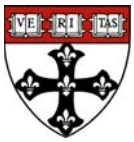

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Financial Incentives for Return of Service in Underserved Areas: A Systematic Review

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Financial incentives for return of service in underserved areas: a systematic review

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Background

In many geographical regions, both in developing and in developed countries, the number of health workers is insufficient to achieve population health goals. Financial incentives for return of service are intended to alleviate health worker shortages: A (future) health worker enters into a contract to work for a number of years in an underserved area in exchange for a financial pay-off.

Methods

We carried out a systematic literature search of PubMed for studies evaluating outcomes of financial-incentive programs published between 1957 and 2007. To identify articles for review, we combined three search themes (health workers or students, underserved areas, and financial incentives). Each theme was operationalized using the Medical Subject Headings of US National Library of Medicine. In the initial search, we identified 5,565 articles, 5,449 of which were excluded based on screening of titles and abstracts, and a further 90 were excluded after full-text review, leaving 26 articles to be included in the final review. We computed random-effects estimates of the pooled proportion of participants in financial-incentive programs who were successfully recruited to practice in underserved areas.

Results

With three exceptions – from Canada, New Zealand, and South Africa – all of the programs evaluated in one of the reviewed studies are located in the US. The programs started between 1930 and 1998. Financial incentives ranged from year-2000 US Dollar

1,358 to 28,470. All reviewed studies are observational. The random-effects estimate of the pooled recruitment proportion was 69% (95% confidence interval 61-77%). In comparison to programs with buy-out options, programs without such an option had significantly higher pooled recruitment proportions (84% vs 65%, $p < 0.001$) but also significantly higher proportions of default (on either service or payment obligation) (16% vs 3%, $p < 0.001$). The proportion of program participants who remained in an underserved area after completing their obligation ranged from 25% to 90%. Four studies find that program participants are significantly less likely to remain in the underserved area of initial practice than non-participants, while one study does not find a significant difference. In contrast, four studies investigating retention in service to the underserved in general (i.e. not only in the area of initial practice) find higher retention rates in participants than in non-participants, while only one study finds the opposite.

Conclusions

Existing studies suggest that financial incentives for return of service can be effective in increasing the number of health workers in underserved areas. However, in most programs large proportions of participants do not serve their obligation. Future studies need to investigate whether financial-incentive programs can be effective in developing countries and whether the findings from observational studies can be confirmed in controlled experiments.

Introduction

In many geographical regions, both in developing and in developed countries, the number of health workers is insufficient to achieve population health goals. The 2004 Joint Learning Initiative (JLI) report *Human Resources for Health* estimated that "Sub-Saharan countries must nearly triple their current numbers of workers by adding the equivalent of one million workers through retention, recruitment, and training if they are to come close to approaching the MDGs [Millennium Development Goals] for health" [1]; the 2006 *World Health Report* concluded that "[t]he severity of the health workforce crisis in some of the world's poorest countries is illustrated by WHO estimates that 57 of them (36 of which are in Africa) have a deficit of 2.4 million doctors, nurses and midwives" [2]. In developed countries, certain areas, such as rural or poor communities, are commonly underserved with health workers, leaving substantial proportions of the population without access to complete primary health care [3-5].[1]

Interventions intended to alleviate health worker shortages include selective recruitment and training for practice in underserved areas, improvements in working conditions or living conditions, and compulsion or incentives [6]. In this article, we systematically review the evidence on one specific set of policy interventions: financial incentives for return of service. These interventions work as follows. A health worker in training or a fully trained health worker enters into a contract to work for a number of years in an

[1] In this article, unless otherwise specified, we use the term underserved area to encompass underserved communities, regions, and populations within countries, as well as countries where by some standards even the best-served geographical regions are underserved. The precise definition of an underserved area differs across the financial incentive programs evaluated in the studies reviewed in this article. The different definitions are shown in Table 1.

underserved area in exchange for a financial pay-off. Financial incentives can increase the numbers of health workers in underserved areas by two mechanisms. First, they can redirect the flow of those health workers who would have been educated without any financial incentive from well-served to underserved areas, for instance by decreasing the net emigration flow of nurses and physicians from developing to developed countries [7-9] or by increasing the net flow of physicians from urban tertiary care to rural primary care in developed countries [10, 11]. This first mechanism can take hold if there are (future) health workers who normally would not work in an underserved area, but who are willing to do so in return for a financial incentive. Financial-incentive programs will increase social well-being through this mechanism if the difference between the marginal benefits of a health worker in an underserved area and a well-served area is positive and larger than the cost of the financial incentive to redirect a health worker from the latter to the former.

Second, financial-incentive programs can add health workers to the pool of workers who would have been educated in the absence of such programs and place them in underserved areas. The second mechanism can take hold if, on the one hand, there are qualified candidates who would not have the means to finance a health care education without a financial incentive and, on the other hand, a country's health care education system can absorb additional students. Financial incentive programs will increase social well-being through this mechanism if the marginal benefit of an additional health worker in an underserved area exceeds the cost of the financial incentive to educate her and place her in such an area.

We have recently shown that a specific type of financial-incentive program, scholarships in return for a commitment to deliver antiretroviral treatment in Sub-Saharan Africa, is highly cost-beneficial under a wide range of assumptions [12]. In the following, we will first update a previous systematic review of financial incentives for return of service. Then, we will critically summarize the findings from existing studies and draw implications for policy and future research. One previous study has systematically reviewed financial-incentive programs for return of service. Sempowski (2004) reviewed 10 studies of financial-incentive programs published between January 1966 and July 2002 [13]. The author concludes that "ROS [return-of-service] programs to rural and underserviced areas have achieved their primary goal of short-term recruitment but have had less success with long-term retention" [13]. Prima facie, an update of the previous systematic review is useful because more than five years have passed since the end of the period of publication of articles considered in the review. The Cochrane Collaboration recommends that systematic reviews "should be updated at least every two years" [14] and a 2007 study of 100 systematic reviews in the medical sciences found that 23% needed updating within two years after the end of the search period, and 50% needed updating within 5.5 years [15].

In addition to the update of evidence, our systematic review differs from the previous review in two aspects. First, the previous review was restricted to studies of physicians, while we consider studies of all types of health workers. Second, the previous review included only studies investigating a small set of program outcomes ("initial recruitment

of physicians, buyout rates and long-term retention") [13]. Our review considers all studies of program *results* (i.e. descriptions of outcomes among program participants without comparison to outcomes in non-participants), program *effects* (i.e. analysis of program effectiveness at the individual-level through comparison of outcomes among participants and non-participants), and program *impacts* (i.e. analysis of program effectiveness at the population level, such as changes in physicians density or population mortality).

Methods

Data sources and search strategies

We carried out a systematic literature search of PubMed for studies evaluating outcomes of financial incentives for return of service published between January 1957 and December 2007. In addition, we searched the reference lists of all publications included in the final review as well as of all articles that were excluded from the review because they were review articles, editorials, or commentaries. Finally, we asked colleagues with a research interest in human resources for health to identify articles on financial incentives for return of service.

To identify articles for review, we combined three search themes using the Boolean operator "and". The first search theme – health workers or students – combined the following Medical subject headings (MeSH) [16] using the Boolean operator "or": "Health Manpower", "Health Personnel", "Students", "Internship and Residency" or "Education, Medical". The second theme – underserved areas – combined MeSH terms

“Medically Underserved Area” or "Professional Practice Location" or “Rural Health” or "Primary Health Care" or “Family Practice” or “Career Choice”. The third theme – financial incentives – combined MeSH terms “Financial Support" or "Training Support" or "Physician Incentive Plans" or “Health Planning". All MeSH terms were used in their “exploded” versions, i.e., in addition to the selected MeSH term, all narrower terms that are categorized below it in the MeSH hierarchy are included in the PubMed search. For instance, the exploded version of the MeSH term “Training Support” includes the term “Fellowships and Scholarships” which is positioned below “Training Support” in the MeSH hierarchy. Entry terms linked to the MeSH term “Training Support” include “Student Loans” and “Educational Subsidies”. A complete list of MeSH terms and their associated concepts can be found on the MeSH website [16].

Selection criteria

Articles were considered for inclusion in the systematic review if they reported data from a quantitative study of results, effects, or impacts of at least one financial-incentive program for return of service. We considered articles published in any language. We excluded studies that evaluate programs that attempt to increase the number of health workers in underserved areas primarily through non-financial means. For instance, studies evaluating the Physician Shortage Area Program (PSAP) of Jefferson Medical College were excluded because the program strives to increase the number of rural family physicians primarily through selective admission of candidates to medical school and through intensive exposure of the program participants to rural family practice, while offering only “a small amount of additional financial aid […] almost entirely in the form

of repayable loans", which "represents only a small portion of each student's entire tuition and expenses" (Rabinowitz et al. 2005). Reviews, commentaries, editorials, news and policy briefs were excluded. Studies of financial incentives for return of service within the military (e.g. [17]) were excluded because experiences with return-of-service programs in the military are likely to be very different from civilian experiences, as the military can exert more control over its members than most civilian institutions over citizens. Studies of financial incentives for research positions (e.g. [18]) were excluded because health workers who conduct medical research are commonly motivated by very different factors than health workers in patient care [19], and the objective of this article is to examine the evidence on financial incentives for return of service in underserved areas. Finally, we excluded studies that only report outcomes that cannot be objectively verified, such as participant or family satisfaction with the financial-incentives program. Figure 1 shows a flowchart of the systematic review. 5,449 of 5,557 articles were excluded based on their English-language titles or abstracts as listed in PubMed. All articles remaining in the search pool after the initial screening were in English.

< Figure 1 >

Statistical analysis

We used DerSimonian and Laird meta-analysis [20] to compute both fixed- and random-effects estimates of the pooled proportion (and its 95% confidence (CI) interval) of program participants who were successfully recruited for practice in underserved areas (the recruitment proportion). Because the meta-analysis assumes that the measure to be

pooled across studies is normally distributed, we first used the arcsine-transformation to normalize the distribution of the recruitment proportions [21]. After meta-analysis of the transformed variable, we retransformed the pooled mean and its 95% CI back to proportions. Heterogeneity of the recruitment proportion across studies was diagnosed with the Q test [22]. When significant heterogeneity was present, we selected the random-effects estimates.

