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Imbalances in the health labour force: an assessment using data from three national health facility surveys

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Accurate knowledge of the characteristics of the health labour force that can affect health care production is of critical importance to health planners and policymakers. This study uses health facility survey data to examine characteristics of the primary health care labour force in Nicaragua, Tanzania and Bangladesh. The characteristics examined are those that are likely to affect service provision, including urban/rural distribution, demographic characteristics, and experience and in-service training, for three types of providers (physicians, nurses and auxiliary nurses). The profiles suggest a pattern of urban/rural imbalances in Nicaragua and Tanzania. The Bangladesh facility survey did not include hospitals, thereby making concrete conclusions on the supply and distribution of providers difficult to make. Multivariate logistic regressions are used to assess the relationship between the urban/rural placement of providers by health need, population demand and facility characteristics. Health need, as measured by child mortality rates, does not have a significant association with the placement of providers in either country, unlike population size and annual growth rates. The mean number of years providers have worked at a facility is significantly associated with a decreased likelihood of rural placement for the three types of providers in Nicaragua. The mean age and percentage of female providers at each facility has a negative association with the placement of rural providers in Tanzania. The use of health facility data to profile the health care labour force is also discussed.

Key words: health labour force, health facility survey, Bangladesh, Nicaragua, Tanzania

Introduction

Accurate knowledge of the health labour force is of critical importance to health planners and policymakers worldwide. This is because careful, informed decision-making is necessary to achieve the right balance between the supply of labour and a population's health demands. Insufficient or inaccurate information about the health labour force, for example, on the number, distribution and qualifications of providers, when combined with efforts to reduce health care spending and increase efficiency, can lead to provider shortfalls or surpluses, i.e. 'imbalances' in health care delivery (Martinez and Martineau 1998). Assessments of the health care labour force conclude that most countries of the world confront some degree of imbalance in the supply and distribution of health care providers (World Bank 1993; Chen et al. 2004; Zurn et al. 2004).

Knowledge of the labour force is also important because labour is one of the key inputs into health systems. The World Health Organization has stated that the health labour force is 'the most important of the health system's inputs', due not only to the dependence on the workforce to provide quality services, but also to the costs involved with training, employing and managing the necessary supply of labour to achieve good health care outcomes (World Health Organization 2001). The health care production function illustrates how various combinations of labour and capital, as production inputs, are combined to produce health care. According to this framework, the quantity and quality of health care that a system produces is a direct result of the particular combination of its production inputs. The production of primary health care, defined in this paper as including family planning, maternal and infant care, and/or services for sexually transmitted infections, is a particularly labour intensive activity that requires educated, trained and skilled labourers. It is therefore essential for health care planners to have information on the characteristics of the labour supply that potentially have an impact on the provision of primary health care.

The quantity of available health care providers is an important aspect of the labour force. The stock of providers is often assessed in relation to population size, typically by the number of physicians or nurses available per capita. A disequilibrium in the availability of health care providers between urban and rural areas, especially among physicians, has been noted before (Zurn et al. 2004). For example, it was found in Nicaragua that 48% of all physicians, 58% of all nurses, and 41% of all

'ancillary nurses and technicians' were employed in the capital city of Managua, where only 20% of the country's population resided (Nigenda and Machado 2000). In Bangladesh, 35% of doctors and 30% of nurses were found to be employed in one of the country's four main urban areas, which were occupied by only 15% of the country's population (Hossain and Begum 1998). Large geographic imbalances in the distribution of the health workforce favouring capital areas have also been found in Mexico, Kenya and Vietnam (Gupta et al. 2003b). An underlying assumption in these analyses is that health needs are uniform across populations, and that geographic imbalances which favour a higher density of providers in urban areas equate to inadequate health care delivery in rural areas, with the consequence of poor health outcomes for the rural populations. Though the assumption is logical, given the often worse health indicators of rural areas in comparison with urban areas, empirical analyses are lacking.

There are many other characteristics of the health labour force that could potentially affect the production of health care, such as inadequate distributions of gender, educational levels, training and experience among health care providers. For example, though women account for the majority of the health work force, physicians are mostly men, while women are overwhelmingly represented in the lower-status occupations (Gupta et al. 2003a; Zurn et al. 2004). In Bangladesh, women account for only 15.5% of all physicians, compared with 81% of all nurses (Hossain and Begum 1998). Because of the nature of primary health care services, the gender of primary care providers can have significant consequences on the health care-seeking behaviour of patients. The gender of providers can also have a major impact on available services, as was found in an analysis of the provision of reproductive health services among general practitioners in Pakistan (Khan and Hall 2004). Though the sample size was small, female practitioners were 13.2 times more likely to provide reproductive health services than were male practitioners.

The degree to which the health workforce is employed in the public sector can be an indicator of the quality and array of services that are provided, especially if the vast majority of health care is provided by the public sector in settings where health care expenditures are limited. Such is the situation for most developing countries (Zurn et al. 2002). Additionally, the distribution of occupational skill mix and provider education, training and experience are hypothesized to significantly affect health care production through the types of services that are offered, the ability of providers to incorporate state-of-the-art knowledge and skills, and the quality of services that are produced. Even providers' job satisfaction and level of motivation can have significant consequences for health care production, acting as a mediator between a provider's capability to provide efficient, quality services and the actual provision of such (Franco et al. 2002).

