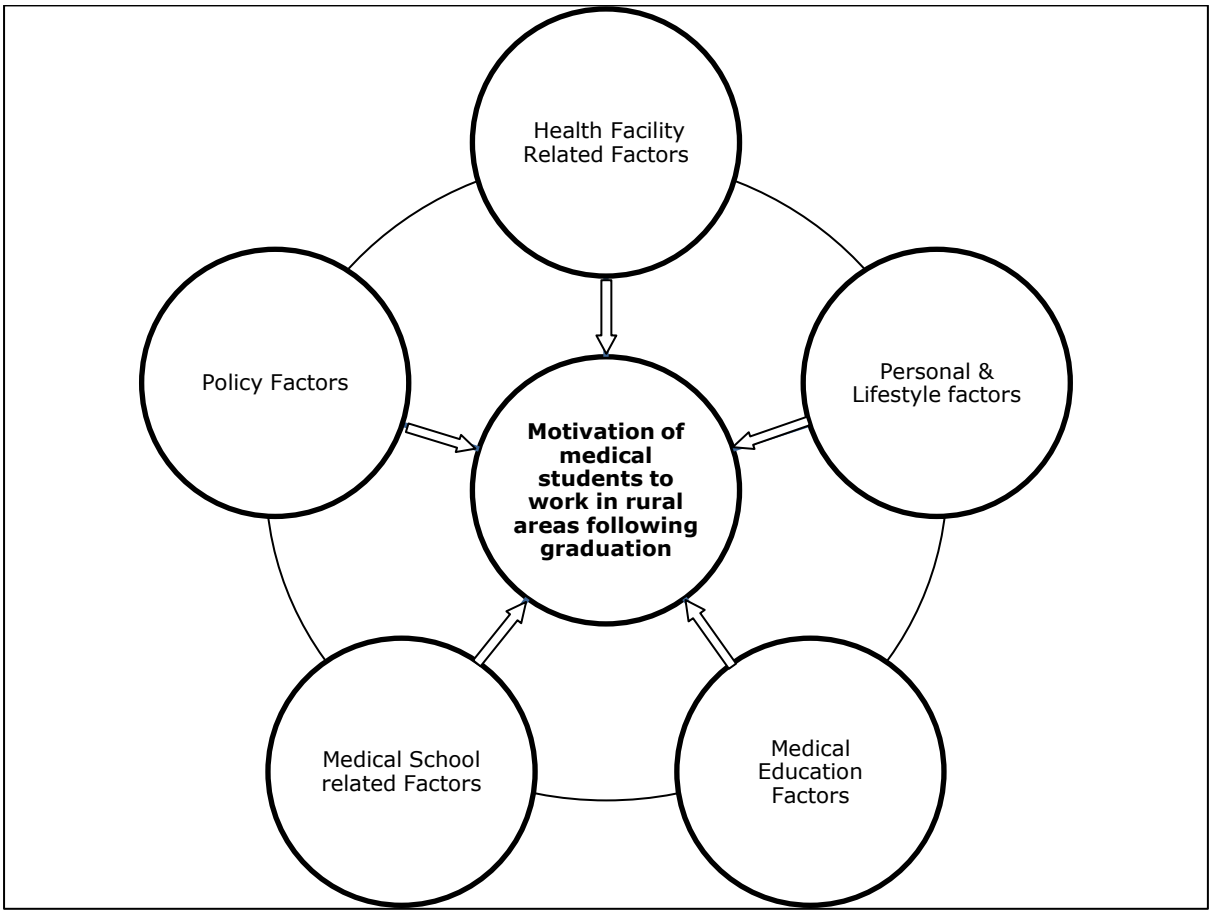

Figure 4 : Conceptual framework for analysing the motivation for medical students to work in rural areas following graduation

Different authors define 'Rural area' differently using various variables and it differs from country to country. Isolation and limited facilities are used for defining rural area by Smith et al. (2008). whereas Crandall & Weber (2005), defines it as a community with some commercial activities, situated at least 30 miles from urban area. Rural has also been defined as communities that are more than 400 kilometres away from a major hospital (Pong & Pitblado 2001). For this study, no separate definition is used for 'rural area' or 'underserved area'. As the purpose of this study is to explore factors for motivation all around the world, rural or underserved area as defined or considered by the authors in different papers have been taken directly.

As shown in the framework, the factors contributing to the core problem will be discussed in the following broad categories:

- **Health Facility Related Factors**
  This category of factors includes all factors related to the health facilities, which the medical student will potentially consider for practicing medicine. All factors of infrastructures for medical diagnosis and treatment, workload, location of the facilities, social isolation and financial incentives are included under this category.
- **Personal & Life style Factors**
  Age, gender, demographics, background (Urban/Rural), family background, values & beliefs, career goal, further education goals, role models, and expected salary are included under this category.
- **Medical Education/ Curriculum Factors**
  Factors related to curriculum and location of medical trainings (Clinical tertiary or Community based) during undergraduate learning are categorised under this category.
- **Medical School Related Factors**
  Location of medical school, selection of the candidates/ admission criteria for medical schooling, public/private medical colleges, level of tuition fees are all listed in this category.
- **Policy Related Factors**
  Scholarship schemes, policy of mandatory rural service are listed in this category

2.4.4 Structure of the report of my analysis

The subsequent chapters will present the analysis of the problem in a structured format. The chapter 3 presents all the findings of the literature review. It is divided into 2 sections; the presentations of the findings guided by the framework and the presentation of the interventions. The factors found are presented under the subheading of the categories of factors from the framework. Summary of the articles used in this review that report on the factors motivating the medical students to work in rural areas following graduation is presented in table 2 which can be found in annex 3. The identified factors classified into five categories are listed in table 3, which can be found in Annex 4. The summary of articles on the existing interventions from the world can be found in table 4 in annex 5. The chapter 4 on discussion is structured based on the specific objectives. The subsequent chapters are conclusions in Chapter 5 and recommendations in chapter 6.

3.0 Study Results/Findings

This review included 48 articles selected using the search strategy and the selection process. Thirty-two studies included in this review relate to the factors explored in this study and 17 articles are related to the interventions and best practices from around the world. One article is included in both explorations of the factors as well as best practices.

The review of factors included 18 cross-sectional studies, 5 qualitative studies, 4 systematic reviews, 2 reviews and one each of cohort, case control and mixed (qualitative and quantitative) studies. The studies selected were from 14 different countries or regions including six each from the United States of America (USA) and Australia, three from Nepal, two each from Canada, Ghana, South Africa, and United Kingdom (UK), and one study each from Bangladesh, Ethiopia, Japan, Malawi, New Zealand, North America (USA &Canada) and Uganda. Grouping into income group of countries, 21 studies are from high-income group, 2 each from upper middle-income group and lower middle-income group and 7 are from the low-income group of countries (World Bank 2014). The studies were rated for level of evidence using the reference from Oxford Centre for Evidence-based Medicine (Oxford Center for Evidence-based Medicine 2014). The reference table 5, can be found in the annex 6. Most studies included are of evidence level 4, while three systematic reviews qualify as level 2a of evidence (systematic review of cohort studies). There is one cohort study, which has defined comparison group but no relative risk was calculated for the outcome. Similarly, for a case control study, the odds ratio was not expressed for rural practice preference. So these two studies are also placed in the 4 level of evidence (Oxford Center for Evidence-based Medicine 2014).

The characteristics of the articles reporting on factors motivating medical students for medical practice in rural areas following graduation can be seen in table 1 of annex 2. The summary of the findings of the articles in this review for analysing factors with key findings can be found in Table 2 in the annex 3.