Results

Table 1 describes the research topics that are investigated by the studies included in the review and the number of studies investigating each research topic (in parentheses). The numbers in parentheses add up to 35 rather than 26 (i.e. the number of studies included in this review) because seven studies investigate more than one topic (five studies investigate two topics and two studies investigate three topics).

< Table 1 >

Table 2 shows descriptions of each of the programs that were evaluated in at least one of the included studies. When information on some program characteristics was not available in the reviewed study itself, we extracted the information from other sources (shown in the column "Other sources" in Table 2). All monetary values in the column "Financial incentives and conditions" in Table 2 are shown both as they are provided in the reviewed study and – for ease of comparison – in year-2000 United States dollars (USD). We used the purchasing power parity index from the World Bank Development

Indicators [23] in order to translate the values of a non-US currency into US dollars and the consumer price index from the US Department of Labor Bureau of Labor Statistics [24] to adjust for differences in the real value of one USD over time.

All programs evaluated in one of the studies included in this review started between 1930 and 1998. With the exception of five programs that accept a range of health professionals (the North Carolina Rural Loan Program, the National Health Service Corps (NHSC), the West Virginia Recruitment and Retention Community Project, and the West Virginia State Loan Repayment Program in the US, as well as the Friends of Mosvold Program in South Africa) the financial incentives of the evaluated programs are targeted only at future or current physicians (Table 2).

With the exception of two programs that cover, respectively, university tuition, fees and "other reasonable educational expenses, such as books, supplies, and equipment" [25] and "funds for university tuition, books, residence fees and food" [26], monetary values of the financial incentives were available for all programs from one of the reviewed studies. The financial incentives per year of service ranged from year-2000 USD 1,358 to 28,470 (Table 2). One study compares the average award amount across five types of programs (scholarship programs, loan programs with service option, loan repayment programs, direct financial-incentive programs, and resident support) and does not find significant differences [27].

< Table 2 >

We identified 26 studies that met all our inclusion and exclusion criteria. The previous systematic review of the financial-incentive programs for return of service by Sempowski [13] identified only 10 articles, three of which were not included in our review. Two articles were not included because they evaluate a program that "tried to increase the number of health workers in underserved areas primarily through non-financial means" [28, 29] (Figure 1); one study was not included because it does not report "data from a quantitative study of results, effects, or impacts of financial incentives for return of service" [30] (see above). Of 19 articles not included in the previous review but in our study, nine were not included in the previous review because they were published after the end of its review period (i.e. after 2002) [27, 31-37]; the remaining 10 studies were not included because of differences in inclusion and exclusion criteria. In particular, our review considers programmatic outcomes and health worker types that were not covered in the previous review (see above).

Of the 26 reviewed studies, 13 evaluate the performance of the NHSC, 10 evaluate financial-incentive programs in US states, three evaluate programs in English-speaking developed countries (Canada, New Zealand), and one evaluates a program in an English-speaking developing country (South Africa).[2] Table 3 describes the topics, design, sample, data sources, outcome measures and effect sizes, conclusions, and methodological limitations of all studies included in the review. Of the 22 studies in which individuals were the unit of observation, sample sizes for analyses were less than

[2] One study evaluates jointly the NHSC and US state programs (see Table 2). It is included in the count of both studies evaluating the NHSC and studies evaluating US state programs.

1,000 in 17 studies and more than one thousand in 5 studies (sample size range across all studies: 24 to 20,757 individuals).

< Table 3 >

Types of financial-incentive programs for return of service

The financial-incentive programs in the reviewed studies vary with regard to spending restrictions, the relative timing of commitment, payment and service, and whether they require financial payback in addition to service or offer financial payback as an alternative to service (Table 2). In the case of financial-incentive programs for students – service-requiring scholarships and educational loans – the enrollees commit to the service before the start of their health care education, receive money during their education, and fulfill their service after completion of education and training. Scholarships do not require financial payback, while student loans with service requirement involve both financial payback and service, and so-called service-option loans offer financial payback as an alternative to service (compare [27, 38, 39]). In the case of financial-incentive programs for medical residents – loan repayments and direct financial incentives – program participants receive payments during their residencies and start serving the obligation after completing the residencies. Fully trained health professionals who enroll in loan repayment or direct financial-incentive programs commit to service in an underserved area shortly before or after completing their residencies and start receiving payments when they take up their service positions. Loan repayments can, of course,

only be used for the purpose of repaying (educational) loans, while direct financial incentives can be used for any purpose.

Program result: recruitment

The recruitment proportion (measured as the proportion of program participants who had completed or were completing their obligation among all participants who were available for practice) varied between 33% and 100% (Table 3). The random-effects pooled recruitment proportion across all 24 programs for which individual-program recruitment was reported in one of the studies included in this review was 69% (95% CI 61-77%, heterogeneity $p < 0.001$) [35-37, 40-44].

Program participants who are available for practice but do not fulfill their commitment to work in an underserved area either default on their obligation or buy out of it. Of the programs evaluated in studies of recruitment, only four did not offer a buy-out option [36, 38, 41, 43]. Some programs allowed participants to repay half [45] or all [40, 46] of the principal without interest en lieu of service repayment; other programs set the buy-out price at the principal plus interest (the "prevailing rate of interest", or a fixed rate of interest varying between 2% and 10% [44]); while yet other programs charged a buy-out price of the principal plus a penalty ("principal plus penalty up to 100%", or "triple the loan amount plus interest" [35]).

The random-effects pooled recruitment proportion across those programs that did not offer a buy-out option (84%, 95% CI 73-92%, heterogeneity $p < 0.001$) was significantly

higher ($p < 0.001$) than the pooled recruitment proportion across those programs that did allow buy-out (65%, 95% CI 56-74%, heterogeneity $p < 0.001$). The random-effects pooled default proportion across those programs that did not offer a buy-out option (16%, 95% CI 8-27%, heterogeneity $p < 0.001$) was significantly higher ($p < 0.001$) than the pooled default proportion across those programs that did allow buy-out (3%, 95% CI 1-7%, heterogeneity $p < 0.001$). Only two of the programs included in the above meta-analysis of recruitment charged penalties equal to or greater than the principal. Those two programs had a significantly ($p < 0.001$) higher random-effects pooled recruitment proportion (72%, 95% CI 66-78%, heterogeneity $p = 0.114$) than those programs that offered buy-out but did not charge a penalty (64%, 95% CI 54-75%, heterogeneity $p < 0.001$).

Program result: retention

The proportion of program participants who remain in a underserved areas after completing their obligation ranges from 25% to 90% across the nine studies of retention that report this measure [35, 36, 40, 44-49]. While these proportions indicate that some substantial proportions of program participants can be retained in underserved areas, the reported proportions cannot be meaningfully compared to each other, because the definition of retention, the sampling criteria, and the observation intervals differ across the studies. The studies measure retention in any small community [46], in any rural community [36, 44, 45, 48, 49], in any community in a specific US state [35], in the underserved area of original program placement [35, 40, 48, 49], or in a practice entered during a specific period of time [47]. Some studies measure retention among all program

participants who had completed their obligation between the start of the program and the start of the study – a time interval that varies widely across this subset of studies (5 years [36, 40], 22 years [48], 24 years [45], and 25 years [35]), and is not reported in one study [44]. Two other studies measure retention in samples of people who graduated from medical school or took up practice in an underserved area during a time interval that ended some years before the start of the study; these studies differ in the length of their enrollment period (3 years [49] vs. 14 years [46]) and the length of the period between the end of the enrollment period and the start of the study (9, 11, and 14 years across three cohorts [49] vs. 29 years [46]).

Program effect: retention and care

In all eight studies of program effect, program participation is defined as having received a financial incentive and having served the obligation; i.e., people who received a financial incentive but could not be recruited to serve in an underserved area are excluded from the cohorts of program participants. Table 4 shows four categories of effect studies by outcome measure and sample. Three categories investigate retention (in the same area, in the same underserved area, or in any underserved area) and one category investigates provision of care in any underserved area.

< Table 4 >

With one exception (which did not find any significant difference [37]) all studies that compare retention in the *same* (underserved) areas between program participants and

non-participants find that participants are significantly less likely to remain in the same (underserved) area [27, 32, 50, 51]. On the other hand, with one exception (which found that NHSC participants faced a significantly higher hazard of non-retention in rural practice than non-participants [50]), all studies that compare differences in retention in *any* (underserved) area between participants and non-participants find that participants are significantly more likely to continue to practice in any (underserved) area [32, 52] or to work with an underserved populations [31, 52, 53].

The studies of program effect report either hazard ratios [27, 50], odds ratios [31, 51, 53], relative risks [37, 52] or beta-coefficients [32] to compare retention among program participants and non-participants. Except for the studies that report hazard ratios, which take into account the duration of retention of each individual in the sample, these studies use a binary concept of retention measured at different time intervals after the initial observation (at least 1 year [37], 3 years and 1 month and 5 years and 1 month [51]) or after graduation from medical school (7-9 years [32], 7 and 11 years [52], 9-10 years [53], 29 years or less [31]).

Program impact: health system and health

Four articles examine whether financial-incentive programs have led to changes in the number or density (i.e. number per population) of certain types health workers [34, 40, 45, 54, 55]. One of the four studies describes the medical student density in Arizona over time to conclude that a scholarship aiming to increase student density was not effective [45]. Two studies compare changes over time (in physician numbers, from 1966 to 1972

[40] and in physician densities, from 1956 to 1986 [54]) in northern Ontario to changes in these measures in Ontario as a whole in order to investigate the impact of a financial-incentive program on the supply of physicians in underserved areas in northern Ontario. The first study concludes that an observed increase in the absolute number of physicians in northern Ontario was likely caused by the program (because the speed of increase rose substantially after introduction of the program in northern Ontario, while there was no change in the speed of increase in Ontario overall) [40]. The second study concludes that an increase in physician density in northern Ontario was not due to the program but due to the overall increase of physicians in the province (because a measure of inequality between physician density in northern Ontario and Ontario as a whole did not improve) [54]. It is possible that an initial effect of the program in the first three years after its introduction (from 1969 to 1972) – as reported in the first study [40] – ceased to exist in the longer run (until 1986) – as reported in the second study [54].