The first objective of this study is to profile primary health care providers in three developing countries, selected for their geographic and cultural diversity and for the availability of recent nationally representative health facility data that include a health personnel survey component. Comparisons are made on the distribution of provider characteristics that are likely to influence the production of health services, placing an emphasis on the quantity, quality and price of the health labour force. The features that affect these components include the stock of providers available and providers' experience, level of education and training, ability, motivation and incentives. Each of these features was considered for the analysis, though not all were able to be assessed due to data constraints.

The second objective of the study is to use multivariate analysis techniques to assess imbalances in the distribution of primary health care providers in Nicaragua and mainland Tanzania. This analysis reveals whether there is a significant positive or negative relationship between the deployment of rural providers and health need, as measured by child mortality rates, and health demand, as measured by population size and annual growth rates. The analysis controls for facility-level characteristics such as facility type, and provider's mean age, sex and years of experience at the facility.

Labour force profiles have previously been compiled using a number of data sources, including census, labour force surveys, occupational surveys and others (Hossain and Begum 1998; Nigenda and Machado 2000; Gupta et al. 2003a,b). The third objective of this paper is to evaluate the use of health facility data for labour force analyses by highlighting some of the benefits of using health facility surveys, as well as indicating what important information is still not being adequately collected.

Data and methods

While a large number of developing countries have implemented a Demographic and Health Survey (DHS) or Reproductive Health Survey (RHS), few have conducted a health facility survey. Among those that have, even fewer have collected data on health staff. Nicaragua, Tanzania and Bangladesh have all recently conducted nationally representative health facility surveys focusing on primary health care, either as part of a DHS or as independent surveys. The main purpose of these facility surveys was to collect information about health service provision to inform the ongoing monitoring and evaluation of national and sub-national health service goals. Each survey also included questionnaires that collected information directly from health personnel.

The Nicaragua data come from the 2001 Encuesta de Establecimientos de Salud, carried out by the Nicaraguan Ministry of Health in conjunction with the MEASURE/Evaluation project at the University of North Carolina at Chapel Hill. The survey consists of public and private facility questionnaires, a facility inventory and a health personnel questionnaire. All public health facilities in the

country were included in the survey with the exception of national specialty hospitals. All private facilities in the country (with a minimum of a clinical laboratory or pharmacy) that provide maternal and infant health care services are also included. A maximum of four personnel from each public facility was selected to complete a personnel questionnaire. The personnel selected included at least one provider from each cadre (physician, nurse, auxiliary nurse) present at the facility on the day of the survey and a fourth selected from the largest cadre, or by random in the case of ties. For details on sampling and other survey issues, see Ministerio de Salud, MINSA and MEASURE Evaluation (2002). The total number of facilities included in the survey is 1214, with 1991 health personnel interviewed.

The Tanzania data come from the 1999 Tanzania Reproductive and Child Health Facility Survey, conducted by the Tanzanian National Bureau of Statistics and MEASURE/Evaluation. The survey consists of seven survey instruments, including in addition to a facility survey, a long and short version of a health personnel questionnaire. The survey employed a sampling strategy that endeavoured to include the entire market of health service provision available for a nationally representative sample of the population (National Bureau of Statistics [Tanzania] and MEASURE Evaluation 2000). Among all physicians, nurses and aides at each facility, two staff were randomly selected from each group to complete the long version of the personnel questionnaire, while the rest completed the short version. Included were 445 facilities from the mainland, with 4704 provider interviews, and an additional 52 facilities from Zanzibar, with 520 providers.

The Bangladesh data come from the 1999–2000 Bangladesh Service Provision Assessment Survey, conducted by the National Institute of Population Research and Training, Mitra and Associates, and ORC Macro, as part of the 1999–2000 Bangladesh Demographic and Health Survey (BDHS). The Service Provision Assessment included a facility questionnaire as well as a service provider and fieldworker questionnaire. The Service Provision Assessment was implemented in each of the sampling clusters used for the BDHS, and included facilities at the Upazila and union level; none were included at the district level (Saha 2002). Although the main facility questionnaire collected information on the number of physicians, nurses and auxiliary staff available for service provision, the personnel selected for the provider questionnaire fall under different occupational categories; namely the family welfare visitors (FWV), sub-assistant community medical officers (SACMO), and NGO health personnel that were assigned to surveyed facilities. A total of 812 facilities were included in the survey, with 909 provider interviews.

Facilities were selected for this study if they offered primary health care, defined to include some aspect of reproductive health care, either family planning services, maternal and infant health care, or sexually transmitted infection (STI) services. The number of public and private facilities included in the analysis is 1207 for Nicaragua (99.4% of original sample), 474 for Tanzania (95.4%), and 772 for Bangladesh (95.1%). For the comparison, the facilities are categorized to represent four tiers of service provision: (1) hospitals, at the highest level of service provision, (2) health centres with inpatient beds, (3) health centres without inpatient beds, and (4) other. The 'other' category is intended to represent the most basic level of service provision and is comprised mostly of health posts in Nicaragua, clinics in Tanzania and rural dispensaries in Bangladesh. Unfortunately for this comparison, the highest tier of health service provision for Bangladesh, i.e. hospitals, is not officially considered to be a source of primary care, and was therefore not included in the survey.

