

Designing financial-incentive programmes for return of medical service in underserved areas of sub-Saharan Africa

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Abstract

Background

In many countries in sub-Saharan Africa health worker shortages are one of the main constraints in achieving population health goals. Financial-incentive programmes for return of service, whereby participants receive payments in return for a commitment to practice for a period of time in a medically underserved area, could potentially alleviate local and regional health worker shortages.

Objectives

To summarize the existing evidence on the effectiveness of financial-incentive programmes for health workers and to discuss essential management components of such programmes.

Methods

We describe the existing evidence and extract from selected publications lessons learnt for the management of financial-incentive programmes.

Results

Financial-incentive programmes can be effective in increasing the supply of health workers to underserved areas, but published studies are largely limited to developed countries. Particular lessons can be learnt for six essential management components: financing (programmes may benefit from innovative donor financing schemes), promotion (programmes should utilize tested communication channels to reach secondary school graduates and health workers), selection (programmes may use selection criteria to ensure programme success and to achieve supplementary policy goals), placement (programmes may use matching of participants to areas to ensure programme success), enforcement (programmes may utilize community-based monitoring or outsource enforcement to existing institutions), and evaluation (programmes should evaluate their performance to improve the evidence base for Africa).

Conclusion

Financial-incentive programmes are a promising intervention to increase the supply of health workers to underserved areas of SSA. Their design can be informed by experiences from financial-incentive programmes in developed countries as well as by lessons learnt from the implementation of educational loans and compulsory community service in the developing world.

Background

One of the main constraints in achieving population health goals in many sub-Saharan African countries is the lack of health workers. The 2004 Joint Learning Initiative (JLI) for 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 and 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

Interventions to alleviate health worker shortages in sub-Saharan Africa (SSA) include selective recruitment of those individuals into health care education who are (given observable characteristics) most likely to remain in SSA in the long run, training specifically for practice in SSA, improvements in working or living conditions, compulsion, or incentives.³ The topic of the present article is financial incentives for return of medical service in an “underserved area” of SSA (e.g., a rural community or specific health care facility): A health worker in training or a fully trained health worker enters into a contract to work for a number of years in an underserved area in exchange for a financial pay-off.

Table 1 describes the characteristics of the different types of financial-incentive programmes that have been used in the past.¹ All five types of financial-incentive programmes can serve to increase the numbers of health workers in underserved areas through two mechanisms. First, all types of financial incentive programmes 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 SSA to Europe, Australia, or the US.⁴⁻⁶ 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. Second, those types of financial-incentive programmes that enrol students before the start of their health care education (service-requiring scholarships, educational loans with service requirement and service-option loans (Table 1)) can add health workers to the pool of workers who would have been educated in the absence of such programmes and place them in underserved areas. The second mechanism can take hold if there are qualified candidates who would not have the means to finance a health care education without a financial incentive and if, in addition, a country’s health care education system can absorb additional students.

¹ All service-option educational loan programmes offer a choice between service and repayment of the financial incentive. The other four types of programmes commonly offer a “buy-out” option. Service-requiring scholarships with a buy-out option are similar to service-option education loans. However, while programme managers of service-option loans would normally consider repayment and service equally desirable outcomes, managers of service-requiring scholarships would normally prefer service over buy-out. This difference manifests itself in the fact that given equal financial incentives, a buy-out is commonly more expensive than the financial repayment of an educational loan.

For a number of reasons, financial-incentive programmes are an attractive option to increase the supply of health workers to medically underserved areas in SSA. First, they offer students who otherwise would not have the means to finance a health care education an opportunity to do so, thus potentially increasing equity of access to higher education. Second, unlike selective recruitment and training strategies or improvements in working and living conditions,³ financial-incentive programmes establish legally enforceable commitments to work in underserved areas and are thus likely to yield a more reliable increase in the supply of health workers to those areas. Third, unlike compulsory service policies,³ they do not compel, but offer a choice to commit to, work in underserved areas.

While financial-incentive programmes are an attractive intervention to direct health worker flows to underserved areas, they are not easy to implement. In this article, we will first summarize the existing evidence on outcomes and effectiveness of financial-incentive programmes for return of service. Next, we will discuss six essential management components of financial-incentive programmes – financing, promotion of the programme, selection of candidates, placement of candidates, enforcement, and evaluation (Figure 1) – and draw out lessons learnt from past implementations of financial-incentive programmes as well as from two related types of programmes (educational loans and compulsory community service). The lessons learnt are extracted from selected publications on the three types of programmes.