The results are presented according to the five factors, which are based on the conceptual framework (Figure 4).

3.1 Health facility related factors

Seven studies have reported one or more factors linked with the health facility at the rural areas. A cross-sectional study among 185 students in Nepal has identified that the students perceived lack of adequate infrastructure, equipment and supplies at the health facility as a negative motivators towards future medical practice in rural areas. Working in rural area has also been perceived to give less opportunity for further education (Shankar & Thapa 2012). This study uses a convenient sampling of students from one of the private medical colleges situated in Kathmandu. Another cross-sectional study with conveniently selected sample among four different medical colleges in Kathmandu reports provision of financial incentive is a motivation factor for a career choice for Nepalese medical students to work in rural areas (Huntington et al. 2012).

The physical facility at the potential working place of a medical student is of concern while choosing a workplace location. Studies from other low-income countries also report perceived lack of infrastructure, equipment, supplies and communication facilities at the health facility to be barriers in consideration by the medical student in choosing a rural location (Bailey et al. 2012; Kaye et al. 2010; Kruk et al. 2010). A factor that does not motivate the medical students in Malawi to work in rural areas is the perception of after hour work load at the rural facility and students also perceive the community will have high expectations from a physician(Bailey et al. 2012). Poor hospital management in the rural area is reported by a study as another perceived factor not in favour of rural medical practice in Uganda and Ghana (Kaye et al. 2010; Kruk et al. 2010). Rural locations are not chosen by students as they lack peer support, senior consultations and less facilities for continuous medical education along with less opportunity for private practice and the trade-off of clinical practice while performing administrative work (Bailey et al. 2012; Kaye et al. 2010). However, students from Uganda perceive to have ease of communication with the patient in rural areas. This is a perceived positive factor for reported in favour of working in rural area.

Findings from high-income countries such as Australia, talk about the lack of professional support at work, after hours work load and high expectation from the community as the negative motivators for not choosing the rural areas by the students for future work location (Azer, Simmons & Elliott 2001; Orpin & Gabriel 2005).

3.2 Personal and life style factors

Personal and lifestyle factors that influence the career location as rural areas are reported by 22 studies in this review. In context of Nepal, practicing in rural area following graduation is twice more likely (odds ratio = 2.0) in male students than female students. Rural background such as being born in a village and schooling from a government in rural area were other two identified factors that influenced students to choose rural area for practice in the future. This was reported by a cross-sectional study in Nepal (Huntington et al. 2012; Zimmerman, Shakya & Pokhrel 2012). It was also seen in Nepal that students with paramedical background prior to medical schooling, completing their high school at older age and lower grades in medical school were some characteristics found linked with working in rural areas (Zimmerman, Shakya & Pokhrel 2012). Expected higher salary in rural area was reported by Nepalese medical students to motivate working in rural areas following graduation (Huntington et al. 2012).

Ethiopian study also suggested rural background of the student to be a motivating factor. According to the Ghanaian study education from rural area prior to medical school was considered to be a factor that encouraged future rural practice (Deressa & Azazh 2012; Kotha et al. 2012). Having lived in a rural community as a motivating factor for students to return to rural areas for medical practice is reported by two Ghanaian studies (Kaye et al. 2010; Kotha et al. 2012). The Ghanaian study also reported that students from lower socioeconomic status is another factor that motivates students to work in rural areas following graduation (Kotha et al. 2012). As positive motivators for choosing rural area for practice, a Malawian study, reported personal value of serving the community that they themselves come from was part of their duty as a citizen to the country. It further reports learning hospital management skills and managing cases that don't reach the tertiary hospitals are other factors that also motivate medical practice in rural areas (Bailey et al. 2012).

Factors not motivating medical practice in rural areas in low-income countries include the needs of the spouse and families like the need for better education for children, which is perceived to be available in the cities as reported by a Ghanaian study (Kruk et al. 2010). The perceived lack of proper housing in rural area is another non-motivator also reported in a Malawian study (Bailey et al. 2012). Another Ghanaian study reports, perceived lack of recreation and entertainment facilities for

themselves and the families as a factor for not choosing rural areas (Kaye et al. 2010). The study also reports perception of being isolated from friends and family circles along with high travel costs associated with travel to and from the rural areas are also non-motivators for medical practice in rural areas (Kaye et al. 2010). A cross-sectional study from South Africa also reports being a male student (12.5%) had higher preference to medical practice in rural areas compared to a female student (5.5%) which however was not statistically significant (Van Wyk, Naidoo & Esterhuizen 2010). Findings from focus group discussion among medical students from South Africa reveal that personal motivation among rural background medical students influence them to return for service in rural area following graduation (Ross 2007).

Results from high-income countries show that being a male student is a factor more likely (odds ratio of 1.32 and 1.57) to be linked with future medical practice in rural areas following graduation (Rosenblatt & Andrilla 2005; Tate & Aoki 2012). Rural background of the medical student was seen as a strong factor predicting rural practice. A study in Australia reported more likeliness (odds ratio = 10) of a student with rural background to practice in rural area compared with other students with non-rural background (Walker et al. 2012). A cross-sectional study from Australia reports rural background students (44%) being more positive towards health service in rural areas compared to urban background students (21%) (Azer, Simmons & Elliott 2001). Review studies from UK, Canada and New Zealand report rural background as a factor that influences medical practice in rural areas among medical students (Crampton, McLachlan & Illing 2013; Curran & Rourke 2004; Hsueh, Wilkinson & Bills 2004). Rural background as a factor has also been reported by a cohort study and a mix (qualitative and quantitative) method study from Australia (Clark et al. 2013; Eley et al. 2012). A review from USA reports rural upbringing of medical students motivates future rural practice among the medical students (Brooks et al. 2002). Rural upbringing along with extrovert personality was reported by a cross-sectional study from USA may motivate students to make career choice in rural area (Royston et al. 2012). Education from school in rural area prior to medical school is reported to motivate medical practice in rural areas among medical students by a case control study from USA (Pretorius, Milling & Mcguigan 2008). Schooling in rural area prior to medical college is also reported by a cross-sectional study from Canada (Tate & Aoki 2012). Having spouse or parents from rural area (Royston et al. 2012) is reported as a factor motivating rural practice for students by another cross sectional study from USA.

Qualitative findings from Australia reports, personal factors and circumstances of life of an individual like getting married or planning a family influences career decision (Eley et al. 2012). The needs of the spouse or partner, need for better education for children along with personal further education needs also influence the career decision on location of the practice area are reported in three studies from Australia (Azer, Simmons & Elliott 2001; Orpin & Gabriel 2005; Roberts et al. 2012). Two studies from USA and Canada, have reported that, future career intentions to specialise in Family Practice or Primary Care is positive motivating factor towards working in rural areas for medical students following graduation (Brooks et al. 2002; Curran & Rourke 2004).

The studies from high-income countries also reported factors related to personal goals, values and interests. Three Australian reviews reported interest in rural lifestyle, perceived friendly environment, expected less pressure or stress, expected opportunity to gain administrative skills, perceived better patient relations, as positive factors motivating students towards working in rural areas. They also reported perceived diverse work experience, perceived rewarding work and sense of more appreciation from rural people, as positive motivators for medical practice in rural areas (Azer, Simmons & Elliott 2001; Eley et al. 2012; Orpin & Gabriel 2005). A cross-sectional study from Australia reported high salary in rural areas is a positive motivation towards rural practice as expressed by the medical students (Orpin & Gabriel 2005).