The number of staff available for providing primary health services is taken from each country's main facility questionnaire. Hence, information on the distribution of available staff by region and facility was obtainable without the addition of the health personnel questionnaires, which enabled a comparison of the total stock of health staff. The surveys collected data on the number of staff that were regularly at the facility; in Nicaragua this included full- and part-time staff. Productivity and actual amount of time providing services could therefore vary across countries due to variations in employment status and degree of absenteeism. Since no universal system of coding was used in any of the three surveys to identify provider type, this comparison uses three broad groups of service providers that are relatively comparable across the surveys; physicians, nurses and auxiliary nurses. As noted previously, physicians and nurses in Bangladesh were not interviewed in the provider questionnaires, thus, information coming from these questionnaires is limited to the 'auxiliary nurse' category. One consequence of the lack of standardized occupational codes is that information about other service providers, especially the lesser skilled providers, is difficult to incorporate into a cross-national analysis. For example, for lack of a comparable occupational group, non-facility-based fieldworkers and health assistants in Bangladesh were not included in this analysis, though they are likely to comprise a significant portion of basic service provision, especially in rural areas. The facility and staff codes used for the present analysis along with the original codes are shown in Table 1.

Additional provider characteristics were obtained from the health personnel data. The data were weighted to account for sample design and the probability of being selected among all providers of each type in each facility. (Data issues prevented the merging of facility and personnel data for Bangladesh; as a result, interviewed personnel were given a sample weight of one.) The characteristics include provider's age, sex, whether they work at a public or private facility, the number of years working at 'this facility', whether or not in-service training has been received in family planning, and whether or not in-service training in family planning has been received within the 2 years

Table 1. Type of facility and service provider as coded for comparison and in original survey

Generated code	Code used in facility survey		
	Nicaragua[a]	Tanzania[b]	Bangladesh[c]
Facility type			
Hospital	National, departmental, private* or military* hospital	Consultant, district, regional or other hospital	NI
Health centre/beds	Health centre, private clinic*, NGO clinic*, EMP+* or private polyclinic*, with beds	Health centre or dispensary with beds	Upazila health complex, NGO health centre* or family welfare centre with beds
Health centre/no beds	Health centre, private clinic*, NGO clinic*, EMP+* or private polyclinic*, without beds	Health centre or dispensary without beds	Upazila health complex, NGO health centre* or family welfare centre without beds
Other	Health post, Casa Materna*, other	Clinic/other	Rural dispensary
Provider type[d]			
Physician	General practitioner or Ob-Gyn	Doctor, assistant medical officer, clinical officer, assistant clinical officer	Doctor or medical officer
Nurse	Nurse	Nursing officer, nurse/midwife, public health nurse B	Nurse or trained midwife
Auxiliary nurse	Auxiliary nurse	MCH aide or nurse assistant/ medical assistant	Sub-assistant community medical officer/medical assistant, medical aides, family welfare visitor

[a]Nicaragua Encuesta de Establecimientos de Salud 2001 (Ministerio de Salud, MINSA, MEASURE Evaluation 2002).
[b]Tanzania Reproductive and Child Health Facility Survey 1999 (National Bureau of Statistics [Tanzania] and MEASURE Evaluation 2000).
[c]Bangladesh Service Provision Assessment Survey, 1999–2000 (Saha 2002).
[d]The degree of similarity between provider roles and skill levels across countries has not been determined.
*Indicates private facility.
+Provisional Medical Clinic.
NI = facility not included in survey.

previous to the survey. Family planning was selected for the training variables because the topic was included in all three surveys and because the provision of family planning is an important component of primary health care. When possible, in-service training in family planning was counted only for topics specifically identified as 'family planning' in the original questionnaires. Thus, in-service training was coded 'yes' for those receiving training in 'family planning' in Nicaragua; 'basic family planning clinical skills' or 'comprehensive family planning clinical skills' in Tanzania; and 'low dose oral pill' and 'IUD insertion and family planning injectable' in Bangladesh (as no general family planning category was available).

A dichotomous variable for urban or rural location of the facility was included in the Nicaragua survey, but was constructed for both the Tanzania and Bangladesh surveys. Tanzania had a three category variable – 'urban', 'mixed' and 'rural' – that was dichotomized by combining the 'rural' and 'mixed' categories. We thus anticipate that differences in our comparisons between urban and rural areas will be somewhat diluted for Tanzania. In Bangladesh, 'Dhaka/Chittagong', 'small city' and 'town' are coded as 'urban'; 'village' and 'countryside' are coded as 'rural'.

For the multivariate analysis, the location of a provider in a rural area is predicted by recent local child mortality rates, local population size and annual growth rates. Facility characteristics are used as control variables. This analysis is conducted for Nicaragua and mainland Tanzania, as data issues precluded the inclusion of Bangladesh and Zanzibar. Mortality data come from recent DHS surveys, and are computed for the smallest administrative units for each country (municipios for Nicaragua and wards for Tanzania), then linked to each facility catchment area (National Bureau of Statistics [Tanzania] and Macro International Inc. 2000; Instituto Nacional de Estadisticas y Censos [Nicaragua] and Macro International Inc. 2002). Child mortality rates are calculated by the number of children who died at age 0–5 years out of the total number of children born within a recent 5-year period, multiplied by 100. The 5-year period is lagged by 2 years from the facility survey to adjust for an 'information effect', or the time between when staffing decisions were made and when providers were present at the facility for the survey.

Population estimates for Nicaragua come from the National Institute of Statistics and Census and are based on 1995 census data (Direccion de Estadisticas Socio-Demograficas 2001), while estimates for Tanzania come from the 1988 census (National Bureau of Statistics 1989). For Tanzania, the 1988–2002 intercensal growth rates at the regional level are used to estimate the 1997 ward population size and growth rate (National Bureau of Statistics 2003).