Existing evidence

We have previously shown that a specific type of financial-incentive programme, scholarships in return for a commitment to deliver antiretroviral treatment in SSA, is highly cost-beneficial under a wide range of assumptions.⁷ In a recent systematic review, we identified 26 studies evaluating financial incentive programmes for return of service.⁸ With the exception of one study from South Africa, which describes the Friends of Mosveld Scholarship Scheme in northern KwaZulu-Natal,⁹ all of the reviewed studies are from the US, Canada, or New Zealand. While financial-incentive programmes elsewhere in SSA have not been evaluated in published studies, they have nevertheless been used in a number of countries in the region, for instance in Swaziland¹⁰ and in Ghana.¹¹ Table 2 shows an overview of studies of financial-incentive programme *results* (i.e., descriptions of outcomes among programme participants without comparison to outcomes among non-participants), programme *effects* (i.e., analysis of programme effectiveness at the individual-level through comparison of outcomes among participants and non-participants), and programme *impacts* (i.e., analysis of programme effectiveness at the population level, such as changes in physicians density or population mortality)⁸. The table describes the type of study, the type of outcome observed in the study, and the main study findings. Overall, the existing evidence suggests that at least in English-speaking developed countries, financial-incentive programmes can be effective in increasing the supply of health workers to underserved areas. Programmes recruit substantial proportions of participants to underserved areas (the random-effects estimate of the pooled recruitment proportion across the studies in our review was 69% (95% confidence interval 61-77%)).⁸ In addition, a number of studies have found that programme

participants are more likely than health workers who did not participate in a financial-incentive programme to remain in some underserved area in the long run¹²⁻¹⁵ although not necessarily in the underserved area of initial placement.^{12, 16-18}

Programme components

First component: financing

Four of the five types of financial-incentive programmes shown in Table 1 necessarily require ongoing external financing, while one type, educational loans with service requirement, could theoretically finance itself in the long term if the total amount of money repaid in a period of time always equalled at least the total amount required to finance the new incentives given out over the same period of time plus the programme's administration costs. Such a steady state of revolving refinance, however, will take a long time to achieve because student loans will only start to be repaid after many years of initial investment.¹⁹ Moreover, both in developed and in developing countries existing student loan programmes usually require financial injections even in the long term, because losses due to unemployment, default, illness, or refusal to repay are usually not priced into the repayment amounts. If they were, such programmes would not be an attractive option for education finance for many eligible students and would increase the rate of repayment refusal among those students who do take out an educational loan.²⁰ While substantial long-term finance is thus required for the incentive programmes, in many African countries public finance for such programmes may not be available because African governments commonly receive only very limited tax revenues, face borrowing constraints, or may not be able to increase the proportion of public finance allocated to spending on education for political reasons.²¹ An alternative is to finance the incentive programmes through aid from international donors. However, traditional donor financing may not be well-suited for this purpose. For one, donors tend to finance projects for periods that may not be sufficiently long to create sustainable programmes and they may be reluctant to provide "running cost" support for training health workers.²¹ The latter problem is highlighted by recent discussions about whether large disease-specific aid agencies, e.g., PEPFAR, the Global Fund to Fight AIDS, Tuberculosis and Malaria, and the GAVI Alliance, should invest in human resources for health in developing countries.^{1, 22-24} In addition, countries which cannot achieve an intended increase in the rate of health worker education through financial-incentive programmes because of limited education capacity may need substantial start-up financing to build educational institutions and to educate health care teachers. The relatively constant flows of traditional donor financing may not allow substantial initial investment with lower rates of continuing finance.

Recent innovation in donor funding may address both shortcomings. On the one hand, donor-financed endowment funds²⁵ can provide steady long-term money flows well-suited to fund scholarships, loans and salary support. On the other hand, organizations such as the International Finance Facility for Immunisation (IFFIm)²⁶ can leverage development aid by issuing bonds on international capital markets against long-term

commitments of annual payments from donor nations in order to "frontload" aid, allowing immediate large-scale investments (such as in education infrastructure).²⁷

Another financing option would be compensation payments from countries receiving health workers to those countries losing them. It has been argued that developed countries that recruit health workers from African countries with severe health worker shortages have an ethical obligation to compensate the governments of these countries for the loss.²⁸ While there may be a number of practical problems in implementing compensation payments – for instance, as pointed out in the *2005 Report of the Global Commission on International Migration*²⁹ migrating professionals commonly work in more than one country, in which case it is unclear which country is responsible for the payments – financial-incentive programmes seem an especially fitting purpose on which to spend such payments because they would contribute to decreasing similar losses in the future.

Second component: promotion

The pool of potential candidates to apply for participation in a financial-incentive programme depends on the start of the programme relative to the stage of health care education (Table 1). In the case of service-requiring scholarships, educational loans with service requirement and service-option loans, potential candidates will be the secondary school graduates who are qualified to pursue a health care education.²¹ In the case of loan repayments and direct financial incentives, it will be fully qualified health care professionals who are eligible for participation. The ratio of potential to de-facto applicants will depend on the knowledge of the programme among eligible people as well as the attractiveness of the programme conditions. While there is little published evidence about how secondary school students attain knowledge of tertiary education, including financing options in SSA,^{30, 31} a range of communication channels have been used successfully to increase students' knowledge of behaviours to reduce health risks.³² They include classroom or group sessions led by teachers^{33, 34} or peers,^{35, 36} or printed material.³⁷ As post-graduate students and health care professionals in Africa commonly use the internet^{38, 39} and e-mail^{40, 41} to access and exchange medical information, financial-incentive programmes for fully qualified health workers may be successfully promoted through advertisements on websites or e-mail campaigns.