Negative motivators towards medical practice in rural areas by students have been found in studies from high-income countries. An Australian study reports that, working in rural area is perceived to give limited future career option which is one reason students are not motivated to practice in rural area after graduation (Orpin & Gabriel 2005). It is reported as a perception in a qualitative study from Australia, that working in rural area separates them from the societal and family networks including friends (Roberts et al. 2012). Students perceive that working in rural areas give rise to frequent need to travel, expensive costs associated with the travel which affects the cost of living are reported by cross-sectional studies in Australia and UK (Azer, Simmons & Elliott 2001; Deaville & Grant 2011). Another factor not favouring work intentions in rural area is the perception that subsequent difficulties to relocate in urban areas from rural areas (Orpin & Gabriel 2005).

3.3 Medical education and curriculum factors

In this review, 13 studies reported medical education and curriculum factors to be associated with career intentions in rural areas. Medical training experience as a medical student is reported to influence selection of rural area as future practice location. Students in Nepal report training in resource constraint settings of rural areas as a medical student prepares them for medical practice in those areas. They perceive such training will motivate them to subsequently work for rural areas after graduation (Shankar & Thapa 2012).

Report from a low middle-income country Ghana show that medical curriculum including rural posting and training in rural areas motivates and prepares a medical student for future practice in rural areas (Kaye et al. 2010).

The high-income countries also have findings that show medical training and education exposure in rural areas, are reported to positively influence the student towards working in rural areas following graduation which includes three systematic reviews and one review article (Barrett, Lipsky & Lutfiyya 2011; Crampton, McLachlan & Illing 2013; Curran & Rourke 2004; Hsueh, Wilkinson & Bills 2004). A cross-sectional study from Japan also reports medical training in rural areas is a motivating factor for future medical practice in similar settings (Tate & Aoki 2012). A cross-sectional study from USA among students from urban medical school who underwent preclinical rural elective reports that rural electives can develop positive intentions of students towards working in rural areas (Crump, Fricker & Ziegler 2009). However a cross-sectional study from Australia, reports that rural coursework did not have any influence with career choice for rural area. A reason for such response for by the student was not mentioned (Orpin & Gabriel 2005).

Medical education is structured by a well-designed curriculum, which provides guided learning to a medical student. Curriculum factors influence the career choice of the student medical student. .Cross-sectional studies from Japan reports, community based education in Jichi Medical University motivates students to work in community settings of rural areas following graduation (Okayama & Kajii 2011; Tani et al. 2014). In addition to community-based education, Tani et al, also report exposure of the medical students to the rural community during early years of medical schooling adds motivation among these students for working in rural areas. Reviews have concluded that 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 (Brooks et al. 2002; Curran & Rourke 2004; Eley et al. 2012; Hsueh, Wilkinson & Bills 2004). Rural posting is reported by a cohort study from Australia to encourage medical students to practice in rural areas (Clark et al. 2013)..

3.4 Medical school related factors

The factors related to the medical school that influence the motivation are reported in five studies in this review. A study from Nepal reports a negative influencing factor associated with medical school is the private medical schools, which have students that spend high tuition fees. High tuition fees paid for the education is associated with no interest for working in rural areas (Huntington et al. 2012). Other studies reporting on low and middle-income countries for medical school related factors were not found in this review.

Reports from high-income countries show that the medical school admission criterion for intake of medical students is found to be a predictive factor for medical students to choose rural practice area following graduation. Review studies from Canada and New Zealand show that admission criteria committed in selecting students with rural background, preference for rural areas and students with career preference for family practice or primary care has been seen to result in medical practice in rural areas following graduation (Curran & Rourke 2004; Hsueh, Wilkinson & Bills 2004). Location of the medical school in rural areas also referred to as Rural Clinical School has an influence in motivating medical students towards working in rural areas after graduation. Review studies from Australia and New Zealand have concluded that medical students from medical schools located in rural areas have been found to be working in rural areas following graduation (Hsueh, Wilkinson & Bills 2004; Ranmuthugala et al. 2007). Location of the medical training also plays an important role in nurturing the medical students to practice in rural areas following graduation. Students are found to be positively influenced by the training environment in rural areas as reported by a review study from Canada (Curran & Rourke 2004).

3.5 Policy related factors

One study in this review identified some policy related factors that influence the medical student's decision to work in rural area following graduation. In Nepal, government scholarship schemes provided to

students with rural background have been reported as a positive factor to influence their motivation. Students under the scholarship are obliged to serve in the rural area for the specified amount of years (Huntington et al. 2012).

3.6 Other factors

Other factors found in this review not falling under anyone of the five categories of factors from the framework are listed here. These findings are from Nepal and Uganda. Students perception of personal security and safety while working away from home is also considered to be a negative motivator for working in rural areas (Kaye et al. 2010; Shankar & Thapa 2012). The Ugandan students also reported political instability to influence their career choice not favouring the rural area (Kaye et al. 2010).

3.7 Interventions focusing on undergraduate medical student in order to promote students to work in rural areas following graduation

Several interventions focusing on undergraduate medical students that aimed to promote the career choice of the students to work in rural location from around the world were found in my search. These studies have reported the interventions to address the medical education and curriculum factors, medical school factors and policy related factors. However, studies intervening on lifestyle and health facility related factors were not found. There are interventions from seven countries reported by 17 papers in this section. The interventions are from high-income (Australia, Japan, Norway and United States) lower middle-income (Nigeria and Philippines) and low-income countries (Congo and Uganda). All the interventions report contribution in increasing the rural medical workforce. Summary of the articles reporting on interventions in this review can be found in Table 4 in Annex 5.

The level of evidence in these studies vary (Oxford Center for Evidence-based Medicine 2014). There is one cohort study with level 2b evidence from USA which expresses outcome in relative risk (Rabinowitz et al. 2011). Another cohort from Australia however does not have outcome in relative risk, thus categorised as level 4 evidence (Playford et al. 2014). Other studies are six cross-sectional studies and two review studies qualifying for evidence of level 4. The cohort study from Australia is categorised as a level 4 evidence because the study does not express the measures of association for outcome(Worley 2008).

3.7.1 Medical Education and Curriculum Interventions

The interventions focusing on the Medical education and curriculum factors were community based medical education from Australia, Japan, Nigeria and United States, and Problem based learning curriculum in rural community settings from Uganda. The Australian students from colleges with curriculum focusing on rural service in rural clinical school were more likely (odds ratio = 7.5) to undertake rural clinical jobs (Playford et al. 2014). Interventions to admit students from rural background are ongoing in Australia. The proportions of rural students in Australian medical colleges have increased from 10% in the year 1989 to 25% in the year 2000 (Dunbabin & Levitt 2003). Jichi Medical University of Japan has a community-based curriculum. It reports 42% of the graduates from the medical college remained in rural area in 1997 (Hsueh, Wilkinson & Bills 2004). Community based curriculum has been used as interventions to motivate medical practice among medical students in Norway, USA and Nigeria (MacDowell, Glasser & Hunsaker 2013; Matsumoto, Masatoshi, Inoue & Kajii 2008; Skinner, Onoka & Ofoebgu 2008).