Results

Number and distribution of available primary health care providers

The distribution of facilities and health staff is shown in Table 2. Only Nicaragua exhibits a clear bias toward locating higher tier facilities in urban areas. In this country, hospitals and health centres are almost exclusively located in urban areas while rural areas are primarily serviced by health posts. Likewise, providers are also disproportionately located in urban areas, with about 81% of the total primary health care workforce of physicians, nurses and auxiliary nurses located in urban areas, where about 57% of the population resides. In Tanzania, the overall distribution of health care facilities appears to be more equitable, though again, the rural areas are more likely to be serviced by smaller, lower tier health facilities. This is also apparent by the much lower percentage of available health care workers in rural areas. In contrast to both these countries, the health facilities surveyed in Bangladesh are more often located in rural areas. This is possibly due to the omission of hospitals from the survey, which are not formally recognized as a source of primary care in the hierarchical Bangladeshi health care environment. As a consequence, the urban population seems to be slightly under-represented by primary health care providers in our study. The degree to which primary care is provided on an outpatient basis in hospitals, or to which private doctors or pharmacies are instead used for primary care services, would undoubtedly affect this result.

Table 2. Urban-rural distribution of population, facility type and provider type[a]

	Urban % (n)	Rural % (n)	p-value[c]	Total n
Nicaragua				
Population (millions)[b]	56.9 (3.0)	43.1 (2.3)		5.3
Facility type				
Hospital	100.0 (29)	0.0 (0)	***	29
Health centre/beds	98.8 (83)	1.2 (1)	***	84
Health centre/no beds	95.3 (261)	4.7 (13)	***	274
Other	19.9 (163)	80.1 (657)	***	820
Total	44.4 (536)	55.6 (671)		1207
Provider type				
Physician	81.6 (1701)	18.4 (383)	***	2084
Nurse	87.3 (1277)	12.7 (186)	***	1463
Auxiliary nurse	77.3 (2445)	22.7 (720)	***	3165
Total	80.8 (5423)	19.2 (1289)		6712
Tanzania				
Population (millions)[b]	34.3 (12.6)	65.7 (24.2)		36.8
Facility type				
Hospital	70.8 (68)	29.2 (28)	***	96
Health centre/beds	53.0 (44)	47.0 (39)		83
Health centre/no beds	39.3 (101)	60.7 (156)	***	257
Other	84.4 (27)	15.6 (5)	***	32
Total	51.3 (240)	48.7 (228)		468
Provider type				
Physician	76.0 (1594)	24.0 (503)	***	2097
Nurse	80.2 (3443)	19.8 (852)	***	4295
Auxiliary nurse	73.6 (4865)	26.4 (1743)	***	6608
Total	76.2 (9902)	23.8 (3098)		13 000
Bangladesh				
Population (millions)[b]	26.2 (37.6)	73.8 (105.8)		143.4
Facility type				
Hospital	NI	NI		NI
Health centre/beds	10.8 (29)	89.2 (240)	***	269
Health centre/no beds	30.5 (141)	69.5 (322)	***	463
Other	15.0 (6)	85.0 (34)		40
Total	22.8 (176)	77.2 (596)		772
Provider type				
Physician	16.8 (280)	83.2 (1384)	**	1664
Nurse	11.5 (466)	88.5 (3584)	***	4050
Auxiliary nurse	13.9 (393)	86.1 (2438)	***	2831
Total	13.3 (1139)	86.7 (7406)		8545

[a]Data from Health Facility Questionnaire of respective survey.
[b]United Nations Population Fund (2003).
[c]T-tests conducted on mean proportions of variable categories by urban/rural distribution.
**$p<0.01$; ***$p<0.001$.
NI = facility not included in survey.

Public/private sector employment

In all three countries, the majority of service providers are employed in the public sector (results not shown in tables). Specifically, the percentage of primary care physicians working in public facilities in Nicaragua is 73%, while it is even higher for nurses (83%) and auxiliary nurses (87%). The public sector is also the largest employer of the primary health care labour force in Tanzania; employing 79% of physicians, 87% of nurses and 91% of auxiliary nurses. Finally, the Bangladesh data show the highest level of government employment, with over 80% of all surveyed providers employed in the public sector; 85% of physicians, 85% of nurses and 82% of auxiliary nurses. The extent of dual public/private practice is not known. However, we can assume that to varying degrees, dual practice is common in all three of these countries (Ferrinho et al. 2004).

Staff mix

An uneven distribution of staff by urban/rural location is again apparent when considering the mean number of staff per facility, as shown in Table 3. Facilities in rural areas are shown to have fewer staff than equivalent facilities in urban areas in both Nicaragua and Tanzania. The degree to which health care facilities in Nicaragua, Tanzania and Bangladesh use auxiliary nurses as a replacement for higher-skilled staff, i.e. physicians and nurses, also varies by country. Thirty-six per cent of health posts in Nicaragua are without the presence of at least one physician or nurse, whereas in Tanzania, almost 13% of rural clinics and 9% of health centres without beds are staffed by auxiliary nurses. The practice is more common in Bangladesh, where 30% of all facilities are without a physician or nurse. However, inferences from these comparisons or recommendations on 'ideal' staffing mixes should not be made without the incorporation of information on local contextual factors, such as the required skills and roles of each type of provider, skill surpluses or shortages, population health care needs and differences in the structure of the health care system (Buchan and Dal Poz 2002).