Third component: selection

Selection of programme participants among all candidates who apply for a place in a financial-incentive programme can contribute to achieving the main objective of the programme, i.e., to increase the supply health workers to medically underserved areas, as well as supplementary policy goals. One strategy to maximize the effectiveness of the programme in increasing the supply of health workers to underserved areas is to select candidates based on characteristics that have been observed to be associated with a low probability of defaulting on the service obligation and a high probability of remaining in an underserved area after completion of the obligation. There is evidence from both developing countries⁴²⁻⁴⁴ and developed countries^{42, 45-49} that health care students from

rural background are more likely to choose rural practice than their peers from urban areas. For instance, a 2003 study from South Africa found that ten years after graduating from medical school doctors of rural origin were 3.5 times more likely than doctors of urban origin to practice in rural areas.⁴⁴ In settings where the selected students would have attained a health care degree even if they had not received the financial incentive, it is difficult to judge whether selective recruitment does indeed maximize programme effectiveness.¹² The selected students might have taken up practice and remained in medically underserved areas, even if they had not received a financial incentive for return of service. However, since in many settings in SSA, health care professionals who are likely to practice in medically underserved areas would not be able to finance a health care education without financial support (e.g., poor rural students), a selective recruitment strategy is likely to increase the supply of health workers to underserved areas.

Policy makers can also use selection into a financial-incentive programme to achieve supplementary health care education goals. Financial equity in access to tertiary education could be improved if eligibility for the financial incentives were based on a means test.⁵⁰ Merit could be rewarded if eligibility were based on secondary school performance. The proportion of health care students from traditionally underrepresented population groups (e.g., women or underrepresented ethnicities) could be increased if these groups received a proportion of the incentives higher than their proportion in the eligible population.

Fourth component: placement

Placement of programme participants in particular underserved areas is likely to be an important determinant of programme success. Policy makers first need to decide on a definition or a process to decide which areas to designate as “medically underserved”. Some programmes in developed countries have used simple definitions of “medically underserved areas” (e.g., rural communities with populations of 5,000 or less⁵¹ or towns or villages with populations of 2,500 or less⁵²); while others have designated areas as underserved through committee consensus informed by a range of criteria (e.g., health worker-to-population ratios, demographic characteristics of the population, and population health^{53, 54}). Once areas have been designated as “medically underserved”, policy makers need match individual programme participants to specific underserved areas. In order to maximize the social value of financial-incentive programmes, policy makers could consider placing participants preferentially in those underserved areas where unmet health care need is greatest, because the impact of a placement on population health in these areas is likely to be greatest. Without such a preferential placement policy, it is possible that the neediest population will benefit least from financial-incentive programmes. For instance, one study of the National Health Service Corps (NHSC), a national incentive programme in the United States, NHSC found that the poorer an underserved area and the worse its population health, the less likely it was to receive a physician who is obligated to work in an underserved area.⁵⁵

However, such a policy would strongly restrict participants' choice of placement area. As a result, participants may be less likely to be satisfied with their work and life during the obligated service, decreasing the chances of long-term retention in the placement area. 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".⁵⁶ A study from South Africa found that physicians were dissatisfied with their compulsory community service placements *inter alia* because, they were forced to serve in a particular location and because their social lives were disrupted⁵⁷ – two problems that should be less likely to occur if programme participants were given the choice to serve in one of many underserved areas. Financial-incentive programmes aiming to attain high retention of obligated health workers in the placement area should attempt to accommodate health workers' wishes to practice in particular underserved areas as far as possible. Optimal placement could be achieved, for instance, by a matching process such as the one used for specialist training places in the US, whereby candidates and training institutions rank each other in order of declining preference and a computer algorithm implements explicit rules to identify the best assignment of candidates to institutions.⁵⁸

Fifth component: enforcement

Programme participants can default on their obligation in several different ways. In programmes without repayment or buy-out option, they can, first, refuse placement and service after having received the financial incentive and, second, comply with placement but fail to perform the specific duties they are obliged to perform in the placement area. An example of the latter type of default is a physician who fails to fulfil her obligation to work in a public-sector hospital in the placement area and instead sees patients in private practice. While the first type of default is comparatively easy to detect (for instance, through spot checks or calls to local hospital administrators), the second type can be difficult to detect (for instance, if the health services administration in the placement area is weak). In programmes with a buy-out option, participants default if they neither fulfil their service obligation nor repay the financial incentive.