3.7.2 Medical School Interventions

The interventions focusing on medical school factors were mainly focusing on the intake of the medical students and the location of the medical school. Recruitment of the students for medical schooling using criteria of rural background was reported to be successful in Australia, Norway, and United States. Admission criteria of selecting students with rural intentions, rural background or rural experiences have been seen to increase the number of physicians joining rural areas after graduation.(Dunbabin & Levitt 2003; Halaas 2005; Hsueh, Wilkinson & Bills 2004; MacDowell, Glasser & Hunsaker 2013; Playford et al. 2014). Apart from rural background, future career intentions to become a family physician or primary care physician were also considered in the admission criteria in Jefferson Medical College (JMC), United States under the Physician Shortage Area Program (PSAP). Cohort study showed PSAP graduates are more likely than non PSAP graduates to serve in rural areas with a relative risk of 9 (Rabinowitz et al. 2011, 2012). The other intervention that addresses the medical school factor was rural location of medical school. This is an example from Catholic University of Graben in Democratic Republic of Congo. The study reported that students trained from this rurally located medical school had 82% of graduates working in rural area compared to 24% of graduates from urban located school (Longombe 2009).

3.7.3 Policy Interventions

The Jichi Medical University from Japan has an ongoing intervention where the medical college policy is to recruit students from rural areas, provide financial support to the medical students during schooling in return for an obligatory service of 9 years at the rural community setting following graduation. This intervention is seen to be successful. A cross-sectional study on 1255 graduates from JMU, reports 70% of the graduates from the college have remained in the area they recruited from (Matsumoto, M, Inoue & Kajii 2008).

4.0 Discussion

According to a study from 2012, only one tenth of the medical students in Nepal showed interest to work in rural areas. This cross-sectional study was the only study found in Nepal regarding the career intentions of the medical students. (Huntington et al. 2012). This study gives a glimpse that a problem exists in the rural career intent of medical students In Nepal, where the doctor population is much lower in the rural areas compared to the WHO standards. This has an impact on the low medical workforce in the rural areas of the country. Similar problems are reported from other countries of the world (Ahmed et al. 2011; Burch et al. 2011; Deressa & Azazh 2012; Diwan et al. 2013; Van Wyk, Naidoo & Esterhuizen 2010). Analysis of the factors that influenced the motivation of medical students to work in rural areas was essential along with interventions to address the low motivation among the Nepalese medical students.

This review guided by the framework explores the factors of motivation for medical students.

4.1 Factors influencing the motivation of medical students to work in rural areas

The analysis has revealed many factors exist around the world in different combinations in low, middle and high-income countries. Studies in this review are more from the high and middle-income countries (predominated by high-income countries), as more studies are carried out more in the high-income countries compared to the middle and low-income countries. I can see that the high and middle-income countries have identified many factors years before the low-income countries based studies were found.

Health Facility related factors

The health facility related factors in this study are 'push factors' that do not motivate 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 repelling effect among the medical students involved. The only pull factor related to health facility was identified to be the provision of extra financial incentive for working in rural areas

(Huntington et al. 2012). These factors are more linked with the health system of the country. These problems are reported from many low-income countries; however, when we look for interventions globally to address such factors, literatures were not found involving medical students as these problems are beyond the medical student or even the medical school or education.

Out of the seven papers that reported on heath facility related factors, six were from the low and lower middle-income countries. The factors mostly include were perceived inadequacy of infrastructure and supplies Only one study from Australia reported on health facility related factors, which however was not related to physical infrastructure or supplies but to professional support at work.

Personal and lifestyle related factors

Personal and lifestyle factors are factors that vary between each individual. Rural background of individual or of someone as close as spouse or parent is a strong personal factor that are identified decades ago to motivate the interest of students for practice in rural area. Interventions have considered rural background for admission of medical students, which are reported mostly from high-income countries. The rural background factor has been reported from Nepal as well to be linked with medical practice in rural area (Huntington et al. 2012). Personal factors reported here are mostly the pull factors. In terms of lifestyle, the choices of the individuals are greatly influenced with personal circumstances of marriage, spouse choice, family needs, and lifestyle choice for living, housing and recreation. The lifestyle factors reported here are mostly the push factors that distract the individual away from rural area.

Medical education and curriculum factor

The most relevant factor for medical students is the medical education and curriculum factor. Rural oriented or community-based education principle gives positive motivation to the student towards rural community. Rural training brings the student closer to the community. The education and curriculum principle of being rural or community oriented is justified by the identified personal factor of rural experience that motivates the students for medical practice in rural area as mentioned earlier. In my experience of working there, BPKIHS in Nepal with its teaching district concept works with district facilities. In this concept, the medical college is responsible for provision of health services

to the people from the district. It provides opportunity for students to learn from rural health facilities and the community benefit from the expertise of the doctors from the medical college (B P Koirala Institute of Health Sciences 2014). Literatures comprehensively reporting on the teaching district concept and its outcome were not found in literature searches. Nepal has community-based education (CBE) in the curriculums of all medical colleges since the inception of the first medical college in 1978. However, a comprehensive analysis of the CBE in Nepal was not found in the literature searches so far. This factor related to medical education is very relevant given the existing curriculum of CBE in Nepal. Having the evidence that CBE motivates students to work in rural areas gives opportunities for further exploration in the Nepalese context.

Medical School factors

Closely linked to the education and curriculum factor is the medical school factor. As the medical school plays an important role from selection of the candidates to implementing its curriculum to producing a doctor, the use of appropriate selection criteria is very important. The findings suggest that schools with criteria to select students with a rural background, experience and education have produced more doctors that are serving in rural areas. The study reports that the location of the school being in a rural area also adds to the motivation of the trained medical students towards rural areas. The push factor identified in the study was high tuition fee associated with private medical school. In Nepal, it was seen that students educated in such school had their preferred work location away from rural area (Huntington et al. 2012). Innovative approach started in PAHS is reported from Nepal, where by selection criteria to include rural background students have been started. They also mention about scholarship support along with rural community project for students (Courneya 2010). However no other literatures on this was found. From my personal experience, I can say that the criterion for providing scholarship seats for rural district candidates is present at BPKIHS. It is a public funded health sciences university with an undergraduate medical college in Nepal. It is not clear however about the outcomes of this criterion as literature searches so far did not result in any papers regarding this subject.

Policy related factors

Policy factors are more related with the system of health, education and human resources planning. Scholarship followed by obligatory service scheme motivates the student to practice in rural areas. This has been

used as a policy intervention in Jichi Medical University, Japan to produce more physicians for rural area (Matsumoto, Masatoshi, Inoue & Kajii 2008). Nepal has scholarship schemes whereby the private medical colleges are obliged to provide 10-20% of seats to government selected students for medical education (Shankar et al. 2006). However, studies evaluating the outcome of the scholarship scheme in Nepal could not be found.

Other factors

Other factors identified in this study are related with safety, security and political situation of the country. Nepal had been previously in a situation of conflict and the medical education was affected as the students could not be taken to the community due to security reasons (Giri & Shankar 2006). The safety and political instability is however an issue at country level affecting all fields, that is beyond the scope of any interventions focusing on medical students.

Relationship between the factors

All the five categories of factors are linked with the income level of the country. However, rural areas of a high-income country are not comparable to the rural areas of low-income countries, yet the motivation for working in rural areas is a challenge faced by all income countries. As we discuss the factors in these categories, it can be seen that the factors are also linked with each other. Personal factors of rural background, education and exposure are closely linked to medical school factors of student intake criteria. The medical school factors are linked across all the above-mentioned categories of factors. Rurally located medical college with community-based curriculum may develop an interest for rural area, which is also considered a personal factor. The policy factors also incorporate, motivating factors of rural background to set criteria for scholarships.