Two further studies of health system impacts of financial-incentive programs use communities as units of observation. One of the studies investigates whether underserved areas that succeed in attracting obligated physicians are different from communities that fail to do so. It finds that communities that are economically worse-off and have worse population health are less likely to receive an obligated physician than communities that are economically better-off and have better population health [55]. The second study investigates whether the presence of an obligated physician in a community changes the supply of non-obligated physicians to that community and finds that when controlling for a range of demographic, economic, and health systems factors the

presence of an obligated physician increases the inflow of non-obligated physicians into a community [34]. Only one study analyzes the effect of a financial-incentive program on a health outcome [33]. The study compares age-adjusted all-cause mortality rates in two periods, 15 years apart, in underserved communities with different levels of staffing by obligated physicians. It finds no clear relationship between the level of staffing and changes in mortality.

Causal inferences

Causal inferences from studies reporting program results are necessarily weak, because the studies lack control groups of individuals who did not receive a financial incentive. The studies of program effect, on the other hand, are based on comparison of cohorts of program participants and non-participants over time. Causal inferences from cohort studies, however, can be limited by confounding factors or by selective enrollment into one of the cohorts. Of the eight studies of program effect, seven control for additional variables in the comparison of retention and provision of care between people who did and did not participate in a financial-incentive program [31, 32, 50-53, 56]. Four of these studies control for sex of the health worker [31, 32, 53, 56], three for his or her ethnicity [31, 32, 53], three for medical specialty [31, 50, 56], two for age [32, 56], and one for marital status [56]. One study assesses and then controls for measures of community-physician match and physician and family satisfaction with working and living in the placement community [51]. Another study does not show the particular control variables, but reports that its effect measures remained significant “while controlling for selected characteristics of physicians” [52].

One study uses a bivariate probit selection model to control for the potential bias due to selective participation in the financial-incentive program by those types of medical students who have a high propensity to remain in an underserved area [32]. The study uses four medical school characteristics as exclusion restrictions (i.e., variables that determine participation but do not independently determine retention). It seems likely that unobserved individual characteristics influence both the choice of medical school and the decision to continue practicing in an underserved area in the long run. For instance, students who choose a medical school with a higher "historical proportion" of students entering primary care (which is one of the exclusion restrictions used [32]) may be more likely to be satisfied practicing for many years in an underserved area (where they are most likely to work as primary care physicians [3]). This relationship between choice of medical school and retention in an underserved area is independent of the decision to participate in a financial-incentive program and is likely to persist even after observed individual characteristics, such as sex, age and ethnicity, are controlled for, i.e. the exclusion restriction is likely invalid.

Finally, the studies of program impact suffer from a number of limitations that weaken the strength of causal conclusions that might be drawn from them. Four of the six studies observe changes over time in the availability of a financial-incentive program and an outcome (number or density of health workers [40, 45, 54] or mortality [54]), but do not control for changes over time of any other variable. Thus, it cannot be ruled out that an observed relationship or the apparent lack of a relationship between the program and the

outcome is due to a confounding variable. In addition, three of the six studies of program impact [54, 55] [40] may suffer from ecological bias [57] because they observe variables at a level of aggregation that is higher than the level at which inferences are made. For instance, Anderson and Rosenberg (1990) [54] observe changes in physicians density in *counties* in order to evaluate the impact of the Ontario Underserviced Area Program in attracting physicians to underserved *communities* within those counties, i.e. the observed average change in physician density in any one county could have been caused by an infinite number of combinations of changes of different directions and effect sizes in the different underserviced and sufficiently serviced communities in the county.

Discussion

With three exceptions – from Canada, New Zealand, and South Africa (see Table 2) – all of the programs evaluated in one of the reviewed studies are located in the US. In absolute numbers, the US-based financial-incentive programs have made a substantial contribution to health care in underserved areas. For instance, between 1972 and 2008, the NHSC – the largest financial-incentive program in the US – placed 27,000 primary care clinicians in underserved areas [58]. At the same time, the NHSC has met only a small proportion of national unmet health care need. In February 2008, 4,600 NHSC clinicians were serving 5 million people in underserved areas, while the NHSC estimated that 53 million people "still lack access to quality health care in the United States" [58].

While most of the evaluated programs were located in the US, the US market for health care education is unusual in comparison to many other countries in that students pay high

tuition for their education. Countries where students of health care do not usually incur large debt (such as many Western and Eastern European countries, Cuba, Malaysia, and Saudi Arabia) may not be as successful as the US in recruiting students and health professionals into programs that provide scholarships or loan repayment in return for service in underserved areas. In many developing countries, on the other hand, education for a health profession can be quite costly because of tuition and school fees as well as costs of housing and living. Some of the experiences from the US may thus be more applicable to health care education markets in developing countries than to other developed countries, even though other differences (such as the capacity to enforce and monitor obligated service (compare [59]) may limit generalizability to developing-country settings. One study from South Africa suggests that scholarship programs for health care education can be a successful instrument to recruit health workers for practice in rural Africa [43]. Future studies should evaluate outcomes of financial-incentive programs from other developing countries where such programs have been offered in the past or are currently offered, such as Swaziland [60], Ghana [61], and Mexico [62].

Notwithstanding the above caveats about generalizability, some stylized facts and implications for policy and future research emerge from our systematic review. First, most of the financial-incentive programs experienced substantial losses to recruitment before the start of the service obligation. These losses were lower in programs without a buy-out option than in programs that allowed buy-out. Among programs that allowed buy-out, those that financially penalized such a choice experienced lower losses than programs that did not. Because we lacked data to control for differences between

programs in self-selection to enroll, it is unclear whether the observed differences in recruitment for work in underserved areas are due to selection effects – individuals who are less certain about their eventual willingness to fulfill an obligation to serve in an underserved area may be less likely to enroll in programs that do not offer buy-out or financially penalize it – or due to an effect of buy-out and penalties on the probability of recruitment independent of selective enrollment. Our results thus do not necessarily imply that policy makers should not allow buy-out, nor that they should charge substantial financial penalties. High financial penalties or the absence of a buy-out option may deter a proportion of individuals from program participation who would have a reasonable probability of fulfilling their service obligation after their health care training in return for a financial incentive.

This deterrence could have negative effects on program performance. For one, programs may not be able to attract a sufficient number of participants. One of the reviewed studies reports that program management lowered the buy-out price in early phases of the program in order to increase the number of applicants [45]. In addition, program effectiveness in increasing the number of health workers practicing in underserved areas may decrease, because only those (future) health workers who are very certain that they want to practice in such an area will sign up for the financial-incentive programs. These health workers, however, are likely to practice in underserved areas even without a financial incentive. In contrast, health workers who are comparatively uncertain whether they want to eventually practice in an underserved area and averse to taking risks may decide not to sign up for the program, even though many of them would have served in

an underserved area, had they enrolled in a financial-incentive program with a low buy-out price. Finally, programs may lose income if they strongly deter or do not offer buy-out. If the buy-out price is set such that the program makes a profit if a candidate repays her obligation, the cash flows from buy-out could be used to financially sustain a program. Theoretically, the buy-out price could be set at a level to fully compensate for the loss of social value incurred because a program participant does not fulfill her obligation. In this case, the candidate would pay the opportunity costs of her service, i.e. the amount of money needed to attract another health worker of equal qualification to the underserved area in which she would have served. We find that the proportion of participants who default (i.e. who neither fulfill their obligation nor buy-out) was 12 percentage points higher in programs that did not offer buy-out than in programs that did ($p < 0.001$). If the repayment price in programs that offer buy-out fully offset the loss of social value from participants failing to fulfill their service obligation, policy makers should prefer these programs over programs without buy-out option.

Second, participants in financial-incentive programs were significantly more likely to leave their first site of practice after completion of their obligation than non-obligated health workers in comparable sites of first practice after similar length of service. There may be several reasons for this finding. For one, those health workers who find practice in any underserved area less attractive than practice in sites that are not underserved, but who nevertheless decide to complete their obligation, are likely to leave the underserved area once they have completed their obligated service. On the other hand, even among those health workers who find practice in an underserved area to be the most attractive

career path in general, the obligated health workers may be more likely to leave the site of initial practice than their non-obligated colleagues in underserved areas. Obligated health workers have less choice over the particular underserved area in which to start practice than their non-obligated peers and are thus less likely to be satisfied with their work and life in the underserved area of first practice than their non-obligated peers. For instance, one study of the NHSC concludes that NHSC enrollees "placed in rural sites in the late 1980s experienced a site-matching process that they felt offered few acceptable sites" and "offered little opportunity to locate the best-suited site among those offered" [51]. Financial-incentive programs aiming to achieve high retention of obligated health workers in the site of first practice should attempt to accommodate health workers' wishes to practice in a particular underserved area as far as possible.

Third, while participants in financial-incentive programs for return of service in underserved areas were less likely to remain in their site of first practice than non-participants, the reviewed studies suggest that participants were more likely to practice in some underserved area or work with an underserved population than their peers who did not participate in a financial-incentive program. This summary finding from our systematic review is in contrast to the conclusion of the one previous review of financial incentives for return of service that incentive programs "have achieved their primary goal of short-term recruitment but have had less success with long-term retention" [13].

Financial-incentive programs in their current design are thus effective not only in placing health workers in a specific underserved area, but also in retaining them in service to the underserved in general. Program planners intending to maximize social value could consider placing participants preferentially in the most underserved among all underserved areas, in order to test whether such a policy would affect long-term retention in service to the underserved. While such a policy would strongly restrict participants' choice of placement and thus run counter to policies trying to increase retention in initial placement sites, it might nevertheless maximize the social value of financial-incentive programs, if long-term retention in underserved areas remained the same, because during their obligation health workers are likely to have greatest impact on health outcomes where unmet health care need is greatest. Without such a preferential placement policy, it is likely that the neediest population will benefit least from financial-incentive programs: One study of the NHSC finds that the poorer an underserved area and the worse its population health, the less likely it is to receive an obligated physician (see Table 3) [55].