In order to ensure that participants fulfil their obligations, programmes must have a monitoring strategy in place to identify defaulters, as well as a strategy for how to deal with detected defaulters. Such strategies will depend on legal, institutional, and technological factors specific to a country. Experiences from educational-loan programmes in Africa suggest that rather than building up an infrastructure to monitor default on service or financial obligations themselves, financial-incentive programmes should outsource this function to existing institutions that already have the structures and experience to deal with contractual default, such as the tax system, the social security system, or banks.⁵⁰ An alternative to using such large existing systems to monitor participants is community-based monitoring approaches, including monitoring through local leaders or community score cards.⁵⁹ Community-based monitoring may be preferable for relatively small local financial-incentive programmes.

Monitoring and punishment are reactive approaches to reduce default. Preventive strategies to decrease default rates include regulation, such as withholding diplomas or licenses from scholarship recipients until they have completed their service²¹ or requiring completion of the service for specialist training,⁴³ as well as agreements between migration source and destination countries to restrict the visa eligibility of obligated health workers before completion of their service.⁵

Sixth component: evaluation

A large number of descriptive case studies and cohort studies have evaluated financial-incentive programmes (Table 2).⁸ However, with one exception from South Africa⁹, all of the published evaluations are from English-speaking developed countries. In order to improve the scope of the existing evidence, financial-incentive programmes in SSA should collect quantitative and qualitative data on their experiences and outcomes and publish them.

The current evidence on the effects of financial-incentive programmes on long-term retention in underserved areas is limited, because it is difficult to establish causality in the relationship between programme participation and retention based on observational studies. On the one hand, participation in a financial-incentive programme 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 programme 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 programme are also more likely to participate in such a programme and that it is the selective participation rather than a programme effect that brings about the higher probability of participants serving in underserved areas compared with non-participants. In order to strengthen the evidence on the effects of the programmes, researchers should conduct controlled experiments where funders and policy makers are willing to support such studies.

Conclusion

Financial-incentive programmes for return of medical service in underserved areas have been used in SSA. However, published evidence on their effectiveness is limited. The design of financial-incentive programmes in SSA – in particular, their financing, promotion, selection, placement, enforcement, and evaluation components – can be informed by experiences from financial-incentive programmes in developed countries as well as by lessons learnt from the implementation of educational loans and compulsory community service in the developing world.

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Authorship

Till Bärnighausen and David E. Bloom jointly conceived and designed the study and contributed equally to the analyses and interpretation of the data, as well as the drafting and revising of the manuscript. Both authors have approved the final version of the manuscript.

Conflict of interest

Both authors declare that they have no conflicts of interest.

Tables and figures

Table 1: Types of financial-incentive for return of service programmes

Type of programme	Time of commitment	Time of money receipt	Spending restrictions	Obligation
Service-requiring scholarships (“conditional scholarships”)	Before the start of health care education or early in the course of health care education	During health care education	Money can only be used for health care education	Service*
Educational loans with service requirement	Before the start of health care education or early in the course of health care education	During health care education	Money can only be used for health care education	Service and financial repayment*
Service-option educational loans	Before the start of health care education or early in the course of health care education	During health care education	Money can only be used for health care education	Service or financial repayment
Loan repayment	After completion of health care education	After completion of health care education, during committed service	Money can only be used to pay back educational debt	Service*
Direct financial incentives	After completion of health care education	After completion of health care education, during committed service	Money can be used for any purpose	Service*

*Programme may have a buy-out option.

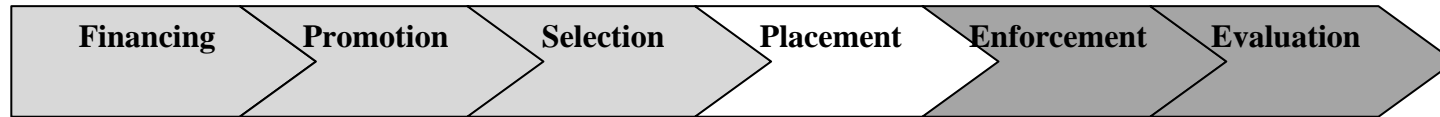
Table 2: Overview of evidence on financial-incentive programmes for return of medical service