4.2 Interventions focused on motivating medical students to work in rural areas after graduation

As shown in table 4 of the annex 5, the interventions from around the world that focus on medical students show that only factors related to medical education (ME) and medical schools (MS) have been found to be addressed. The possible explanation for this can be that the health facility factor is more of a factor that needs to be addressed by the health system of a country. Interventions on medical students were not found so far for

this factor. The personal factor of rural background is linked to the medical school intake criteria however the personal factors are also factors that cannot be modified by any interventions on the medical students with an exception for rural interest that may be increased by rural exposures during medical studies. The factors of lifestyle choices are beyond the scope of intervention while focusing on medical students. Literatures were also not found in this area. The rural background factor, however, has a link with the medical school criteria, which has been used to design admission criteria of the student in medical schools.

Successful interventions from Australian, Norway and United states are focusing on the selection criteria of medical schools that take students with a rural background, which is a pull factor as identified in this study as well. Another intervention has to do with community-based education or rural service oriented learning, which has been implemented through curriculum in Australia, Japan, Nigeria and Uganda. All 18 medical colleges that offer undergraduate medical education in Nepal are located in cities. Although Nepal also has CBE in its medical curriculum, the duration and timings of the CBE in medical colleges in Nepal vary. While the implementation and execution of the curriculum are yet to be evaluated we do have evidence about the curriculum and selection criteria for student that are more oriented to the rural community from public schools like PAHS, BPKIHS and IOM in Nepal. Studies regarding evaluation of the community-based education in Nepal were not found. A study from Nepal reported that the medical students perceive that training them in resource constraint settings could help prepare them for such places (Shankar & Thapa 2012).

Obligatory service scheme in Jichi Medical University is successful in increasing the number of physician practising in rural areas (Matsumoto, Masatoshi, Inoue & Kajii 2008). The government of Nepal has a national scholarship scheme available for undergraduate medical students in medical colleges of Nepal and in some countries of Asia. This is followed by obligatory rural service for two years. The implementation of the obligatory services and its outcome was not found in literature searches so far. Though the obligatory scheme has succeeded in Japan, based on the rural context of a high-income country and a low-income country Nepal, it is too early to say anything about the success or failure of the scheme in Nepal.

4.3 Limitations of the study

The search strategy may have resulted in missing out some articles that could have contributed here. Since there was no primary data collection in the context of Nepal in this study, the findings of this review may not reflect the real time situation in Nepal. A stakeholder analysis could have added relevant information, especially for discussion and recommendations that would be more practical.

4.4 Critical Analysis of the Framework

The framework provided five categories of the factors for analysis in this review. This framework broadly allows categorising different factors that directly or indirectly influence the motivation of a medical student to work in rural area following graduation. Although the factors are independently affecting the motivation, they also have links with each other, combining the effect on motivation. The framework illustrates how the factors interact with the student's motivation as well as with each other.

However, some limitations are seen in the framework as the factors are analysed. Although the framework gives a wider area for exploration of the factors while we look for interventions, the factors that can be addressed focusing on medical students are limited to medical education, curriculum, medical school and policy related factors. Some findings could not be analysed under any category of the framework. The findings are personal safety as a concern and political instability as mentioned in two separate studies (Kaye et al. 2010; Shankar & Thapa 2012).

The health facility related factor is clearer for retaining a physician rather than motivating a student. The framework also has limited scope to demonstrate clear interaction of the factors towards final motivation of a medical student.

5.0 Conclusions

Low motivation among medical students for working in rural areas is a problem worldwide. Although the definition of rural area varies from country to country, the common representation of rural area seem to be any area that is considered non-urban. Many high-income countries like Australia, Canada and United States have recognised factors related to motivation among medical student to work in rural areas decades ago and have initiated few interventions to address the shortages of physicians in the country. Multiple factors are identified from global experiences that fall in all five categories of the motivation framework used in this review (Figure 4).

Multiple The health facility related factors that influence the motivation of medical students are also a motivating factor for physicians and other health professionals. The personal and lifestyle related factors are identified as inherent factors of any individual and especially in this case the medical student. A medical student with a rural background is associated with a subsequent career in rural area after graduation. As the students are already exposed to these factors before entering medical school, these factors can be considered as 'non-modifiable' personal factors. While intervention cannot be designed to modify the factor itself, the personal factors are of immense importance when interventions are designed to select medical students for admission.

The most relevant factors for medical students are medical education and medical school factors. Rural location of medical school provides opportunity for students with any personal background or lifestyle to train in a rural area and be acquainted with the rural lifestyle during the training. The admission criteria of selecting students with rural background motivate the students to build upon their experiences towards working in rural areas after graduation. Community based medical education brings the students closer and exposes them to the needs of the community. This provides competencies to a student towards becoming a doctor who is responsive to the needs of the people living in rural areas. We can now see that all factors identified have a connection with the rural experience as a factor. A service bond or a service contract is a policy factor that motivates students to work in rural areas following their graduation.

In terms of Nepal, the medical education and the medical school factors identified are more relevant. As a low-income nation, all citizens have a natural tendency to move towards an urban area for better facilities and to be closer to the centre of a more centralised government system. Medical students showing a high motivation to work in urban area clearly demonstrate that tendency.

Existing interventions in motivating medical students to work in rural areas are around the factors of medical school, education and curriculum. Successful interventions around the world have medical school admission criteria designed to select students with a rural background. In addition, rural experience and interest are also factors considered in the admission criteria in many countries.

There is evidence from around the world that community based medical education have positive results in increasing the number of physicians working in the rural areas. Due to lack of studies, in Nepal, we can neither critically comment on the current role CBE is playing for motivation nor on what needs to be done to the existing CBE model for a better outcome. Due to lack of evidence from Nepal, it is not clear to say that scholarship schemes followed by obligatory service in designated rural areas could be a successful policy intervention.

The findings from this study are useful for medical educators and the policy makers of the country to improve medical education in producing physicians according to the need of the community.

6.0 Recommendations

This study has found relevant interventions to motivate medical students to work in rural areas of Nepal. These recommendations strengthen the existing practices and initiate new practices in order to increase the motivation among medical students to work in rural areas following graduation. The recommendations are grouped as Policy, Practice and Research categories as follows:

1. **Policy:** The government should initiate a national program to select students with rural background into medical schools who will serve the rural areas after graduation.
   Key consideration here should be to ensure that students selected are truly from rural backgrounds. Appropriate financial and social support to encourage students from rural areas must be in place so that the students are aware and apply for the selection process.
2. **Policy:** Government should make regulations on building new medical schools in rural areas in order to provide an environment for learning in a rural community.
   Key consideration here is that government should provide incentives and support for these newer schools in terms of infrastructure or technical support. This will encourage them to establish the schools in rural area compared to the existing ones that are in urban areas.
3. **Practice:** The Nepal medical council should stimulate community-based education and encourage community based clinical training to engage the medical students in learning in health facilities that are in rural areas. The existing teaching district concept of BPKIHS, that has almost a year of the clinical training in district health facilities, could be replicated with strengthened activities by all medical schools after careful study. In this concept, the medical college is also responsible for the health of the people from the teaching district.
   Key consideration here is for the government to play a pivotal role between the medical school and the district health facilities, so that the medical school has a place to deliver clinical training in rural areas and the district health facility also benefits from the services provided by the consultants that arrive at their facilities for teaching purposes. It is of utmost importance to ensure that the existing district facilities benefit from this partnership rather than compromising the existing services offered by these facilities.