It is difficult to establish causality in the relationship between program participation and retention in underserved areas. On the one hand, participation in a financial-incentive program may expose enrollees to experiences that motivate their future choice regarding whether to practice in underserved areas (such as rural practice), which they would not have had, had they not enrolled – in which case program participation could have caused the later choice of practice site. On the other hand, it is also possible that those future health workers who are more inclined than their peers to practice in underserved areas

before participation in a financial-incentive program are also more likely to participate in such a program and that it is the selective participation rather than a program effect that brings about the higher probability of participants serving in underserved areas compared with non-participants.

Most of the studies of program effect controlled for some basic demographic characteristics of health workers, such as sex, age, or marital status. However, many factors that would seem to be important determinants of provision of care and retention in underserved areas were not controlled for in any of the studies of program effect. One factor that is likely to determine program effect is the income differential between these areas and well-served areas in which the health worker could find employment (compare, e.g., [63]). The higher the differential the more attractive it will be for the health worker to buy out of the obligation and, if she does not buy out, the more attractive it will be a move to a well-served area after completion of the service obligation.

Moreover, only two studies controlled for self-selection to participate in a financial-incentive program based on the propensity to provide care in underserved areas before enrollment in the program (over and above differences already captured by basic demographic variables). One study investigates the association between participation and retention in "providing substantial care to the underserved" while controlling for "strong interest in underserved practice prior to medical school" [53]. Another study controls for selective participation, using a bivariate probit selection model [32]. Both studies find that NHSC participants are more likely to practice in any underserved area or provide

care for an underserved population. However, the first study uses a very restricted sample of individuals, limiting the generalizability of the results to other cohorts (Table 3). The second study controls for sample selection with two simultaneous equations, but it uses exclusion restrictions in the statistical estimation of the system that may not be valid (see above). To confirm the finding that participation in financial-incentive programs increases retention in underserved areas, future studies using already-existing data should emphasize control of selection biases in the analyses. Policy makers who are planning new programs should consider adopting experimental designs, such as cluster randomizing financial-incentive programs to classes of medical students, to be able to more rigorously test program effectiveness.

Fourth, there is contradictory evidence regarding the impact of financial-incentive programs on health worker numbers and densities, and the evidence on impact is weakened by methodological limitations, including lack of control for likely confounders and ecological bias. However, impact on health worker numbers and densities will be a function of the scale of financial-incentive programs as well as of recruitment, retention, and the effect of obligated heath workers on the supply of non-obligated health workers to underserved communities. The scale of some of the programs reviewed in this study was considerable (see above). Although there are substantial losses to recruitment to underserved areas across the reviewed programs, the recruited proportions of obligated health workers are substantially higher than the proportions of non-obligated health workers choosing practice in underserved areas (Table 3, compare [64, 65]). Finally, financial-incentive programs may in fact increase retention in underserved areas among

participants (see above). Overall, we would thus expect that the reviewed financial-incentive programs should have had considerable impact on health worker population densities in underserved areas. One effect that could decrease such a health system impact is the response of non-obligated physicians to the placement of obligated health workers in an underserved area. It is plausible that obligated health workers will deter non-obligated physicians from practice in underserved communities because the former will compete with the latter for patients and practice personnel. Conversely, it seems also plausible that the inflow of obligated health workers into underserved communities attracts non-obligated physicians to the same communities as the health services situations in these communities stabilize and referral and exchange among colleagues become increasingly possible. One of the reviewed studies shows that the presence of an NHSC clinician increases the supply of non-NHSC physicians to underserved areas (see Table 3) [34]. It is thus unlikely that changes in the supply of non-obligated physicians diminish the effect of financial-incentive programs on total physician supply to underserved areas. Combining evidence from several studies, it thus seems probable that at least in the US financial-incentive programs have had a positive impact on the health workforce in underserved areas.

Conclusion

Financial-incentive programs for return of service are one of the few health policy interventions to improve the distribution of human resources for health on which substantial evidence exists. Existing studies suggest that financial incentives can be effective in increasing the number of health workers in underserved areas. In order to

improve the scope of evidence on financial-incentive programs for return of service in underserved areas, future studies should evaluate programs from a more diverse set of countries, especially in the developing world. In these studies, researchers should attempt to control selection biases as rigorously as possible, using selection models in observational studies and controlled experiments where funders and policy makers are willing to support such experiments.

Competing interests

The authors declare no competing interests.

Authors' contributions

Till Bärnighausen and David Bloom jointly formulated the study design, obtained and analyzed the data, interpreted the findings, and wrote the article.

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Figure 1: Flowchart of the systematic review

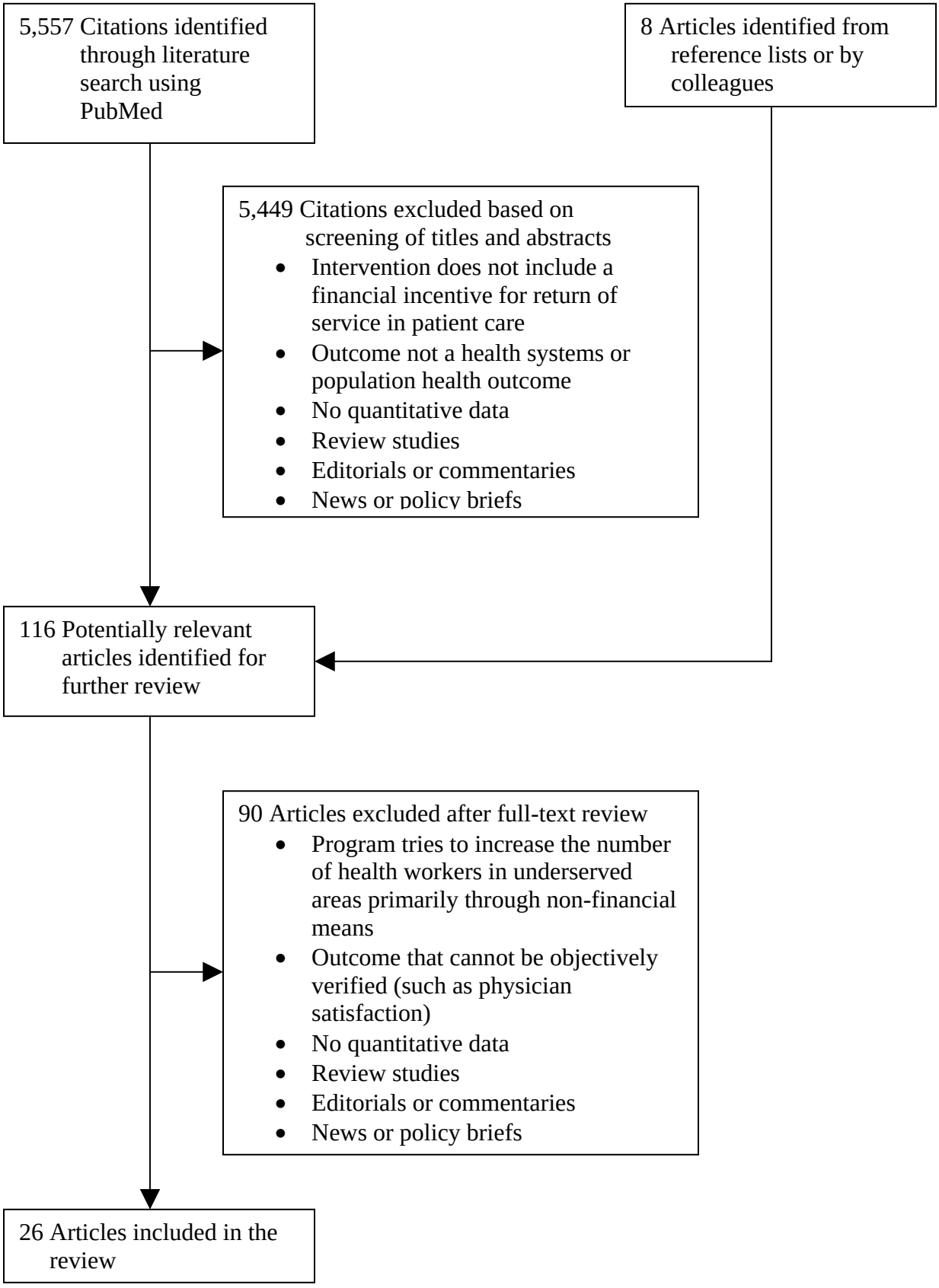

Table 1: Study topics

Program result (Program outcomes among participants)	**Program effect** (Program effectiveness at the individual level)	**Program impact** (Program effectiveness at the population level)
• *Recruitment* What proportion of program participants take up practice in an underserved area? (10)	• *Retention* Are program participants (after completion of their obligation) more likely to remain at their site of first practice or in any underserved area than non-participants (after service of the same time length as an obligation)? (5)	• *Health system* Does the program lead to improvements in health system structures (such as physician density)? (5)
• *Retention* What proportion of program participants continue to practice in an underserved area at some period of time after completing their obligation? (10)	• *Provision of care* Are program participants more likely to provide care in any underserved area than non-participants? (4)	• *Health* Does the program lead to improvements in health outcomes (such as mortality)? (1)

The term underserved area in the table encompasses a specific underserved area, any underserved area, and underserved populations. The number of studies investigating a topic is shown in parentheses. The numbers in parentheses add up to 35 rather than 26 (i.e. the number of studies included in this review) because seven studies investigate more than one topic (five studies investigate two topics and two studies investigate three topics).