Study	Type of study	Type of outcome	Study findings
Fitz et al. 1977 ⁵¹	Description of programme outcomes	<i>Programme result</i> Recruitment Retention	59% of participants recruited for practice in underserved areas, 4% repaid their financial incentives About half of recruited participants remained in an underserved area for most of their working lives
Mason 1971 ⁶⁰	Description of programme outcomes	<i>Programme result</i> Recruitment	60% of participants recruited for practice in underserved areas, 37% repaid their financial incentives
Bradbury 1963 ⁵²	Description of programme outcomes	<i>Programme result</i> Recruitment	75% of participants recruited for practice in underserved areas
Navin and Nichols 1977 ⁶¹	Description of programme outcomes Time series	<i>Programme result</i> Recruitment Retention <i>Programme impact</i> On the health system	59% of participants recruited for practice in underserved areas, 37% repaid their financial incentives Increase in supply of medical students not attributed to programme
Bass and Copeman 1975 ⁵³	Description of programme outcomes Time series	<i>Programme result</i> Recruitment Retention <i>Programme impact</i> Health system	53% of participants recruited for practice in underserved area, 47% repaid their financial incentive Increase in supply of physicians to underserved areas attributed to programme
Anderson and Rosenberg 1990 ⁶²	Before-after comparison	<i>Programme impact</i> Health system	Increase in supply of physicians to underserved areas not attributed to programme
Woolf et al. 1981 ⁵⁵	Univariate comparison of means Discrimant analysis	<i>Programme impact</i> Health system	Underserved areas that are economically worse-off and have worse population health are less likely to receive a programme participant than underserved communities that are economically better-off and have better population health
Pathman et al. 1992 ¹⁷	Retrospective cohort study	<i>Programme effect</i> Retention	Participants are less likely to remain in the underserved area of original placement and in any rural practice than non-participants

Study	Type of study	Type of outcome	Study findings
Pathman et al. 1994 ¹⁸	Retrospective cohort study	<i>Programme effect</i> Retention	Participants are less likely to remain in the underserved area of original placement than non-participants
Pathman and Konrad 1996 ⁶³	Retrospective cohort study	<i>Programme effect</i> Retention	Participants belonging to an ethnic minority do not differ in their retention in the underserved area of first placement from non-minority participants
Rosenblatt et al. 1996 ⁶⁴	Description of programme outcomes	<i>Programme result</i> Retention	52% of participants continue to practice in some underserved area about 6 years after completion of their obligated service
Cullen et al. 1997 ⁶⁵	Retrospective cohort study	<i>Programme result</i> Retention	Substantial proportions of participants remain in underserved areas after completion of their obligated service
Rabinowitz et al. 2000 ¹⁵	Retrospective cohort study	<i>Programme effect</i> Retention	Participation determines retention in some underserved area
Mofidi et al. 2002 ⁶⁶	Description of programme outcomes	<i>Programme result</i> Retention	After completion of their obligated service, a substantial proportion participants continues to provide care to disadvantaged patients
Probst et al. 2003 ¹³	Retrospective cohort study	<i>Programme effect</i> Retention	After completion of their obligated service, participants are more likely to treat disadvantaged patients than non-participants
Holmes 2004 ¹²	Retrospective cohort study	<i>Programme effect</i> Retention	Participants are less likely to remain in the underserved area of original placement than non-participants, but more likely to remain in some underserved area
Pathman et al. 2005 ⁶⁷	Pre-post comparison	<i>Programme impact</i> Health	Inconclusive findings on whether a large financial-incentive programme affected population mortality
Pathman et al. 2006 ⁶⁸	Retrospective cohort study	<i>Programme impact</i> Health system	Presence of a participant increases the supply of non-participants to an underserved area
Weiss et al. 1980 ⁶⁹	Description of programme outcomes	<i>Programme result</i> Recruitment	56% of participants recruited for practice in an underserved area
Holmes and Miller 1985 ¹⁴	Description of programme outcomes	<i>Programme result</i> Recruitment	68% of participants recruited for practice in underserved areas, 32% repaid their financial incentives

Study	Type of study	Type of outcome	Study findings
Lapolla et al. 2004 ⁷⁰	Description of programme outcomes	<i>Programme result</i> Recruitment Retention	75% of participants recruited for practice in underserved areas, 25% repaid their financial incentives 82% of participants remained in an underserved area upon completion of their obligated service
Pathman et al. 2000 ⁵⁶	Retrospective cohort study	<i>Programme result</i> Recruitment	Participants are significantly more likely to remain in and underserved after completion of their obligated service than non-participants
Dunabin et al. 2006 ⁷¹	Description of programme outcomes	<i>Programme result</i> Recruitment Retention	87% of participants recruited for practice in underserved areas Substantial proportions of participants remain in underserved areas after completion of their obligated service
Jackson et al. 2003 ⁷²	Retrospective cohort study	<i>Programme result</i> Recruitment <i>Programme effect</i> Retention	78% of participants recruited for practice in underserved areas, 22% repaid their financial incentives Participants do not differ in their retention in the underserved area of first practice from non-participants
Pathman et al. 2004 ¹⁶	Description of programme outcomes Retrospective cohort study	<i>Programme result</i> Recruitment <i>Programme effect</i> Retention	Participants that enrol in a programme after graduating from medical school are more likely than participants that enrol in a programme during medical school to be recruited for service in an underserved area Participants are less likely to remain in the underserved area of original placement than non-participants
Ross 2007 ⁹	Description of programme outcomes	<i>Programme result</i> Recruitment	100% of participants recruited for practice in underserved areas

Figure 1: Management components of financial-incentive programmes



All six components pertain to financial-incentive programmes. In addition, some components pertain to educational loan programmes (), community service programmes (), or both educational-loan and community-service programmes ().