4. **Practice:** The ministry of Health and the Ministry of education should form an authoritative body to regulate Compulsory service in a rural area for the students who have gained financial support in the form of a scholarship from the government or any other public initiatives.
   Key consideration here is to ensure that the government has enough positions in the rural areas to deploy these students after graduation.
5. **Practice:** The Ministry of education should assign more weight for students with rural background during selection in addition to the merit criteria that exists for scholarship schemes. This policy will encourage the rural students to apply for such scholarships.
   Key consideration here is to ensure that genuine candidates from rural background and education are selected into the scheme.
6. **Research:** Nepal Health Research Council in partnership with Health Sciences University should commission and promote researches in medical education. The research should focus on career intention, CBE, and exploring the needs for motivating the students towards rural areas. Evidences from such studies are crucial for regulating medical education and human resources for health.
   Key consideration here must be to involve all medical colleges, local government bodies, community partnership along with leadership from the government.
7. **Research:** The Ministry of Education and the Ministry of Health and Population in partnership with Health Sciences University should conduct researches on outcome of existing scholarship schemes followed by obligatory service and possibility of community partnership in medical education in Nepal.
   Key consideration during implementation of this recommendation requires involvement of the medical students, medical schools, community, regulatory bodies and the human resources for health planning section of the ministry of health.

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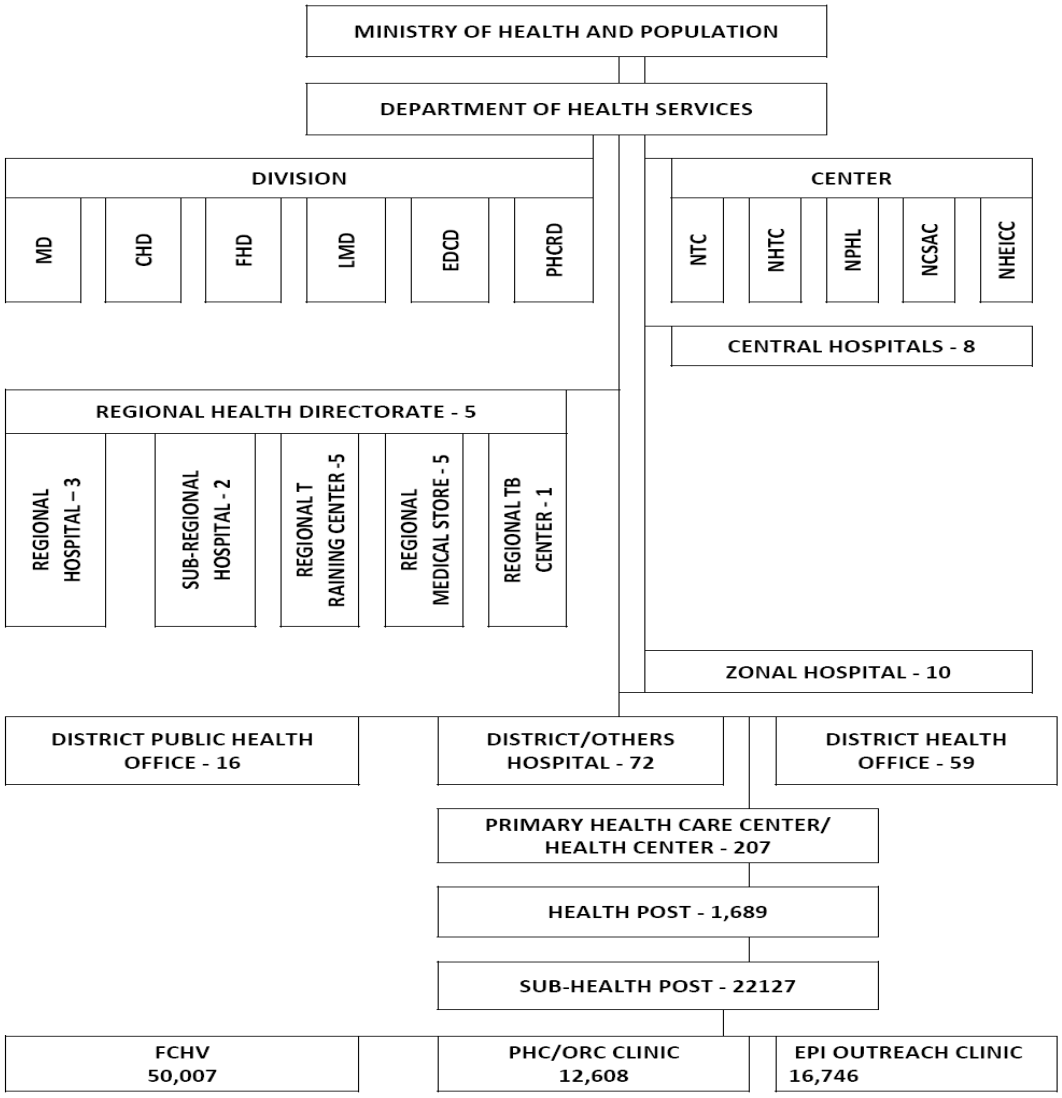
8.0 Annexes

Annex 1: Organisation of Health care services in Nepal



MD: Management Division; CHD: Child Health Division; FHD: Family Health Division; LMD: Logistic Management Division; EDCD: Epidemiology and Disease Control Division; PHCRD: Primary Health Care Revitalisation Division;
NTC: National Tuberculosis Centre; NHTC: National Health Training Centre; NPHL: National Public Health Laboratory; NCASC: National Centre for AIDS and STD Control; NHEICC: National Health Education Information and Communication Centre;
FCHV: Female Community Health Volunteers; PHC/ORC: Primary Health Care/Out Reach Centre;

Figure 5 : Organisation chart of Public Health Services in Nepal

(Source: Department of Health Services 2014)

Annex 2: Summary articles reporting on factors influencing motivation among students

Table 1 : Characteristics of the 32 articles reviewed for analysis of the factors influencing the motivations of the medical students to practice in rural areas following graduation

Income group of countries	High-income (21)
	Upper middle-income (2)
	Lower middle-income (2)
	Low-income (7)
Countries	USA (6)
	Australia (6)
	Nepal (3)
	Canada (2)
	Ghana (2)
	South Africa (2)
	UK (2)
	Bangladesh (1)
	Ethiopia (1)
	Japan (1)
	Malawi (1)
	New Zealand (1)
	USA & Canada (1)
	Uganda
Level of Evidence	Level 2a (3)
	Level 4 (29))
Study Design	Cross-sectional study (18)
	Qualitative (5)
	Systematic review (4)
	Review (2)
	Cohort (1)
	Case control (1)
	Qualitative and quantitative (1)

Annex 3: Summary articles reporting on factors influencing motivation among students