Table 2: Evaluated financial-incentive programs

Program name	Location	Period	Objective	Population	Definition of underserved area	Financial incentives and conditions	Evaluation studies	Other references
Common-wealth Fund Medical Under-graduate Scholarship Program	Massachusetts, Mississippi, Tennessee, US	1930-1944	"[T]o alleviate medical shortages in rural areas"	Undergraduate medical students attending medical school at Tufts, Tulane, or Vanderbilt University	Rural communities with a population of 5,000 or less (subsequently raised to 10,000 or less)	*Scholarships for medical students:* Total of USD 1,300 per year over 4 years (between 1930 and 1944; amount equivalent to year-2000 USD 13,405 in 1930 and 12,719 in 1944). In return, the students agree to spend not less than 3 years in practice in an underserved area in their state of origin.	Fitz et al. 1977 [46]	N/A
11 US state scholarship and educational loan programs	Arkansas, Georgia, Illinois, Iowa, Kentucky, Minnesota, North Carolina, North Dakota, South Carolina, Virginia, West Virginia, US	Pro-grams started between 1942 and 1968	To increase the number of physicians practicing in underserved areas	Medical students in the respective US state	Different definitions of underserved area (town with population size below a certain threshold, rural community, rural county, rural area, "area of critical need", anywhere in the state)	*Scholarships and loans with service option for medical students:* Between USD 1,000 and USD 2,775 per year for 2-4 years (in 1970; lower amount equivalent to year-2000 USD 4,438, higher amount equivalent to year-2000 USD 10,097).	Mason 1971 [44]	N/A

Program name	Location	Period	Objective	Population	Definition of underserved area	Financial incentives and conditions	Evaluation studies	Other references
North Carolina Rural Loan Program	North Carolina, US	Since 1945	"[T]o help smaller communities to obtain professional services"	Students of medicine, dentistry, pharmacy and nursing	"[A]ny town or village having less than 2,500 population according to the last decennial census, or area outside such towns or villages, or area approved by the Medical Care Commission that is considered to meet the spirit and intent of the student loan program"	*Loans for students:* USD 1,600 per year for unmarried students (in 1963; amount equivalent to year-2000 USD 9,000) and USD 1,900 for married students (in 1963; amount equivalent to year-2000 USD 10,687). For each year the loan is received, the students agree to practice in an underserved area for one year. The loans bear an interest rate of 2%, beginning at the time the loan is advanced. The loans are repaid in monthly installments of 2% of the total amount borrowed, commencing six months after start of practice.	Bradbury 1963 [38]	N/A
Arizona Medical Student Exchange Program	Arizona, US	Since 1953	"[T]o increase the number of graduating physicians who will return to practice in Arizona"	Arizona medical students	Any area in Arizona	*Payments to medical schools to reduce students' tuition:* USD 2,000 (in 1953; amount equivalent to year-2000 USD 12,899), raised to USD 6,000 (by 1977; amount equivalent to year-2000 USD 17,050). For each year the scholarship is received, the students agree to practice 2 years (1953-1957) or 1 year (after 1957) in Arizona.	Navin and Nichols 1977 [45]	N/A

Program name	Location	Period	Objective	Population	Definition of underserved area	Financial incentives and conditions	Evaluation studies	Other references
Ontario Under-serviced Area Program (UAP)	Ontario, Canada	Since 1969	To increase the number of physicians per population in underserved areas in Ontario	Canadian physicians and medical students	Designation of an area as underserved area decided by a committee composed of members of the MoH, based on multiple factors: "[n]umber of doctors in the area" and "their age and health", "type and amount of practice", demographic profile of the population, "[s]ocioeco-nomic status of the area", "[l]ocal demand for medical services", "[a]vailability of adequate housing and office facilities for physicians", and "[h]ealth needs and resources" (Bass and Copeman 1975)	*Scholarships for medical students:* CAD 5,000 per year (in 1987; amount equivalent to year-2000 USD 5,921). For each year the scholarship is received, the students agree to spend one calendar year in general practice in an underserved area after completion of internship. *Direct financial incentives for physicians:* CAD 10,000 per year served in an underserved area for a maximum of four years (between 1980 and 1988; amount equivalent to year-2000 USD 17,591 in 1980 and year-2000 USD 11,279 in 1988).	Bass and Copeman 1975 [40]; Anderson and Rosenberg 1990 [54]	[66]

Program name	Location	Period	Objective	Population	Definition of underserved area	Financial incentives and conditions	Evaluation studies	Other references
National Health Service Corps (NHSC)	US nationwide	Since 1972 (scholar-ships) Since 1987 (loan repay-ments)	To increase the number of physicians and other health professionals in federally designated Health Professional Shortage Areas (HPSA)	Students enrolled in allopathic or osteopathic medical school, family nurse practitioners, nurses, midwives, physician assistants, dentists	HPSA status can be assigned to areas, population groups, and facilities. HPSA status is assigned taking into account the practitioner-to-population ratio, availability and accessibility of clinicians in adjacent areas, indicators of need (such as infant mortality) and capacity (such as poverty levels) [25]	*Scholarships for students:* Full scholarships covering tuition, fees, and "other reasonable educational expenses, such as books, supplies, and equipment" [25]. For each year the scholarship is received, the students agree to serve one year at a location designated as HPSA, with a minimum commitment of 2 years. *Loan repayments for physicians:* Maximum repayment of USD 25,000 per year for a required initial 2-year contract (in 2007; amount equivalent to year-2000 USD 20,336). One year amendments for a maximum of USD 35,000 per year (in 2008; amount equivalent to year-2000 USD 28,470).	Woolf et al. 1981 [55]; Pathman et al. 1992 [50]; Pathman et al. 1994 [51]; Pathman and Konrad 1996 [47]; Rosenblatt et al. 1996 [48]; Cullen et al. 1997 [49]; Rabinowitz et al. 2000 [53]; Mofidi et al. 2002 [67]; Probst et al. 2003 [31]; Holmes 2004 [32]; Pathman et al. 2005 [33]; Pathman et al. 2006 [34]	[25, 68]

Program name	Location	Period	Objective	Population	Definition of underserved area	Financial incentives and conditions	Evaluation studies	Other references
Scholarship for Indian students in health sciences	Arizona, Utah, Colorado, New Mexico, US	Since 1972	To supply health manpower to the Navajo Indian Reservations and immediately adjacent communities	Indian medical students	Navajo Indian Reservations and immediately adjacent communities	*Scholarships for medical students:* Ranging from USD 650 to 11,000 per year (in 1980; lower amount equivalent to year-2000 USD 1,358 and higher amount equivalent to year-2000 USD 22,988).	Weiss et al. 1980 [41]	N/A
Oklahoma Rural Medical Education Scholarship Loan	Oklahoma, US	Since 1975	"[T]o increase the number of practicing physicians in underserved and rural areas" (Holmes and Miller 1985)	Osteopathic and allopathic medical students	Rural communities in Oklahoma	*Scholarships for medical students:* USD 15,500 per year over 4 years (in 2008; amount equivalent to year-2000 USD 12,202). For each year the scholarship is received, the students agree to practice one year in a rural community in Oklahoma (after residency in a primary care specialty).	Holmes and Miller 1985 [42]; Lapolla et al. 2004 [35]	[69]

Program name	Location	Period	Objective	Population	Definition of underserved area	Financial incentives and conditions	Evaluation studies	Other references
NHSC **Indian Health Service Corps** **State scholarships** **State loan repayment programs** **Practice and hospital-sponsored financial incentives**	US nationwide	Programs operating in the 1980s and 1990s	To increase the number of physicians in underserved areas	Medical students, medical residents, and physicians	Different definitions of underserved area	*NHSC:* See above. *Indian Health Service Corps:* Up to USD 20,000 per year (in 2006; amount equivalent to year-2000 USD 17,083). For each year the scholarship is received, the students agree to serve one year in an Indian health program, with a minimum commitment of 2 years (Indian Health Service 2006). *State scholarships:* See above and below. *State loan repayment program:s* See above and below. *Practice and hospital-sponsored financial incentives:* Not provided.	Pathman et al. 2000 [52]	[70]

Program name	Location	Period	Objective	Population	Definition of underserved area	Financial incentives and conditions	Evaluation studies	Other references
New South Wales Department of Health Rural Resident Medical Officer Program (Cadetship Program)	New South Wales (NSW), Australia	Since 1989	"[T]o help overcome a junior doctor workforce shortage in rural hospitals" in New South Wales "[T]o increase recruitment to the rural medical workforce" (Dunabin et al. 2006)	Australian and New Zealand medical students	Rural hospitals in the NSW Rural Hospital Network	*Scholarships for medical students:* AUD 15,000 per year over the two final years of medical school (in 2007; amount equivalent to year-2000 USD 12,458). In return, the students agree to serve 2 of their first 3 postgraduate years in a rural hospital belonging to the NSW Rural Hospital Network.	Dunbabin et al. 2006 [36]	[71]

Program name	Location	Period	Objective	Population	Definition of underserved area	Financial incentives and conditions	Evaluation studies	Other references
Community Scholarship Program (CSP) **Health Sciences Scholarship Program (HSSP)** **Recruitment and Retention Community Program (RRCP)** **State Loan Repayment Program (SLRP)**	West Virginia, US	CSP: 1991-1997 HSSP: Since 1996	"[T]o attract medical students, residents, and physicians to practice in rural and underserved areas" of West Virginia	CSP: medical students from HPSA HSSP: fourth year medical students RRCP: medical residents, physicians and other qualified health professionals SLRP: physicians and other qualified health professionals	HPSA	*CSP: scholarships for medical students:* Amount determined by HPSA community who co-sponsors the scholarship (with additional funding from federal and state funds). For each year the scholarship is received, the students agree to serve one year in the HPSA where their home is located *HSSP: scholarships for medical students:* USD 10,000 (in 2001; amount equivalent to year-2000 USD 9,725) For the award, the students agree to serve 2 years in an underserved area. *RRCP: direct financial incentives to medical residents, physicians, and other qualified health personnel:* Maximum of USD 20,000 per year for up to 6 years (in 2001; amount equivalent to year-2000 USD 19,450) For each year the award is received, the recipients agree to serve 1 year in an underserved area. *SLRP: direct financial incentives to physicians and other qualified health professionals:* Maximum of USD 40,000 (in 2001; amount equivalent to year-2000 USD 38,901) for a commitment to serve 2 years at a non-profit site in a HPSA. The award can be received twice.	Jackson et al. 2003 [37]	N/A