Table 3. Mean number of primary health care providers per facility, by urban/rural distribution; number and percentage of facilities having no highly skilled staff[a]

	Urban			Rural			Facilities with no physician or nurse on staff % (n)
	Physician	Nurse	Auxiliary nurse	Physician	Nurse	Auxiliary nurse	
Nicaragua (n = 1207)							
Hospital	14.6	21.0	36.9	–	–	–	0.0 (0)
Health centre/beds	4.9	2.3	6.2	2.0	1.0	1.0	1.2 (1)
Health centre/no beds	2.7	1.4	2.3	2.0	1.1	3.9	2.6 (7)
Other	1.1	0.6	1.5	0.5	0.3	1.0	36.3 (298)
Total	3.2	2.4	4.6	0.6	0.3	1.1	25.4 (306)
Tanzania (n = 463)							
Hospital	16.6	42.4	59.7	9.1	24.0	40.8	0.0 (0)
Health centre/beds	4.4	5.2	6.6	2.1	2.0	6.8	0.0 (0)
Health centre/no beds	2.2	2.1	3.8	1.1	0.6	2.1	8.9 (22)
Other	2.4	5.2	5.6	0.4	1.4	2.4	12.9 (4)
Total	6.8	14.7	20.6	2.3	3.8	7.7	5.6 (26)
Bangladesh (n = 768)							
Hospital	NI	NI	NI	NI	NI	NI	NI
Health centre/beds	3.5	6.4	5.7	5.2	10.7	6.8	5.2 (14)
Health centre/no beds	1.2	2.1	1.6	0.4	3.1	2.4	44.0 (201)
Other	1.0	0.0	1.0	0.5	0.5	1.5	46.2 (18)
Total	1.6	2.7	2.3	2.3	6.1	4.1	30.3 (233)

[a]Data from Health Facility Questionnaire of respective survey.
NI = facility not included in survey.

Age and sex

Table 4 presents the demographic characteristics of service providers taken from the provider questionnaires. Overall, the country data show that for most provider types, younger providers are more often located in rural areas than in urban areas. The mean age of providers in Nicaragua indicates a younger workforce than in either Tanzania or Bangladesh (with the exception of NGO medical personnel in Bangladesh); with physicians having the lowest mean age among provider types. Physicians in Nicaragua are also less likely to be female in comparison with physicians in Tanzania.

Bangladesh data for physicians and nurses were not available for this comparison, whereas information on the auxiliary health staff was collected as three separate categories. These three categories, as shown in Table 4, show distinct differences within the auxiliary nurse cadre, indicating that this professional category may not be as neatly defined as those of physicians and nurses. For example, 100% of FWVs in urban areas are female, compared with only 62% of SACMOs. Also, there is a significant drop in the percentage female for rural SACMOs, whereas the NGO medical personnel show a slight increase.

Provider experience

Table 4 also shows that only Nicaragua exhibits a clear pattern of uneven urban/rural distribution by the mean number of years providers have worked in their current facility, with providers in urban areas having spent an average of twice as many years working in their current facility as providers in rural areas. Nicaraguan physicians have spent the fewest number of years at their current facility; in fact 42% in urban areas and 73% in rural areas have worked for less than 1 year at the surveyed facility (in comparison with nurses for example, where 17% of urban nurses and 54% of rural nurses have spent less than 1 year at the current facility; results not shown in table).

Recent in-service training

Results from the comparison of recent in-service training in family planning show that less than half of physicians and nurses in Nicaragua and Tanzania have received training in basic family planning service provision within the 2 years prior to the date of the survey. In fact, most providers in Tanzania report no in-service training in family planning at all: 81% of physicians, 75% of nurses and 83% of auxiliary nurses in urban areas, and in rural areas, 84% of physicians, 75% of nurses and 88% of auxiliary nurses. The largest difference between recent in-service training between urban and rural providers in either Nicaragua or Tanzania is exhibited by nurses and auxiliary nurses in Nicaragua, where rural nurses and auxiliary nurses are much more likely to have received recent training. In Bangladesh, differences among the auxiliary nursing staff are again apparent; in this case, FWVs and NGO medical personnel, the most likely to provide family planning services, are also the most likely to have received recent family planning in-service training.

Table 4. Distribution by age, sex and experience of primary health care providers by urban/rural distribution[a]

	Physician	Nurse	Auxiliary nurse		
Nicaragua (n = 1983)[b]					
Mean age					
Urban	32.3*	35.2**	35.1**		
Rural	30.3	30.9	32.7		
Percentage female					
Urban	55.3	97.3**	94.5***		
Rural	50.2	87.7	82.3		
Mean no. of years at facility					
Urban	3.6***	7.5***	9.0***		
Rural	1.6	2.6	4.7		
Mean no. having recent training					
Urban	39.9	29.8	28.8		
Rural	38.4	46.5*	50.6***		
Tanzania					
Mean age (n = 1496)[c]					
Urban	39.0	39.4	39.8**		
Rural	37.7	38.8	36.0		
Percentage female (n = 4658)					
Urban	78.0***	84.7***	85.4***		
Rural	70.5	78.5	77.2		
Mean no. of years at facility (n = 1503)[c]					
Urban	6.1	6.5	8.2		
Rural	5.2	7.7	7.6		
Mean no. having recent training (n = 4673)					
Urban	5.7	5.9	5.2		
Rural	4.7	8.5	3.8		
			Auxiliary nurse[d]		
			FWV	SACMO	NGO
Bangladesh (n = 906)					
Mean age (n = 904)	n.a.	n.a.			
Urban			41.2*	36.8	30**
Rural			39.5	37.1	27.1
Percentage female	n.a.	n.a.			
Urban			100.0	61.5***	85.6
Rural			98.3	20.0	90.7
Mean no. of years at facility	n.a.	n.a.			
Urban			3.6	1.8	3.0
Rural			5.1**	4.7**	2.2
Mean no. having recent training	n.a.	n.a.			
Urban			44.0	15.4	58.5
Rural			52.6	25.5	48.3