References

1. JLI. Human resources for health: overcoming the crisis. Boston: Harvard University Press 2004.
2. World Health Organization. Working together for health: the World Health Report 2006. Geneva: World Health Organization 2006.
3. Lehmann U, Dieleman M, Martineau T. Staffing remote rural areas in middle- and low-income countries: a literature review of attraction and retention. *BMC Health Serv Res.* 2008;8:19.
4. Bärnighausen T, Bloom DE, Humair S. Human Resources for Treating HIV/AIDS: Needs, Capacities, and Gaps. *AIDS Patient Care STDS.* 2007 Oct 18.
5. Stilwell B, Diallo K, Zurn P, Vujicic M, Adams O, Dal Poz M. Migration of health-care workers from developing countries: strategic approaches to its management. *Bull World Health Organ.* 2004 Aug;82(8):595-600.
6. Dovlo D. Migration of nurses from sub-Saharan Africa: a review of issues and challenges. *Health Serv Res.* 2007 Jun;42(3 Pt 2):1373-88.
7. Bärnighausen T, Bloom DE. "Conditional scholarships" for HIV/AIDS health workers: educating and retaining the workforce to provide antiretroviral treatment in sub-Saharan Africa National Bureau of Economic Research Working Paper 13396. 2007.
8. Bärnighausen T, Bloom D. Financial incentives for return of service in underserved areas: a systematic review (under review). 2008.
9. Ross AJ. Success of a scholarship scheme for rural students. *S Afr Med J.* 2007 Nov;97(11):1087-90.
10. Kober K, Van Damme W. Public sector nurses in Swaziland: can the downturn be reversed? *Hum Resour Health.* 2006;4:13.
11. Dovlo D, Nyonator F. Migration by graduates of the University of Ghana Medical School: a preliminary rapid appraisal. *Human Resources for Health Development Journal.* 1999;3(1):40-51.
12. Holmes GM. Does the national health service corps improve physician supply in underserved locations? *Eastern Economic Journal.* 2004;30(4):563-81.
13. Probst JC, Samuels ME, Shaw TV, Hart GL, Daly C. The National Health Service Corps and Medicaid inpatient care: experience in a southern state. *South Med J.* 2003 Aug;96(8):775-83.
14. Holmes JE, Miller DA. A study of 138 return service scholarship applications awarded by the Oklahoma Physician Manpower Training Commission. *J Okla State Med Assoc.* 1985 Oct;78(10):384-8.
15. Rabinowitz HK, Diamond JJ, Veloski JJ, Gayle JA. The impact of multiple predictors on generalist physicians' care of underserved populations. *Am J Public Health.* 2000 Aug;90(8):1225-8.
16. Pathman DE, Konrad TR, King TS, Taylor DH, Jr., Koch GG. Outcomes of states' scholarship, loan repayment, and related programs for physicians. *Med Care.* 2004 Jun;42(6):560-8.
17. Pathman DE, Konrad TR, Ricketts TC, 3rd. The comparative retention of National Health Service Corps and other rural physicians. Results of a 9-year follow-up study. *JAMA.* 1992 Sep 23-30;268(12):1552-8.