Program name	Location	Period	Objective	Population	Definition of underserved area	Financial incentives and conditions	Evaluation studies	Other references
20 US state scholarship programs **12 state loan programs with service option** **24 state loan repayment programs** **6 state direct financial-incentive programs for medial residents** **7 state direct financial-incentive programs for fully trained health professionals**	40 US states	All US state programs operating in 1996	"[T]o entice young generalist physicians into rural and medically underserved areas"	Medical students, medical residents, and physicians	Different definitions of underserved area	Across all programs on average USD 14,000 per year of service (in 1996; amount equivalent to year-2000 USD 15,365) (differences between award means of the 5 program types not significant, $p = 0.55$). *Scholarship programs:* For each year the scholarship is received, the students agree to serve 1 year in an underserved area. *Loan programs with service option:* The medical students can either repay the loan at standard interest rates or repay the loan by serving 1 year in an underserved area per year of receipt of loan. *Loan repayment programs:* Medical residents commit to service in an underserved area in exchange for loan repayment (commitment usually near the end of residency training). *Direct financial-incentive programs for medical residents:* Medical residents commit to service in an underserved area in exchange for monetary reward (commitment usually at the beginning of the residency). *Direct financial-incentive programs for fully trained health professionals:* Medical residents commit to service in an underserved area in exchange for a monetary reward (commitment usually near the end of residency training).	Pathman et al. 2004 [27]	N/A

Program name	Location	Period	Objective	Population	Definition of underserved area	Financial incentives and conditions	Evaluation studies	Other references
Friends of Mosvold Scholarship Scheme (FOMSS)	Umkhan-yakude district, KwaZulu-Natal, South Africa	Since 1998	To "help integrate graduates into the workforce in the district"	Students from Umkhan-yakude district who have been admitted to a tertiary health care education institution, complete at least 2 weeks of work experience at one of the hospitals in the district, and are selected by committee of local residents	District of Umkhanyakude	*Scholarships for students admitted to a tertiary health care education institution:* "Funds for university tuition, books, residence fees and food" [26]. For each year the scholarship is received, the students agree to work one year as health professionals in Umkhanyakude district.	Ross 2007 [43]	[26]

USD = United States dollar, CAD = Canadian dollar, AUD = Australian dollar, MoH = Ministry of Health, N/A = not applicable.

Table 3: Reviewed studies

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
Common-wealth Fund Medical Under-graduate Scholarship Program	Fitz et al. 1977 [46]	*Program result:* Recruitment Retention (in small communities)	Description of program outcomes	All individuals who ever took part in the program (N = 144)	Common-wealth Fund records	*Proportion of participants who had completed their practice obligation by 1973:* Of 144 participants, 11 (8%) did not complete medical school or died. Of 133 participants available for practice, 74 (54%) completed the practice obligation and 5 (4%) repaid the financial incentive, while the remainder defaulted. *Proportion of participants who practiced in small communities in 1973 (43 years after program start and 29 years after program cessation):* Of 99 former recipients still in practice in 1973, 50 (51%) practiced in communities of less than 25,000 population.	A substantial proportion of participants did not complete their practice obligation. However, it is difficult to evaluate the program because of WWII. Most of the non-completers (52) requested and obtained release after WWII. Nevertheless, about half of the participants practiced in small communities for most of their working lives.	Descriptive study No control group Duration of individual retention not taken into account WWII created an exceptional situation during program operation

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
11 US state scholarship and educational loan programs	Mason 1971 [44]	*Program result:* Recruitment Retention (in rural communities in the state)	Description of program outcomes	All individuals who ever participated in one of the state programs and were available for practice in 1970 (N = 1,089)	Records of the individual state programs	*Proportion of participants who had completed or were completing their practice obligation in 1970:* Of 1,089 participants available for practice, 658 (60%) completed or were completing their obligation and 406 (37%) repaid the financial incentive, while the remainder defaulted. *Proportion of participants who remained in rural communities of their state after completion of obligation (neither date of measurement nor duration information provided):* Georgia: 50% Kentucky: 90% North Carolina: 65%	A substantial proportion of participants did not complete their practice obligation. However, the proportion of participants recruited to rural areas varied widely across programs. A substantial proportion of participants remained in rural communities after completion of obligation.	Descriptive study No control group Duration of individual retention not taken into account

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
North Carolina Rural Loan Program	Bradbury 1963 [38]	*Program result:* Recruitment	Description of program outcomes	All students who were ever enrolled in the program between 1945 and 1963 (N = 320)	Records of the North Carolina Medical Care Commission	*Proportion of participants who had completed or were completing their practice obligation in 1963:* Of 320 participants, 120 (38%) were still in school, post-graduate training or served in the military, 46 (14%) withdrew from school or failed academically, and 13 (4%) withdrew their application or had died. Of 141 participants available for practice, 106 (75%) had completed or were completing their obligation and 35 (25%) defaulted on their obligation.	A large proportion of participants did not complete medical school. A substantial proportion of participants defaulted on their practice obligation.	Descriptive study No control group

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
Arizona Medical Student Exchange Program	Navin and Nichols 1977 [45]	*Program result:* Recruitment Retention (in any rural community in the state) *Program impact:* Health system	Description of program outcomes Time series	All students who ever participated in the program between 1953 and 1977 and who had completed their medical training in 1975 (N = 149)	Records of the Western Interstate Commission for Higher Education	*Proportion of participants who had completed or were completing their practice obligation in 1975:* Of 149 participants, 67 (45%) served their obligation in a metropolitan area within Arizona, 21 (14%) served their obligation in a non-metropolitan area in Arizona and 55 (37%) repaid the financial incentive, while the remainder defaulted. *Proportion of participants who remained in rural communities of their state after completion of their obligation:* >85% *Time series of medical student density in Arizona:* The per-capita number of medical students did not increase from 1953 to 1967 (consistently 20% below national average), but increased steeply from 1968 onwards.	A substantial proportion of participants defaulted on their practice obligation. A large proportion of participants who completed their obligation remained in Arizona. The program did not succeed in increasing the medical student population density in Arizona. The steep increase in per-capita medical students in 1968 is attributed to the opening of the first medical school in Arizona in that year.	*Program outcome:* Descriptive study No control group Duration of individual retention not taken into account *Program impact:* No analysis of time series undertaken except for visual impression No control for confounding by other variables that changed over time

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
Ontario Under-serviced Area Program (UAP)	Bass and Copeman 1975 [40]	*Program result:* Recruitment Retention (in underserved area of original placement) *Program impact:* Health system	Description of program outcomes Time series	All participating students who had completed their internship in 1974 (N = 104) 7 annual values (1966-1972) of the number of physicians in each of three geographical areas (all Ontario, northern Ontario, communities in northern Ontario with population of les than 15,000)	Canadian Medical Directory	*Proportion of participating medical students who had completed or were completing their practice obligation in 1974:* Of 104 students, 55 (53%) completed or were completing their practice obligation and 49 (47%) repaid the financial incentive. *Proportion of students who in 1974 had remained in the original placement location after completion of their obligation:* 74% *Time series of total number of physicians (expressed relative to their 1966 baseline value):* From 1966 to 1972 monotonic increase in the relative number of physicians in all Ontario (from 1.0 to over 1.3) and in northern Ontario (from 1.0 to almost 1.2). From 1966 to 1969 slight decline in the relative number of physicians in communities in northern Ontario with population of less than 15,000 (i.e. before the program was introduced) and steep increase from 1970 (after introduction of the program) to 1972 (from 1.0 to almost 1.25).	A high proportion of participants defaulted. A large proportion of participants who completed their obligation remained at the original placement location. The time series suggests that the program was effective in increasing the number of physicians practicing in small communities in northern Ontario.	*Program outcome:* Descriptive study No control group Duration of individual retention not taken into account *Program impact:* No analysis of time series undertaken except for visual impression No control for confounding by other variables that changed over time Ecological bias possible (because units of observation are groups of communities)

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
UAP	Anderson and Rosenberg 1990 [54]	*Program impact:* Health system	Before-after comparison of physician density in northern counties of Ontario (where most underserved areas are located) vs. in Ontario overall over a 30- year period (1956-1986, i.e. covering time before and after introduction of UAP in 1969)	Panel of all 10 counties in northern Ontario observed at seven points in time	Canadian Medical Directory Census Canada	*Physician population density in 1986 relative to physician population density in 1956:* 1.86-4.88 across the 10 northern counties Location quotient (physician density in the counties of northern Ontario relative to the physician population density in Ontario as a whole) in 1986 relative to location quotient in 1956: 0.88-1.33 across the northern 10 counties	The fact that the location quotient improved little over the 30-year observation period suggests that the increase in physician population density in northern Ontario (where most of the underserved areas in Ontario are located) was caused by an overall increase in physicians in the state rather than by UAP.	Observational study No control for confounding by other variables that changed over time Ecological bias possible (because not all communities in one county are underserved)

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
National Health Service Corps (NHSC)	Woolf et al. 1981 [55]	*Program impact:* Health system	Univariate comparison of means of demographic, economic, health, and education variables between the two types of sites Discriminant analysis	All communities that were eligible to receive a NHSC physician and were continuously staffed from October 1975 to October 1976 (N = 76) All communities that were eligible to receive a NHSC physician before August 1975 and had never been staffed up to August 1977 (N = 78)	NHSC records Health Resources and Services Administration Area Resource File	*Means comparison:* Staffed communities had significantly higher median family income, lower poverty prevalence, higher income growth, lower infant mortality, lower unemployment, and higher median educational attainment. *Discriminant analysis:* Seven variables contribute significantly and substantially to separation given the other variables in the discriminant function (sign of coefficient in parentheses): income growth (-), poverty prevalence (-), physician population density (-), employment ratio (+), infant mortality rate (-), median family income (+), proportion of people 65 years of age or older (-).	The study suggests that underserved communities that are economically worse-off and have worse population health are less likely to receive a NHSC physician than underserved communities that are economically better-off and have better population health.	Observational study Study covers only the first few years of the NHSC program Ecological bias possible (because community characteristics are measured at the level of the county)