[a]Data from Health Provider Questionnaire of respective survey, weighted for survey design where applicable; t-tests and survey regressions used to compare mean proportions of variables by urban/rural distribution.
[b]Information collected only from providers working in public facilities.
[c]Information collected only in long version of Health Provider Questionnaire.
[d]Auxiliary nurse categories include: family welfare visitors (FWV); sub-assistant community medical officers (SACMO); NGO medical personnel (NGO).
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Multivariate results

The description of variables used for the regression analysis is shown in Table 5. The dependent variables used for the analysis are rural (vs. urban) location of physicians, nurses and auxiliary nurses. The independent variables consist of one measure of health need, i.e. the recent local child mortality rate; two measures of health demand, i.e. the recent local population size and annual growth rate; and four facility characteristics. The facility characteristics include the type of facility and the mean age, sex and years working at the facility of providers.

Table 6 presents the results of the three logistic regression analyses. As shown in the table, the direction of the relationship between provider's rural location and child mortality is usually negative in the full models, indicating that higher child mortality corresponds to a lower likelihood of a provider being placed in a rural area. Although the correlation is of borderline significance for rural nurses in Tanzania ($p = 0.08$), these relationships are otherwise not statistically significant. Health demand, as measured by local population size and annual growth rates, shows a negative and highly significant relationship with the placement of rural physicians and auxiliary

Table 5. Description of variables used for multivariate regression analyses[a]

	Nicaragua				Tanzania			
	n	Mean	SE	Min/Max	n	Mean	SE	Min/Max
Dependent variables								
Personnel type								
Rural physician	523	0.18	0.02	0–1	290	0.34	0.04	0–1
Rural nurse	380	0.13	0.02	0–1	226	0.19	0.03	0–1
Rural auxiliary nurse	984	0.25	0.02	0–1	378	0.29	0.05	0–1
Independent variables								
Child mortality (×100)[b]	1887	3.99	0.12	0–20	894	28.33	4.50	0–100
Population (0,000s)[c]	1887	20.04	2.51	0.39–94.56	894	1.71	0.10	0.34–13.33
Annual growth rate (×100)[d]	1887	2.55	0.03	0.55–4.07	894	2.43	0.05	1.4–4.8
Facility type								
Hospital	1887	0.35	0.03	0–1	894	0.75	0.02	0–1
Health centre with beds	1887	0.10	0.01	0–1	894	0.10	0.01	0–1
Health centre without beds	1887	0.27	0.02	0–1	894	0.13	0.02	0–1
Health post/dispensary	1887	0.28	0.02	0–1	894	0.02	0.01	0–1
Mean sex of providers at facility								
Female (vs. male)	1887	0.82	0.01	0–1	884	0.84	0.01	0–1
Mean age of providers at facility	1887	33.92	0.19	18–59	894	33.98	0.20	24–50
Mean no. years at facility	1887	6.43	0.18	0–25	894	7.44	0.36	0–21

[a]Weighted for survey design; public providers only.
[b]Nicaragua per municipio, 1995–1999; Tanzania per ward, 1993–1997.
[c]Nicaragua municipio population, 2000; estimated Tanzania ward population, 1997.
[d]Nicaragua municipio growth rate 2000–2001; Tanzania regional annual intercensal growth rate 1988–2002.

Table 6. Multivariate regression results of rural location of provider by child mortality, community and facility characteristics[a]

	Nicaragua			Tanzania		
	Rural physician	Rural nurse	Rural auxiliary nurse	Rural physician	Rural nurse	Rural auxiliary nurse
Simple model	β	β	β	β	β	β
Child mortality	0.05	0.09	0.06*	0.01	−0.02**	−0.02*
N	523	380	984	290	226	378
Full model						
Child mortality	0.02	−0.02	−0.01	−0.01	−0.02	−0.01
Annual growth rate	−0.56**	−0.56	−0.55**	−0.43	−0.41	−0.47**
Population size	−0.03***	−0.10	−0.15***	0.08	0.29	0.96***
Health centre with beds	−3.76***	−3.61***	−5.47***	0.95*	1.33**	0.87
Health centre without beds	−3.07***	−3.33***	−3.43***	2.27***	0.33	2.35***
Mean age of providers at facility	−0.07*	−0.05	−0.05*	−0.26***	−0.26***	−0.34***
Mean sex of providers at facility	−1.50***	−1.53*	−0.10	−5.43***	−5.88***	−4.17***
Mean no. years at facility	−0.24***	−0.34***	−0.16***	0.23***	0.17*	0.27***
n	523	380	984	286	223	375

[a]Logistic regression models run separately by provider type, weighted for survey design; public providers only.
*p < 0.05; **p < 0.01; ***p < 0.001.

nurses in Nicaragua, whereas the relationships are significant only for auxiliary nurses in Tanzania. The regression results also confirm that the placement of rural providers in Nicaragua is negatively associated with a number of facility characteristics, such as a higher mean age of providers, a higher proportion of female providers, and more years of experience working at the facility. This is especially true for physicians. In Tanzania, rural physicians are also less likely to be found in facilities with a higher mean age of providers and a higher percentage of women, though more likely to be located in facilities where providers have more years working at the facility.

Discussion

In summary of these results, we find a varied distribution of the primary health care workforce by urban/rural location, age, gender and experience, though the general findings support what has been observed in other

developing countries (Wibulpolprasert 1999; Machado and Pereira 2002). A few of the patterns are demonstrated by all three of these countries, for example, the high degree of public sector employment.