18. Pathman DE, Konrad TR, Ricketts TC, 3rd. The National Health Service Corps experience for rural physicians in the late 1980s. *JAMA*. 1994 Nov 2;272(17):1341-8.
19. Woodhall M. Student loans: potential, problems, and lessons from international experience. *JHEA/RESA*. 2004;2(2):37-51.
20. Woodhall M. Lending for learning: designing a student loan programme for developing countries. London: The Commonwealth Secretariat 1987.
21. Bossert T, Bärnighausen T, Bowser D, Mitchell A, Gedik G. Assessing financing, education, management and policy context for strategic planning of human resources for health. Geneva: World Health Organization 2007.
22. GAVI. 11th GAVI board meeting: human resources and immunization. 2003 15-16 July 2003: GAVI; 2003.
23. Ooms G, Van Damme W, Temmerman M. Medicines without doctors: why the Global Fund must fund salaries of health workers to expand AIDS treatment. *PLoS Med*. 2007 Apr 17;4(4):e128.
24. The Global Fund to fight AIDS tamGF. Partners in impact: results report. Geneva: Global Fund 2007.
25. Glassman A, Lane C. Better aid for AIDS treatment: the promise of endowment funds. 2007 [cited 30 June 2008]; Available from: http://www.brookings.edu/opinions/2007/1129_hiv_aids_glassman.aspx#_ftn3
26. About IFFIm. [cited 30 June 2008]; Available from: http://www.iff-immunisation.org/01_about_iffim.html
27. DFID and HM Treasury. International finance facility proposal - April 2004. Norwich, UK: HM Treasury 2004.
28. Mensah K, Makintosh, M., Henry, L. The 'skills drain' of health professionals from the developing world: a framework for policy formulation. London: Medact 2005.
29. Global Commission on International Migration. Migration in an interconnected world: new directions for action. Geneva: Global Commission on International Migration 2005.
30. Saint W. Bibliography on higher education in sub-Saharan Africa. 2004 [cited 12 June 2008]; Available from: http://portal.unesco.org/education/en/files/31230/10861814601Bibliography_on_Higher_Education_in_Africa.pdf/Bibliography%2Bon%2BHigher%2BEducation%2Bin%2BAfrica.pdf
31. Teferra D, Altbach PG. African higher education: an international reference handbook. Bloomington, IN: Indiana University Press 2003.
32. Paul-Ebhonhimen V, Poobalan A, van Teijlingen ER. Systematic review of effectiveness of school-based sexual health interventions in sub-Saharan Africa. *BMC Public Health*. 2008;8(4).
33. Klepp KI, Ndeki SS, Seha AM, Hannan P, Lyimo BA, Msuya MH, et al. AIDS education for primary school children in Tanzania: an evaluation study. *AIDS*. 1994;8:1157-62.
34. Klepp KI, Ndeki SS, Leshabari MT, Hannan PJ, Lyimo BA. AIDS education in Tanzania: promoting risk reduction among primary school children. *American Journal of Public Health*. 1997;87:1931-6.

35. Agha S. An evaluation of the effectiveness of a peer sexual health intervention among secondary-school students in Zambia. *AIDS Education and Prevention*. 2002;14:269-81.
36. Agha S, Van Rossem R. Impact of a school-based peer sexual health intervention on normative beliefs, risk perceptions, and sexual behaviour of Zambian adolescents. *Journal of Adolescent Health*. 2004;34:441-52.
37. James S, Reddy PS, Ruiter RAC, Taylor M, Jinabhai CC, Van Empelen P, et al. The effects of a systematically developed photo-novella on knowledge, attitudes, communication and behavioural interventions with respect to sexually transmitted infections among secondary school learners in South Africa. *Health Promotion International*. 2005;20:157-65.
38. Geissbuhler A, Bagayoko CO, Ly O. The RAFT network: 5 years of distance continuing medical education and tele-consultations over the internet in French-speaking Africa. *International Journal of Medical Informatics*. 2007;76(5-6):351-156.
39. Smith H, Bukirwa H, Mukasa O, Snell P, Akeh-Nsoh S, Mbuyita S, et al. Access to electronic health knowledge in five countries in Africa: a descriptive study. *BMC Health Serv Res*. 2007.
40. Fraser HSF, McGrath SD. Information technology and telemedicine in sub-Saharan Africa. *BMJ*. 2000;321:465-6.
41. Cooke FJ, Holmes A. E-mail consultations in international health. *Lancet*. 2000;356:138.
42. Daniels ZM, Vanleit BJ, Skipper BJ, Sanders ML, Rhyne RL. Factors in recruiting and retaining health professionals for rural practice. *J Rural Health*. 2007;23(1):62-71.
43. Wibulpolprasert S, Pengpaibon P. Integrated strategies to tackle the inequitable distribution of doctors in Thailand: four decades of experience. *Hum Resour Health*. 2003 Nov 25;1(1):12.
44. de Vries E, Reid S. Do South African medical students of rural origin return to rural practice? *S Afr Med J*. 2003 Oct;93(10):789-93.
45. World Organization of Family Doctors (WONCA) Working Party on Rural Practice. Policy on quality and effectiveness of rural health care. 2002 [cited 20 July 2007]; Available from: http://www.globalfamilydoctor.com/aboutWonca/working_groups/rural_training/Quality_of_Rural_Healthcare.htm#35a
46. Rabinowitz HK, Diamond JJ, Markham FW, Hazelwood CE. A program to increase the number of family physicians in rural and underserved areas: impact after 22 years. *JAMA*. 1999 Jan 20;281(3):255-60.
47. Rabinowitz HK. Recruitment, retention, and follow-up of graduates of a program to increase the number of family physicians in rural and underserved areas. *N Engl J Med*. 1993 Apr 1;328(13):934-9.
48. Laven GA, Beilby JJ, Wilkinson D, McElroy HJ. Factors associated with rural practice among Australian-trained general practitioners. *Med J Aust*. 2003 Jul 21;179(2):75-9.