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
NHSC	Pathman et al. 1992 [50]	*Program effect:* Retention (in same underserved area) Retention (in any underserved area)	Retrospective cohort study	Primary care physicians practicing in a rural county who were selected in a national stratified sample in 1981, were still alive in 1990, could be contacted and responded to a mail survey in 1990 (N = 304)	Mail survey conducted by the Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill	*Hazard ratio of non-retention in the same practice as in 1981: NHSC vs. non-NHSC physicians:* 2.11 ($p < 0.0001$) 1.98 ($p = 0.0002$) (when controlling for training in internal medicine and stated importance of small community living) *Hazard ratio of non-retention in any rural practice: NHSC vs. non-NHSC physicians:* 1.74 ($p < 0.004$) 1.56 ($p = 0.02$) (when controlling for training in internal medicine and stated importance of small community living)	NHSC physicians are less likely to remain in their practice of original placement and in any rural practice than non-NHSC physicians.	Observational study Selection bias due to selective participation in the NHSC not controlled for

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
NHSC	Pathman et al. 1994 [51]	*Program effect:* Retention (in same underserved area)	Retrospective cohort study	All primary care NHSC physicians who started their service obligation in a rural HPSA from 1987 to 1990 (N = 417) Stratified random sample of non-NHSC physicians comparable in age and career stage who began working in a rural HPSA from 1987 to 1990 (N = 206)	Mail survey in 1991	*Odds ratio of retention at first practice site: NHSC vs. non-NHSC physicians:* 0.56 ($p = 0.004$) after 3 years and 1 month 0.25 ($p < 0.001$) after 5 years and 1 month 0.41 ($p = 0.01$) after 5 years and 1 month (when controlling for measures of community-physician match and physician and family satisfaction)	NHSC physicians are less likely to remain in their practice of original placement in a HPSA than non-NHSC physicians are to remain in their first practice in a HPSA.	Observational study Selection bias due to selective participation in the NHSC not controlled for

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
NHSC	Pathman and Konrad 1996 [47]	*Program result:* Retention (in practice entered in a specific period of time; differences between minority and non-minority NHSC physicians)	Retrospective cohort study	All primary care physicians placed through NHSC in a HPSA between 1987 and 1990 (N = 398)	Mail survey in 1991	*Relative risk of retention in practice entered between 1987 and 1990: minority NHSC vs. non-minority NHSC physicians:* 0.71 (p = 0.24) 1 year beyond obligation	Minority and non-minority NHSC physicians do not differ in their retention in the practice of original placement after completion of the obligation.	Observational study No control of confounding
NHSC	Rosenblatt et al. 1996 [48]	*Program result:* Retention (in the county of original NHSC placement) Retention (in rural practice)	Description of program outcomes	All physicians who graduated from medical school between 1980 and 1983, had received NHSC scholarships, completed family medicine residencies, completed their obligation in a rural area, and responded to the survey (N = 258)	Mail survey in 1994 Health Resources and Services Administration Area Resource File Public Health Service records American Medical Association Masterfile	*Proportion of NHSC physicians who remain in the country of original placement (and average of 6.1 years after the end of their obligation):* 25% *Proportion of NHSC physicians who have left the county of original placement, but continue to practice in a rural county:* 27%	A substantial proportion of NHSC physicians continue to practice in the county of their original placement or in any other rural site after completion of the obligation.	Descriptive study No control group Duration of average retention reported but duration of individual retention not taken into account

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
NHSC	Cullen et al. 1997 [49]	*Program result:* Retention (in the rural county of original NHSC placement) Retention (in any rural county)	Description of program outcomes	All NHSC scholarship recipients who graduated from medical school between 1975 and 1983 and were placed in a rural county (N = 6249)	American Medical Association Masterfile	*Proportion of NHSC participants who remained in their rural county of original NHSC placement in December 1991:* 13% (among those graduated from medical school in 1975-1977) 17% (1978-1980) 20% (1981-1983) *Proportion NHSC participants who remained in any rural county:* 35% (1975-1977) 36% (1978-1980) 40% (1981-1983)	Substantial proportions of NHSC physicians remain in rural counties after completion of their NHSC obligation.	Descriptive study No control group
NHSC	Rabino-witz et al. 2000 [53]	*Program effect:* Provision of care (in any underserved area)	Retrospective cohort study	Stratified random sample of all allopathic and osteopathic physicians with a primary care specialty who graduated from a US medical school in 1983 or 1984 (N = 2,955)	American Medical Association Masterfile Mail survey in 1993	*Odds ratio of "providing substantial care to the underserved": NHSC vs. non-NHSC physicians:* 2.2 (95% CI 1.6-3.0) (when controlling for sex, ethnicity, family income when growing up, childhood in inner-city/rural area, strong interest in underserved practice prior to medical school, clinical experience with the underserved during medical school)	"Participation in the NHSC is the only experiential factor related to caring for the underserved".	Observational study

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
NHSC	Mofidi et al. 2002 [67]	*Program result:* Retention (providing care to an underserved population)	Description of program outcomes	Stratified random sample of all dentists who had completed their NHSC service obligation between 1980 and 1997 (N = 249)	Mail survey in 1998	*Proportion of NHSC dentists in 1998 who provided care to an underserved population after completion of their obligation:* 47%	A substantial proportion of NHSC dentists continue to provide care to the underserved after their obligated service.	Descriptive study No control group Duration of individual retention not taken into account
NHSC	Probst et al. 2003 [31]	*Program effect:* Provision of care (in any underserved area)	Retrospective cohort study	All allopathic and osteopathic physicians practicing in South Carolina during 1998 who were not enrolled in residency training, had graduated from medical school in 1969 or later and were not currently meeting a NHSC service obligation (N = 3,608)	Physician licensure and inpatient discharge files from the Office of Research and Statistics of the South Carolina Budget and Control Board NHSC files from the Cecil D. Sheps Health Services Research Center at the University of North Carolina at Chapel Hill	*Odds ratio of being highly engaged in Medicaid inpatient practice in 1998: NHSC alumni vs. non-NHSC alumni physicians:* 1.93 (95% CI 1.18-3.13) (when controlling for physician's sex, ethnicity, medical specialty, period of graduation from medical school, medical education in South Carolina, graduation from a non-US medical school)	NHSC alumni are more likely to treat Medicaid patients in their inpatient practice than non-NHSC physicians.	Observational study Selection bias due to selective participation in the NHSC not controlled for Duration of individual inpatient practice not taken into account

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
NHSC	Holmes 2004 [32]	*Program effect:* Retention (in same area) Provision of care (in any underserved area)	Retrospective cohort study	All US physicians who graduated from medical school in 1977-1979 (N = 19,253), 1982-1984 (N = 20,757), 1987-1989 (N = 19,500) First observation of practice location in 1981, 1986, and 1991 for the 1977-1979, 1982-1984, and 1987-1989 cohorts, respectively (i.e. 2-4 years after graduation from medical school).	American Medical Association Masterfile HPSA designation from the Bureau of Primary Health Care in the Health Resources and Services Administration	*NHSC enrollee coefficients in multiple probit regression with location in community of first practice (five years after first observation of practice location) as outcome variable:* Between -0.248 and -0.272 across the three graduation cohorts (all $p < 0.01$) (when controlling for age, sex, ethnicity) -0.466 (not sig.), -0.866 ($p < 0.01$), and -1.748 ($p < 0.01$) in the 1977-1979, 1982-1984, and 1987-1989 cohort, respectively (when controlling for age, sex, ethnicity, and controlling for endogeneity of decision to enroll in NHSC) *NHSC enrollee coefficients in multiple probit regression with practice in any HPSA as outcome variable:* Between 0.528 and 0.745 across the three graduation cohorts (all $p < 0.01$) (when controlling for age, sex, ethnicity) 0.482 (not sig.), 0.745 ($p < 0.01$), 0.161 (not sig.) in the 1977-1979, 1982-1984, and 1987-1989 cohort, respectively (when controlling for age, sex, ethnicity, and controlling for endogeneity of decision to enroll in NHSC)	NHSC physicians are less likely to remain in their first practice location than non-NHSC physicians, even after endogeneity of the decision to enroll in the NHSC is controlled for. The results further suggest that NHSC physicians are more likely to serve in any HPSA than non-NHSC physicians. However, this effect remains only significant in one of the three graduation cohorts, once endogeneity of the decision to enroll in the NHSC is controlled for.	Observational study Duration of individual retention not taken into account Exclusion restrictions (medical school characteristics) used in selection models to control for selective participation in the NHSC may not be valid

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
NHSC	Pathman et al. 2005 [33]	*Program impact:* Health	Pre-post comparison	Non-HPSA counties (N = 772) HPSA counties that received various levels of NHSC staffing between 1984 and 1988: 0 years of staffing (N = 172) 1-7 years of staffing (N = 293) 8-11 years of staffing (N = 84) 12-15 years of staffing (N = 71)	NHSC files Health Resources and Services Administration Area Resource File	*Age-adjusted all-cause mortality rates (standardized to the 1981-1983 rate for non-HPSA counties) in 1981-1983/1996-1998:* Non-HPSA: 1.000/0.947 HPSA, 0 years staffing: 1.022/0.982 HPSA, 1-7 years staffing: 1.027/0.992 HPSA, 8-11 years staffing: 1.092/1.055 HPSA, 12-15 years staffing: 1.089/1.027	There were improvements in age-adjusted mortality rates in all 5 types of counties, suggesting that changes other than the NHSC staffing were responsible for the improvements. Greater relative improvements in age-adjusted mortality were seen in non-HPSA counties than in all HPSA counties with the exception of counties staffed with NHSC clinicians for 12-15 years. It is possible that NHSC staffing is only effective in reducing mortality rates if it is continuous over extended periods of time.	Observational study No control of confounding by other variables that changed over time