There is a clear pattern of uneven urban/rural distribution in Nicaragua, where rural areas are likely to be served by the lowest tier of service facilities and staffed with fewer health care personnel than equivalent facilities in urban areas. More than one-third of health posts, which are almost entirely located in rural areas, are without a physician or nurse. On average, providers in Nicaragua are young, especially those in the rural areas. In addition, the average rural provider has spent less than half the number of years at their current facility compared with the average urban provider. These results suggest that newly trained providers that are deployed to rural areas to fulfil mandatory service requirements return to urban areas as soon as the restrictions are lifted. Such a distribution of the health workforce is in direct contrast to Nicaragua's chronic rural poverty and related health needs. Patterns demonstrated by the multivariate analysis support this profile, indicating that the deployment of health care providers is more likely to be based on population demand rather than health need, and that rural areas are underserved by higher skilled, older, female and more experienced providers.

The characteristics of primary health care providers in Tanzania follow a somewhat similar pattern. Although a more equitable number of facilities are located in rural areas, these facilities tend to be without inpatient beds. In addition, all types of rural facilities are staffed by fewer numbers of health care providers than those in urban areas. As a consequence, like Nicaragua, the majority of physicians, nurses and auxiliary nurses are located in urban areas. Providers in rural areas also tend to be younger and are less likely to be female than their counterparts in urban areas. However, experience, as measured by the mean number of years spent at the current facility and percentage of staff with in-service training in family planning, is more similar among the staff in the urban and rural areas of this country. Overall, recent in-service training in family planning is very low for all provider cadres, irrespective of location, with less than 10% of any group having had recent comprehensive training. Health need appears to have a non-significant association with the location of providers when considered along with population demand and facility characteristics.

Without information on the full array of facilities providing primary health care services in Bangladesh, concrete conclusions about the distribution of facilities and staff between urban and rural areas are difficult to make. The majority of surveyed facilities and service providers are located in rural areas, as is the majority of the country's population. The facilities located in rural areas also have more staff per facility than do the equivalent facilities in urban areas. These results indicate a more equitable balance between health needs and the health care services at the sub-District level. However, many facilities still lack highly skilled staff, as almost half of the 463 health centres without inpatient beds are without a primary care physician or nurse. Unfortunately for this analysis, we do not have data on the age, sex and experience of physicians and nurses in Bangladesh. Instead, we were able to present a more in-depth look at the types of auxiliary providers offering facility-based primary care.

Conclusion

This analysis profiled the primary health care workforce in three developing countries by examining the characteristics that can potentially affect the production of quality health care services. The labour force was hypothesized to affect service provision through such factors as the quantity (stock, distribution) and quality (demographics, experience, training) of providers (the price of providers is also a characteristic that can influence production, but was not an indicator that was assessed by all of these surveys).

The data for the analyses came from recent nationally representative health facility surveys. A main benefit of using these facility data is that each survey collected information on providers as part of the main facility questionnaire, including the number and type of providers available to offer primary health care services. This allowed for accurate estimations of the stock of providers working in primary health care and of their distribution by occupational cadre, facility type and urban/rural area. The ability to compare provider distributions by facility type is a particular advantage of this source of data. In addition, each of these surveys collected information from a separate provider questionnaire, which added the potential for further analysis of the health labour force by demographic, training and experience indicators. The facility data were linked to DHS and census data to include indicators of health need, whereas the ability to link datasets may be something other data sources may not be able to provide. Furthermore, the three facility surveys were not limited to public facilities, or to any one type of facility, but rather, attempted to include the full array of service options available to potential users. In this area, the Bangladesh survey fell short of allowing for a complete analysis of the workforce by not including hospitals or hospital staff available for primary health care. Bangladesh also did not collect personnel information on physicians or nurses. These two issues make the cross-national comparisons problematic.

A constraint to the use of these facility surveys, other than those mentioned previously, is that although a similar format was used, the actual questionnaire content varied by country, thereby limiting the scope of comparisons that could be made across the three countries. This underscores the finding of a recent review of health facility surveys that inconsistency between surveys, and

the subsequent difficulty in making comparisons, is one of the main roadblocks to the increased use of health facility surveys as a source of data for policy making (Lindelow and Wagstaff 2003).

As a result of the differences in content, a number of informative and important provider characteristics are missing from this analysis. For example, only the Nicaragua questionnaire offered complete measures of education and experience by obtaining information on the highest level of education achieved and number of years at that level, whether currently studying, the number of years in the health service, as well as a series of questions on previous work experience and concurrent employment. In contrast, the Tanzania survey offered the largest and most specific list of in-service training categories, which can provide a more complete assessment of training needs than that presented by our selection of one category of services. Knowledge of provider incentives and motivation is also important, but is difficult to assess with data from these surveys, though each of the three surveys included at least one question that could be assessed for motivation; Nicaragua asked about type of labour contract and concurrent employment, Tanzania measured salary group, and Bangladesh assessed the supervision of job performance. In addition, Nicaragua and Bangladesh each asked providers to identify the major problems they face in performing their job, a question that could potentially provide health planners with essential information about improving the provision of health care. Such information could also be useful to assess the roots of rural to urban 'brain drain'.

These additional education, training and incentives/motivation indicators would provide valuable information to characterize the labour force, and if added to the facility survey indicators described in this paper, would present a comprehensive workforce profile. It is also recommended that future facility surveys include indicators of health service provision that could be used to assess output, or efficiency, such as those proposed by Diallo et al. (2003). These include, for example, the number of ambulatory patients seen per hour or the average number of hours spent on patient care per day or per week, among others. With such improvements to the collection of personnel data, health facility surveys can be uniquely useful sources of information for addressing many health policy issues.