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 et al. 2011)	Bangladesh	Cross-sectional	• Four percent of medical students interested to practice in rural areas
(Azer, Simmons & Elliott 2001)	Australia	Cross-sectional	• 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 et al. 2012)	Malawi	Qualitative	• 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, Lipsky & Lutfiyya 2011)	North America	Review	• Rural Training experience influence career choice and practice location • Rural training is valued by the medical students as positive learning experience
(Bazargan et al. 2006)	United States	Cross-sectional	• Concerns on finances played important role in career choice. • Interest in primary care specialty showed higher likelihood of working in underserved areas
(Brooks et al. 2002)	United States	Review	• Rural upbringing, family physician as specialty preference, medical curriculum committed to rural service and rural rotation strongly influenced medical practice in rural area.
(Clark et al. 2013)	Australia	Cohort	• Rural background was associated with uptake of medical practice in rural areas • Extended placement in rural areas motivated students to take up medical practice in rural area more than rural background.
(Crampton, McLachlan & Illing 2013)	United Kingdom	Review	• Rural exposure during undergraduate training and rural background increased likelihood of

			medical practice in rural areas.
(Crump, Fricker & Ziegler 2009)	Unites States	Cross-sectional	• Rural Medical Elective from urban medical school increased likelihood of medical practice in rural areas.
(Curran & Rourke 2004)	Canada	Review	• 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 & Grant 2011)	United Kingdom	Qualitative	• 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 motivation for rural practice.
(Deressa & Azazh 2012)	Ethiopia	Cross-sectional	• 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 et al. 2012)	Australia	Mix Method	• Interest for rural lifestyle, rural background, and time spent at the rural clinical posting motivated for medical practice at rural areas. • Personal and family reasons such as marriage, starting family had strong influence in career choices.
(Hsueh, Wilkinson & Bills 2004)	New Zealand	Review	• 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 et al. 2012)	Nepal	Cross-sectional	• 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 et al. 2010)	Uganda	Qualitative	• 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 et al. 2012)	Ghana	Cross-sectional	• 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 et al. 2010)	Ghana	Cross-sectional	• 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 & Kajii 2011)	Japan	Cross-sectional	• Community based education motivates the medical student for community health care.
(Orpin & Gabriel 2005)	Australia	Cross-sectional	• 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 incentives are better patient relations, diverse work experiences and rewarding work. • Disincentives 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, Milling & Mcguigan 2008)	United States	Case Control	• Medical students from rural high school background are more likely to practice in rural area.
(Ranmuthugala et al. 2007)	Australia	Review	• Rural clinical schools and curriculum focusing on rural health motivate practice in rural area.
(Roberts et al. 2012)	Australia	Qualitative	• 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 & Andrilla 2005)	United States	Cross-sectional	• Males more motivated to work in rural areas. • Student debt was not seen as influencing career decision for rural area.
(Ross 2007)	South Africa	Qualitative	• Students from rural background return to

			practice in rural areas.
(Royston et al. 2012)	United States	Cross-sectional	• 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 & Thapa 2012)	Nepal	Cross-sectional	• 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 et al. 2014)	Japan	Cross-sectional	• Community based medical education and early exposure to community increases motivation among students to work for rural community
(Tate & Aoki 2012)	Canada	Cross-sectional	• Male students, rural living experience, attended rural school and rural medical education experiences are related to influencing practice at rural area.
(Van Wyk, Naidoo & Esterhuizen 2010)	South Africa	Cross-sectional	• 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 et al. 2012)	Australia	Cross-sectional	• Rural origin of the student, Rural Clinical School
(Wayne et al. 2010)	USA	Cross-sectional	• Rural background, older age (>25 years) at matriculation and member of underrepresented minority
(Zimmerman, Shakya & Pokhrel 2012)	Nepal	Cross-sectional	• 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.

Annex 4: Table of Identified factors

Table 3 : Summary of the identified factors influencing the motivation of medical students to work in rural areas following graduation

Health Facility related factors
Lack of physical facilities Lack of equipments and supplies Lack of peer support Lack of consultation from seniors Lack of Communication facilities Lack of good opportunities for private practice Continuing education facilities Poor hospital management After hour work load Trade off of clinical practice for performing administrative work High expectation from the community Patient Communication in rural areas Financial incentives for rural practice Understaffing
Personal and Lifestyle factors
Gender: Male Rural background Rural birth Rural upbringing Prior exposure to rural community Education from rural school prior to medical schooling Having spouse or parents from rural area Older age at medical school entry Para-medical background prior to medical school Family background (Low SES) Spouse of partner's needs Children education needs Need for further education Lack of Proper housing Poor living conditions Lack of entertainment facilities Personal circumstances; getting married, planning family Future career intention in Family practice or Primary care Cost of living Good salary Role model preceptors Expected better patient relations, Expected diverse work experience, Expected rewarding work Working for the home district community

Duty of a citizen to serve community people Appreciation by rural community Isolation from families and friends Difficulties in relocating to urban areas Frequent need to travel Expensive travel cost Rural lifestyle interest Less pressure and stress Expected friendly environment Get to manage cases that don't reach tertiary hospitals Gain Management skills Limited future career options Lower grade in medical school
Medical Education and Curriculum factors
Rural medical training and education exposure Rural service oriented curriculum Community based education Time spent in rural rotation and posting Early exposure to the community Training in resource constraint settings
Medical School related factors
Medical school admission criteria selecting students with rural preferences, career preference of Primary care or Family Practice Medical school in rural areas/Rural clinical Schools Rural training environments Students of Private medical colleges paying high tuition fees
Policy factors
Government Scholarship schemes Obligatory services in rural areas
Other factors
Political stability Personal safety of physician

Annex 5: Summary interventions on medical students

Table 4 : Summary of interventions on medical students that promote working in rural areas

Author	Study Type & Level of evidence	Program Location & Year Started	Interventions	Factors addressed*
(Halaas 2005)	Personal View, Level 5 (Expert opinion)	Rural Physician Associate Program (RPAP), University of Minnesota Medical School, United States, 1971	• Medical Student selection criteria for selecting students with rural background	• MS
(Hsueh, Wilkinson & Bills 2004)	Review, Level 4 (Case series)	Jichi Medical School, Japan, 1972	• Community based education • Financial support to medical students • Recruitment criteria selecting rural students followed by obligatory rural service after graduation	• ME • MS • PF
(Matsumoto, M, Inoue & Kajii 2008)	Cohort, Level 4 (Relative Risk not calculated)			
(Hsueh, Wilkinson & Bills 2004)	Review, Level 4 (Case series)	Tromso School of Medicine, Norway, 1972	• Rural Location of medical college • Recruitment of students with willingness to serve in rural areas	• MS
(Rabinowitz et al. 2011)	Cohort, Level 2b (Relative Risk is calculated)	Physician Shortage Area Program (PSAP), Jefferson Medical College, United States, 1974	• Recruitment of students in to medical school with Rural Background, experience and future career interest in General Practice or Family Medicine	• MS
(Rabinowitz et al. 2012)	Cross-sectional,			

	Level 4 (Case series)			
(Longombe 2009)	Cross-sectional, Level 4 (Case series)	Catholic University of Graben, Democratic Republic of Congo, 1989	• Rural Location of Medical School	• MS
(MacDowell, Glasser & Hunsaker 2013)	Cross-sectional, Level 4 (Case series)	Rockford Rural Medical Education (RMED) program, University of Illinois, United states, 1993	• Admission criteria selecting students with rural background and • Community -based rural medical curriculum • Rural preceptorship	• ME • MS
(Worley 2008)	Cohort, Level 4 (Relative Risk not calculated)	Parallel Rural Community Curriculum (PRCC), Flinders University School of Medicine, Australia, 1997	• Rural Community-based clinical education	• ME
(Skinner, Onoka & Ofoebgu 2008)	Cross-sectional, Level 4 (Case series)	19 out of 20 Medical Schools of Nigeria, 1997	• Community Based Education	• ME
(Sen Gupta et al. 2013)	Case control, Level 3b (Individual case control study)	James Cook University, Australia, 2000	• Students selection from rural background • Assessment practices developed in collaboration with rural representatives • Clinical placements in rural and remote areas	• ME • MS
(Dunbabin & Levitt 2003)	Review, Level 4	Participating Medical Schools of Australian Rural Clinical	• Selecting medical students from rural background and	• ME • MS