49. Laven GA, Wilkinson D, Beilby JJ, McElroy HJ. Empiric validation of the rural Australian medical undergraduate scholarship 'rural background' criterion. *Australian Journal of Rural Health*. 2005;13:137-41.
50. Albrecht Z, Zimmarmann A. Student loans and their alternatives: improving the performance of deferred payment programs. *Higher Education*. 1992;23(4):357-74.
51. Fitz RH, Mawardi BH, Wilber J. Scholarships for rural medicine. The Commonwealth Fund experience with a pre-World War II indenture program. *Trans Am Clin Climatol Assoc*. 1977;88:191-6.
52. Bradbury SF. The North Carolina Medical Care Commission. Evaluation of the Rural Loan Program by Recipients of Medical and Dental Loans. *N C Med J*. 1963 Oct;24:489-91.
53. Bass M, Copeman WJ. An Ontario solution to medically underserved areas: evaluation of an ongoing program. *Canadian Medical Journal*. 1975;113:403-7.
54. US Department of Health and Human Services Health Resources and Services Administration (HRSA). About NHSC. 2008 [cited 10 March 2008]; Available from: <http://nhsc.bhpr.hrsa.gov/about/>
55. Woolf MA, Uchill VL, Jacoby I. Demographic factors associated with physician staffing in rural areas: the experience of the National Health Service Corps. *Med Care*. 1981 Apr;19(4):444-51.
56. Pathman DE, Konrad TR, King TS, Spaulding C, Taylor DH. Medical training debt and service commitments: the rural consequences. *J Rural Health*. 2000 Summer;16(3):264-72.
57. Reid SJ. Compulsory community service for doctors in South Africa--an evaluation of the first year. *S Afr Med J*. 2001 Apr;91(4):329-36.
58. Englander R, Carraccio C, Zalneraitis E, Sarkin R, Morgenstern B. Guiding medical students through the match: perspectives from recent graduates. *Pediatrics*. 2003 Sep;112(3 Pt 1):502-5.
59. World Bank Community-based Monitoring and Evaluation Team. *Sleeping on our own mats: an introductory guide to community-based monitoring and evaluation* Washington, D.C.: World Bank Rural Development II 2002.
60. Mason HR. Effectiveness of student aid programs tied to a service commitment. *J Med Educ*. 1971 Jul;46(7):575-83.
61. Navin TR, Nichols AW. Evaluation of the Arizona Medical Student Exchange Program. *J Med Educ*. 1977 Oct;52(10):817-23.
62. Anderson M, Rosenberg MW. Ontario's underserved area program revisited: an indirect analysis. *Soc Sci Med*. 1990;30(1):35-44.
63. Pathman DE, Konrad TR. Minority physicians serving in rural National Health Service Corps sites. *Med Care*. 1996 May;34(5):439-54.
64. Rosenblatt RA, Saunders G, Shreffler J, Pirani MJ, Larson EH, Hart LG. Beyond retention: National Health Service Corps participation and subsequent practice locations of a cohort of rural family physicians. *J Am Board Fam Pract*. 1996 Jan-Feb;9(1):23-30.
65. Cullen TJ, Hart LG, Whitcomb ME, Rosenblatt RA. The National Health Service Corps: rural physician service and retention. *J Am Board Fam Pract*. 1997 Jul-Aug;10(4):272-9.

66. Mofidi M, Konrad TR, Porterfield DS, Niska R, Wells B. Provision of care to the underserved populations by National Health Service Corps alumni dentists. *J Public Health Dent.* 2002 Spring;62(2):102-8.
67. Pathman DE, Fryer GE, Green LA, Phillips RL. Changes in age-adjusted mortality rates and disparities for rural physician shortage areas staffed by the National Health Service Corps: 1984-1998. *J Rural Health.* 2005 Summer;21(3):214-20.
68. Pathman DE, Fryer GE, Jr., Phillips RL, Smucny J, Miyoshi T, Green LA. National Health Service Corps staffing and the growth of the local rural non-NHSC primary care physician workforce. *J Rural Health.* 2006 Fall;22(4):285-93.
69. Weiss LD, Wiese WH, Goodman AB. Scholarship support for Indian students in the health sciences: an alternative method to address shortages in the underserved area. *Public Health Rep.* 1980 May-Jun;95(3):243-6.
70. Lapolla M, Brandt EN, Jr., Barker A, Ryan L. State public policy: the impacts of Oklahoma's physician incentive programs. *J Okla State Med Assoc.* 2004 May;97(5):190-4.
71. Dunbabin JS, McEwin K, Cameron I. Postgraduate medical placements in rural areas: their impact on the rural medical workforce. *Rural Remote Health.* 2006 Apr-Jun;6(2):481.
72. Jackson J, Shannon CK, Pathman DE, Mason E, Nemitz JW. A comparative assessment of West Virginia's financial incentive programs for rural physicians. *J Rural Health.* 2003;19 Suppl:329-39.