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
NHSC	Pathman et al. 2006 [34]	*Program impact:* Health system	Retrospective cohort study	All rural HPSA staffed by NHSC physicians, nurses, and/or physician assistants in 1984 and at least 3 of the preceding 5 years (N = 141) All rural HPSA that had no NHSC clinician assigned from the above disciplines between 1979 and 2001 (N = 142)	American Medical Association Masterfile NHSC files Health Resources and Services Administration Area Resource File	*NHSC staffing coefficients in multiple linear regression with ratio change in non-NHSC primary care physician density from 1981 to 2001 as outcome variable:* 1.06 ($p < 0.01$) (when controlling for population size, ethnic composition, per-capita income, poverty prevalence, youth unemployment rate, education, presence of a hospital, presence of a community or migrant health center, non-NHSC primary care physician population density at baseline, presence of at least one non-NHSC primary care physician at baseline)	Presence of an NHSC clinician increases the supply of non-NHSC physicians to HPSA.	Observational study

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
Scholarship for Indian students in health sciences	Weiss et al. 1980 [41]	*Program result:* Recruitment	Description of program outcomes	All students who were supported by the scholarship between 1973 and 1977 and had graduated in 1980 (N = 124)	Navajo Health Agency Office of Student Affairs records	*Proportion of participants who practiced in the Navajo Indian reservation or immediately adjacent communities after graduation:* Of 124 participants, 34 (27%) continued their education, 9 (7%) were lost to follow-up or died, 5 (4%) were unemployed and 76 (62%) were employed Of the 76 participants available for practice, 56 (74%) worked in the Navajo Indian reservation or immediately adjacent communities, while the remainder did not serve in those areas.	In a program without obligation, but encouragement, to serve in a particular area of need after graduation, a substantial proportion of enrollees decide to serve in such an area.	Descriptive study No control group

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
Oklahoma Rural Medical Education Scholarship Loan	Holmes and Miller 1985 [42]	*Program result:* Recruitment	Description of program outcomes	All scholarship recipients from 1976 to 1985 (N = 138)	Oklahoma Physician Manpower Training Commission records	*Proportion of participants who met their obligation through service in rural or underserved areas in Oklahoma:* Of 138 students, 94 (68%) met their obligation through service, while 44 (32%) repaid the financial incentive.	After graduation from medical school, a substantial proportion of participants chose the buy-out option of the scholarship.	Descriptive study No control group
Oklahoma Rural Medical Education Scholarship Loan	Lapolla et al. 2004 [35]	*Program result:* Recruitment Retention (in the community of original placement) Retention (in any community Oklahoma)	Description of program outcomes	All physicians who fulfilled their service obligation (N = 313)	Oklahoma Physician Manpower Training Commission records	*Proportion of participants who met their obligation through service in rural or underserved areas in Oklahoma:* Of 544 participants available for practice, 407 (75%) had completed or were completing their obligation and 138 (25%) repaid the financial incentive.[3] *Proportion of participants who remained in the original placement community upon completion of their obligation:* Of 313 students, 167 (53%) remained in the original placement community, 91 (29%) relocated to another community in Oklahoma, and 55 (18%) relocated to another state.	A substantial proportion of NHSC physicians continued to practice in Oklahoma upon completion of their obligation.	Descriptive study No control group Duration of individual retention not taken into account

[3] The true absolute numbers may be slightly different, because they were derived from percentages that are shown rounded to the first integer in the source study [35].

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
NHSC **Indian Health Service Corps** **State scholarships** **State loan repayment programs** **Practice and hospital-sponsored financial incentives**	Pathman et al. 2000 [52]	*Program effect:* Provision of care (in any underserved area)	Retrospective cohort study	Stratified random sample of all physicians who graduated from US medical schools in either 1988 or 1992 and were listed four years after graduation with a principal specialty of family practice, general internal medicine or general pediatrics (N = 468)	American Medical Association Masterfile	*Proportions of financial-incentive program participants vs. non-participants who practiced in any rural area in 1999:* 33.3 vs. 6.5% ($p < 0.001$) *Average proportion of Medicaid and uninsured patients of all patients who are cared for by participants vs. non-participants in 1999:* 54.1 vs. 29.4% ($p < 0.001$) The positive association of participation with practice in rural areas and with the proportion of Medicaid and uninsured patients remained significant "while controlling for selected characteristics of physicians".	Participants in financial-incentive programs are significantly more likely to practice in a rural areas and care for underserved populations than non-participants.	Observational study Selection bias due to selective participation in a financial-incentive program not controlled for

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
New South Wales Department of Health Rural Resident Medical Officer Program (Cadetship Program)	Dunbabin et al. 2006 [36]	*Program result:* Recruitment Retention (in any rural community)	Description of program outcomes	All medical students who accepted the scholarship between 1989 and 2004 and should have graduated from medical school by 2004 (N = 157) All medical students who accepted the scholarship between 1989 and 1998, had graduated from medical school, and had completed their rural service (N = 82)	New South Wales Rural Doctors Network records Medical Directory of Australia Mail survey in 2004	*Proportion of participants (1989-2004 cohort) who had completed or were completing their practice obligation in 2004:* Of 157 participants, 4 (3%) did not graduate from medical school. Of the 153 participants who graduated from medical school, 133 (87%) had completed or were completing their practice obligation and 20 (13%) withdrew from the program. *Proportion of participants (1989-1998 cohort) who had completed their rural service and (in 2004) were practicing in a rural community:* Of 82 former cadets, 35 (43%) were working in a rural area (compared to 21% of all medical practitioners nationally).	Recruitment into practice obligation is high and retention in rural communities after completion of obligation is substantial.	Descriptive study No control group Duration of individual retention not taken into account

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
Community Scholarship Program (CSP) **Health Sciences Scholarship Program (HSSP)** **Recruitment and Retention Community Program (RRCP)** **State Loan Repayment Program (SLRP)**	Jackson et al. 2003 [37]	*Program result:* Recruitment *Program effect:* Retention (in same underserved area)	Retrospective cohort study	All participants in at least 1 of the 4 incentive programs who had completed at least 1 year of their obligation (N = 105 for study of program result, N = 44 for study of program effect) All primary care physicians who graduated from US medical schools and were practicing in West Virginia counties defined as "rural" by both the federal Office of Management and Budget and the West Virginia Rural Health Education Partnership (N = 107)	West Virginia Board of Medicine licensure files West Virginia School of Osteopathic Medicine Mail survey in 2002	*Proportion of participants who had completed or were completing their practice obligation in 2002:* Of 105 participants available for practice, 82 (78%) had completed or were completing their practice obligation and 23 (22%) repaid the financial incentive. *Comparison of the proportion of participants vs. the proportion of all other primary care physicians who were still practicing at their first practice site in 2002:* "Obligated physicians were less likely to leave their service sites during the first 4 years of practice than were non-obligated physicians. After obligations were completed and physicians were free to leave, retention dropped into the range seen among nonobligated physicians." After 4 years, 32% of all participants were no longer at their first practice site, compared with 38% of all other primary care physicians (relative risk 0.84, p = 0.475)*.	Recruitment into practice obligation is relatively high. Retention in the first practice site is not significantly different between program participants and non-participants.	Observational study No control of confounding Selection bias due to selective participation in a financial-incentive program not controlled for

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
20 US state scholarship programs **12 state loan programs with service option** **24 state loan repayment programs** **6 state direct financial-incentive programs for residents** **7 state direct financial-incentive programs for fully trained health professionals**	Pathman et al. 2004 [27]	*Program result:* Recruitment *Program effect:* Retention (in same area)	Description of program outcomes Retrospective cohort study	All primary care physicians serving or having served their obligation in 1991 or 1996 (N = 330) Stratified random sample of all graduates of US allopathic and osteopathic medical schools in 1988 and 1992 who 4 years after graduation were in primary care practice in the US and were not obligated to serve in a specific location (N = 468)	American Medical Association Masterfile Records of the individual state programs 1999 US census Health Resources and Services Administration Area Resource File Mail survey in 1998 and 1999	*Proportion of program participants who had completed their practice obligation by 2004:* 44.7% (average of service-option loan programs) 66.5% (average of scholarship programs) 93.0% (average of all other programs) *Proportion of program participants who had repaid the financial incentive by 2004:* 49.2% (average of service-option loan programs) 27.2% (average of scholarship programs) 2.3% (average of all other programs) *Hazard ratio of retention at first practice site: program participants vs. program non-participants:* 0.70 (p = 0.029) 0.75 (p = 0.080) (when controlling for ages, sex, medical specialty, marital status)	Programs that obligate physicians after graduating from medical school achieve higher obligation completion ratios than programs that obligate students during medical school. Retention in the first practice site is lower among obligated than among non-obligated physicians.	*Program outcome:* Descriptive study *Program effect:* Observational study Selection bias due to selective participation in a financial-incentive program not controlled for

Program name	Study	Topics	Study design	Sample and sample size	Data sources	Outcome measures and effect sizes	Conclusions	Methodological limitations
Friends of Mosvold Scholarship Scheme (FOMSS)	Ross 2007 [43]	*Program result:* Recruitment	Description of program outcomes	All individuals who participated in the program between 1999 and 2002 and who graduated from a health care education program before 2006	FOMSS records	*Proportion of participants who practiced in Umkhanyakude district after graduation:* Of 24 participants who graduated, 1 (0.4%) died and 3 (1%) pursued further education or training. Of 20 participants available for service, 20 (100%) had completed or were completing their practice obligation.	A rural scholarship program in South Africa can achieve complete recruitment.	Descriptive study

The term underserved area in the table encompasses a specific underserved area, any underserved area, and underserved populations. WWII = Second World War, HPSA = Health Professional Shortage Area, not sig. = not significant at the 5% level, *calculated using information available in the article.

Table 4: Studies of program effect

		Observed outcome	
		Same area as at baseline	Any underserved area
Sample	All physicians	*Retention in the same area:* Holmes 2004 Pathman et al. 2004	*Provision of care in any underserved area:* Rabinowitz et. al. 2000 Probst et al. 2003 Holmes 2004 Pathman et al. 2000
	Physicians who work in an underserved area at baseline	*Retention in the same underserved area:* Pathman et al. 1992 Pathman et al. 1994 Jackson et al. 2003	*Retention in any underserved area:* Pathman et al. 1992

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