	(Case series)	School Initiative in Australia, 2002	locations, rural training • curriculum focusing in rural service	
(Playford et al. 2014)	Cohort, Level 4 (Relative Risk not calculated)	Rural Clinical School initiative of Australian Government, Rural Clinical School of Western Australia , 2002	• Selecting medical students from rural background and locations, rural training • curriculum focusing in rural service	• ME • MS
(Forster et al. 2013)	Case control, Level 3b (Individual case control study)	Australian Rural Clinical School in University of New South Wales, Australia, 2002	• Students selection from rural background • Students spending 1-3 years at the rural clinical schools	• MS
(Kaye, Mwanika & Sewankambo 2010)	Cross-sectional, Level 4 (Case series)	Makerere University College of Health Sciences, Kampala, Uganda, 2003	• Problem Based Learning Curriculum in the community Settings	• ME
(Mariam et al. 2014)	Qualitative Study, Level 4 (Case series)	Community-based education programs in Africa, Medical Education Partnership Initiative (MEPI), 2010	• Community-based Education	• ME
(Strasser & Neusy 2010)	Review, Level 4 (Case series)	Northern Ontario School of Medicine, Canada, 2001	• Rural community-based school, rural recruitment criteria for students	• MS
		Zamboanga School of Medicine, Philippines, 1994	• University-Community partnership, Rural community exposure	• ME • MS

* ME= Medical education and curriculum, MS= Medical school, PF= Policy Factors

Annex 6: Level of Evidence

Table 5 : Levels of Evidence (Oxford Centre for Evidence-based Medicine 2014)

Level	Therapy / Prevention, Aetiology / Harm	Prognosis	Diagnosis	Differential diagnosis / symptom prevalence study	Economic and decision analyses
1a	SR (with homogeneity*) of RCTs	SR (with homogeneity*) of inception cohort studies; CDR" validated in different populations	SR (with homogeneity*) of Level 1 diagnostic studies; CDR" with 1b studies from different clinical centres	SR (with homogeneity*) of prospective cohort studies	SR (with homogeneity*) of Level 1 economic studies
1b	Individual RCT (with narrow Confidence Interval"i)	Individual inception cohort study with > 80% follow-up; CDR" validated in a single population	Validating** cohort study with good" " " reference standards; or CDR" tested within one clinical centre	Prospective cohort study with good follow-up****	Analysis based on clinically sensible costs or alternatives; systematic review(s) of the evidence; and including multi-way sensitivity analyses
1c	All or none§	All or none case-series	Absolute SpPins and SnNouts" "	All or none case-series	Absolute better-value or worse-value analyses " " " "
2a	SR (with homogeneity*) of cohort studies	SR (with homogeneity*) of either retrospective cohort studies or untreated control	SR (with homogeneity*) of Level >2 diagnostic studies	SR (with homogeneity*) of 2b and better studies	SR (with homogeneity*) of Level >2 economic studies

		groups in RCTs			
2b	Individual cohort study (including low quality RCT; e.g., <80% follow-up)	Retrospective cohort study or follow-up of untreated control patients in an RCT; Derivation of CDR" or validated on split-sample§§§ only	Exploratory** cohort study with good" " " reference standards; CDR" after derivation, or validated only on split-sample§§§ or databases	Retrospective cohort study, or poor follow-up	Analysis based on clinically sensible costs or alternatives; limited review(s) of the evidence, or single studies; and including multi-way sensitivity analyses
2c	"Outcomes" Research; Ecological studies	"Outcomes" Research		Ecological studies	Audit or outcomes research
3a	SR (with homogeneity*) of case-control studies		SR (with homogeneity*) of 3b and better studies	SR (with homogeneity*) of 3b and better studies	SR (with homogeneity*) of 3b and better studies
3b	Individual Case-Control Study		Non-consecutive study; or without consistently applied reference standards	Non-consecutive cohort study, or very limited population	Analysis based on limited alternatives or costs, poor quality estimates of data, but including sensitivity analyses incorporating clinically sensible variations.
4	Case-series (and poor quality cohort and case-control studies§§)	Case-series (and poor quality prognostic cohort studies***)	Case-control study, poor or non-independent reference standard	Case-series or superseded reference standards	Analysis with no sensitivity analysis

5	Expert opinion without explicit critical appraisal, or based on physiology, bench research or "first principles"	Expert opinion without explicit critical appraisal, or based on physiology, bench research or "first principles"	Expert opinion without explicit critical appraisal, or based on physiology, bench research or "first principles"	Expert opinion without explicit critical appraisal, or based on physiology, bench research or "first principles"	Expert opinion without explicit critical appraisal, or based on economic theory or "first principles"

Produced by Bob Phillips, Chris Ball, Dave Sackett, Doug Badenoch, Sharon Straus, Brian Haynes, Martin Dawes since November 1998. Updated by Jeremy Howick March 2009

Notes

Users can add a minus-sign "-" to denote the level of that fails to provide a conclusive answer because:

- ***EITHER*** a single result with a wide Confidence Interval
- ***OR*** a Systematic Review with troublesome heterogeneity.

Such evidence is inconclusive, and therefore can only generate Grade D recommendations.

*	By homogeneity we mean a systematic review that is free of worrisome variations (heterogeneity) in the directions and degrees of results between individual studies. Not all systematic reviews with statistically significant heterogeneity need be worrisome, and not all worrisome heterogeneity need be statistically significant. As noted above, studies displaying worrisome heterogeneity should be tagged with a "-" at the end of their designated level.
"	Clinical Decision Rule. (These are algorithms or scoring systems that lead to a prognostic estimation or a diagnostic category.)
"i	See note above for advice on how to understand, rate and use trials or other studies with wide confidence intervals.
§	Met when all patients died before the Rx became available, but some now survive on it; or when some patients died before the Rx became available, but none now die on it.
§§	By poor quality cohort study we mean one that failed to clearly define comparison groups and/or failed to measure exposures and outcomes in the same (preferably blinded), objective way in both exposed and non-exposed individuals and/or failed to identify or appropriately control known confounders and/or failed to

	carry out a sufficiently long and complete follow-up of patients. By poor quality case-control study we mean one that failed to clearly define comparison groups and/or failed to measure exposures and outcomes in the same (preferably blinded), objective way in both cases and controls and/or failed to identify or appropriately control known confounders.
§§§	Split-sample validation is achieved by collecting all the information in a single tranche, then artificially dividing this into "derivation" and "validation" samples.
" "	An "Absolute SpPin" is a diagnostic finding whose Specificity is so high that a Positive result rules-in the diagnosis. An "Absolute SnNout" is a diagnostic finding whose Sensitivity is so high that a Negative result rules-out the diagnosis.
"i"i	Good, better, bad and worse refer to the comparisons between treatments in terms of their clinical risks and benefits.
" " "	Good reference standards are independent of the test, and applied blindly or objectively to applied to all patients. Poor reference standards are haphazardly applied, but still independent of the test. Use of a non-independent reference standard (where the 'test' is included in the 'reference', or where the 'testing' affects the 'reference') implies a level 4 study.
" " " "	Better-value treatments are clearly as good but cheaper, or better at the same or reduced cost. Worse-value treatments are as good and more expensive, or worse and the equally or more expensive.
**	Validating studies test the quality of a specific diagnostic test, based on prior evidence. An exploratory study collects information and trawls the data (e.g. using a regression analysis) to find which factors are 'significant'.
***	By poor quality prognostic cohort study we mean one in which sampling was biased in favour of patients who already had the target outcome, or the measurement of outcomes was accomplished in <80% of study patients, or outcomes were determined in an unblinded, non-objective way, or there was no correction for confounding factors.
****	Good follow-up in a differential diagnosis study is >80%, with adequate time for alternative diagnoses to emerge (for example 1-6 months acute, 1 – 5 years chronic)