References

Buchan J, Dal Poz MR. 2002. Skill mix in the health care workforce: reviewing the evidence. *Bulletin of the World Health Organization* **80**: 575–80.

Chen L, Evans T, Anand S et al. 2004. Human resources for health: overcoming the crisis. *The Lancet* **364**: 1984–90.

Diallo K, Zurn P, Gupta N, Dal Poz M. 2003. Monitoring and evaluation of human resources for health: an international perspective. *Human Resources for Health* **1**: 3.

Direccion de Estadisticas Socio-Demograficas. 2001. *Estimaciones Municipales*. Managua, Nicaragua: INEC.

Ferrinho P, Van Lerberghe W, Fronteira I, Hipolito F, Biscaia A. 2004. Dual practice in the health sector: review of the evidence. *Human Resources for Health* **2**: 14.

Franco LM, Bennett S, Kanfer R. 2002. Health sector reform and public sector health worker motivation: a conceptual framework. *Social Science and Medicine* **54**: 1255–66.

Gupta N, Diallo K, Zurn P, Dal Poz MR. 2003a. Assessing human resources for health: what can be learned from labour force surveys? *Human Resources for Health* **1**: 5.

Gupta N, Zurn P, Diallo K, Dal Poz MR. 2003b. Uses of population census data for monitoring geographical imbalances in the health workforce: snapshots from three developing countries. *International Journal for Equity in Health* **2**: 11.

Hossain B, Begum K. 1998. Survey of the existing health workforce of Ministry of Health, Bangladesh. *Human Resources for Health Development Journal* **2**: 109–16.

Instituto Nacional de Estadisticas y Censos [Nicaragua], Macro International Inc. 2002. *Encuesta Nicaraguense de Demografia y Salud, 2001*. Managua, Nicaragua and Calverton, MD: INEC and Macro International Inc.

Khan NJ, Hall SE. 2004. The determinants of reproductive health service provision by General Practitioners in Pakistan. *Health Policy and Planning* **19**: 209–17.

Lindelow M, Wagstaff A. 2003. *Health facility surveys: an introduction*. World Bank Policy Working Paper No. 2953. Washington DC: World Bank. Available at: [http://www-wds.worldbank.org/servlet/WDS_IBank_Servlet?pcont=details&eid=000094946_03012511205070].

Machado MH, Pereira S. 2002. Los recursos humanos y el sistema de salud en Brasil. *Gaceta Sanitaria* **16**: 89–93.

Martinez J, Martineau T. 1998. Rethinking human resources: an agenda for the millenium. *Health Policy and Planning* **13**: 345–58.

Ministerio de Salud, MINSA, MEASURE Evaluation. 2002. *Encuesta de Establecimientos de Salud: Nicaragua 2001*. MEASURE Evaluation Technical Report Series No. 13. Chapel Hill, NC: Carolina Population Center, University of North Carolina at Chapel Hill.

National Bureau of Statistics [Tanzania]. 1989. *1988 Population and Housing Census Data*. Available from personal communication with S Ngallaba, National Bureau of Statistics, 1999.

National Bureau of Statistics [Tanzania]. 2003. *2002 Population and Housing Census*. Dar es Salaam: National Bureau of Statistics. Available from the Tanzania National Website: [http://www.tanzania.go.tz/census/].

National Bureau of Statistics [Tanzania], Macro International Inc. 2000. *Tanzania Reproductive and Child Health Survey, 1999*. Calverton, MD: National Bureau of Statistics and Macro International Inc.

National Bureau of Statistics [Tanzania], MEASURE Evaluation. 2000. *Tanzania Reproductive and Child Health Facility Survey, 1999*. MEASURE Evaluation Technical Report Series No. 7. Chapel Hill, NC: Carolina Population Center, University of North Carolina at Chapel Hill.

Nigenda G, Machado MH. 2000. From state to market: the Nicaraguan labour market for health personnel. *Health Policy and Planning* **15**: 312–8.

Saha T. 2002. *Bangladesh Service Provision Assessment Survey 1999–2000*. Calverton, MD: National Institute of Population Research and Training (NIPORT), Mitra and Associates, and ORC Macro.

United Nations Population Fund and Population Reference Bureau. 2003. *Country Profiles for Population and Reproductive Health: Policy Developments and Indicators 2003*. New York: UNFPA. Available at: [http://www.unfpa.org/upload/lib_pub_file/200_filename_profiles2003.final.pdf].

Wibulpolprasert S. 1999. Inequitable distribution of doctors: can it be solved? *Human Resources for Health Development Journal* **1**: 2–39.

World Bank. 1993. *World Development Report 1993: Investing in health*. New York: Oxford University Press for the World Bank. Available at: [http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1993/06/01/000009265_3970716142319/Rendered/PDF/multi0page.pdf].

World Health Organization. 2001. *World Health Report 2000: Health systems – improving performance*. Geneva: World Health Organization.

Zurn P, Dal Poz M, Stilwell B, Adams O. 2002. *Imbalances in the health workforce: briefing paper*. Geneva: World Health Organization. Available at: [http://www.who.int/hrh/documents/en/imbalances_briefing.pdf].

Zurn P, Dal Poz M, Stilwell B, Adams O. 2004. Imbalance in the health workforce. *Human Resources for Health* **2**: 13.

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