AN INVESTIGATION OF INFRASTRUCTURAL FACTORS AFFECTING THE REALIZATION OF HEALTH RELATED MILLENNIUM DEVELOPMENT GOALS IN KENYA.

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ABSTRACT

Health as a key determinant of economic development has attracted global development strategies including the Millennium Development Goals (MDGs). The realization of the three health MDGs in Kenya has remained a big challenge despite various strategies and efforts. The objective of this study was to investigate the infrastructural factors that affect the realization of the MDG 4, MDG 5 and MDG 6 in Kenya. The study used annual time series data covering the period from 1980-2011 and adopted quantitative research design methodology. The study used three linear models were Child Mortality, Maternal Morality and annual Disease Burden as dependent variables were independently regressed on annual bed capacity, staffing levels and per capita expenditure on health. The findings of the study were that only annual disease burden was significantly influenced annual bed capacity, staffing levels and per capita expenditure on health. To ensure robustness of the findings, co integration tests were carried out to determine whether long term relationship existed among the variables in this model. The outcome was that no long term relationship existed hence there was no need for further analysis with error correction model. This paper has highlighted policy indications based on the findings of the empirical results. This study recommends investigations on the effects of demand-side factors.

1.0 INTRODUCTION
1.1 Background

Health enables attainment of personal efficiency, personal ambition; contributes to individuals life spans, contributes to happiness and success and ultimately improves the overall quality of life. At national level, health is one of the key determinants of economic development and poverty reduction as observed by Feranti *et al* (2008). Suhrke *et al* (2005) noted that health was included in national development strategies and policy frameworks globally and at country levels as exemplified by the poverty reduction strategy papers (PRSPs) and the Millennium Development Goals. The United Nations General Assembly, in its Millennium Summit in 2000 in acknowledging the centrality of human development, adopted the Millennium Development Goals (MDGs) Of

these goals three are related to health as a realization of the influence of health on development. Ministry of Planning [MOP] reports (2008) showed that most of the African countries through NEPAD and African Peer Review Mechanism (APRM) have made significant improvements towards realizing good health policies and governance even though the realization of the MDGs in Africa remained a challenge. UNDP (2012) noted that with the deadline for the MDGs on the horizon, progress could be reported in most areas, despite the impact of the global economic and financial crisis. According to Hetch *et al* (2010) despite this expanded attention, progress on the ground toward global health goals including those embodied in the Millennium Development Goals (MDGs) was found slow with the gap required in funding remaining large.

Schellekens, *et al*, (2007) posited, Africa suffers the biggest health burden in that with only 14% of the world's population, the continent endured 44 % of the global burden of communicable diseases, 60% of the world's malaria cases, 30% of tuberculosis cases and 60% of HIV/AIDS.   Anup (2011) attributed the poor health infrastructure to inadequate funding noting that Africa was spending 1% of total global expenditure with sub Saharan Africa spending only 0.3%.

1.2 Statement of the problem

The Government of Kenya has over time implemented several policies and strategies earmarked towards improving the healthcare systems and towards the realization of the health related MDGs. Among these includes the National guidelines for implementation of primary healthcare of 1986, Poverty Reduction Strategy of 1999, the Kenya health policy framework of 1994, the National Health Sector Strategic Plans (NHSSP) 1 and 2 of 1999-2004 and 2005-2010. The Fiscal Management Act and Medium Term Expenditure framework (MTEF) method of sector funding, the Kenya's Vision 2030, the Constitution of Kenya 2010 and the Kenya health policy 2012. Reports by United nations development group (2013) shows that Kenya still lags behind in the realization of health related MDGs. Studies by the Ministry of Planning (2007 and 2010) showed that the country was still lagging behind in its efforts towards the realization of the health related MDGs. The study also showed that although modest growth in the health sector had been achieved, access to basic healthcare and referral services remained a significant challenge. Just 48% of Kenya's population had access to basic health services within 5km. 80% of public healthcare facilities were understaffed; infrastructure and equipment were obsolete in many health facilities and availability of essential medicines and medical supplies was inconsistent;. In the study, it was also unclear the magnitude of effect which each of the identified infrastructural factors affected the realizations of MDGs. The study aimed to fulfill these concerns and to provide adequate knowledge upon which future policies could be based.

1.3 Research objective
This research seeks to identify and examine the supply-side factors that affects the realization of the health related Millennium Development Goals in Kenya.

1.4 Specific objectives

i. To examine the effects of physical infrastructure and equipments in the realization of health related MDGs in Kenya
ii. To examine the effects of medical supplies in the realization of health related MDGs in Kenya.
iii. To examine the effects of health staffing levels in the realization of health related MDGs in Kenya.

1.5 Justification of the Study

Health research has high value to any society since it provides important information about disease trends and risk factors, outcomes of treatment or public health interventions, functional abilities, patterns of care, and health care costs and use. To economists, medical research has enormous impact on productivity and can contribute greatly to the national economy as well as the individual's benefits. By examining the effects of physical infrastructure; health staffing levels and medical supplies on the realization of health related MDGs in Kenya, this study provides a framework within which the Government of Kenya could base future health policies.

1.7 Scope of the Study

This study covered the effects of supply-side factors in accessing healthcare and attainment of MDGs 4, 5 and 6 in Kenya. The researcher relied on the existing datasets acceptable for research purposes for period from 1980 to 2011.

2.1 Theoretical review

Health care, due to its high upfront costs and centrality to humankind, is often considered best left outside the domain of markets. Existence of imperfect Information where data on health outcomes, access and the effectiveness of various treatment options remains non-existent, inadequate or inappropriately risk-adjusted in most health systems. Studies on social equity and access to public utilities are fraught with theoretical and empirical questions. Mainardi (2004) observed that adequate coverage and efficiency of public health services were high priorities for sustainable growth and development but regretted that public healthcare continued to fall short of demand, and remained unevenly distributed among the population. United Nations (2010) noted that a key challenge to attainment of the MDGs was strengthening the health system by building the capacity to manage programmes and addressing critical bottlenecks, especially a shortage of skilled health workers, inadequate budget for the health sector, poor procurement and supply systems, and other critical management problems (Division of Reproductive Health, 2005).

2.2.1 Physical Infrastructure and Equipments

Mwabu (2009) identified infrastructural and facility related factors that included physical infrastructure, safe water supplies, equipments, medical and non medical supplies, transportation services and health services such as sanitation. Sunil (2011) observed sustainable operation of facilities, included buildings, medical equipment, medical Communication Information Technology

and support services with equitable access and distribution. WHO (2008) noted that the quality of healthcare depended on the quality and adequacy of physical installations and appropriateness of use. USAID (1994) added that provision of effective health services required the government to address issues of inadequate health personnel, financing, drugs, health infrastructure, inefficiency in health delivery, and inequality in delivery of healthcare.

Mwabu (2009) observed that in many sub-Saharan countries, several infrastructural factors came to play in determining access to health care. Gwatkin (2007) and Otieno (2010) noted that there was inadequate coverage in rural areas of several countries and hospitals in Sub- Saharan Africa due to lack of proper physical infrastructure, equipments and drugs.   Mwabu (2007) noted that planning in Kenya, including numbers, types of infrastructure and site selection, was resource based rather than need based with Khadhar (2011) adding that specific universally applied criteria for selection of sites for development, needed be developed to avoid many health facilities being situated in unsuitable or inaccessible locations. The poor state of healthcare facilities in Kenya was observed by TI- Kenya (2012) who noted that poor people in rural areas had only the option of treatment at primary care facilities.
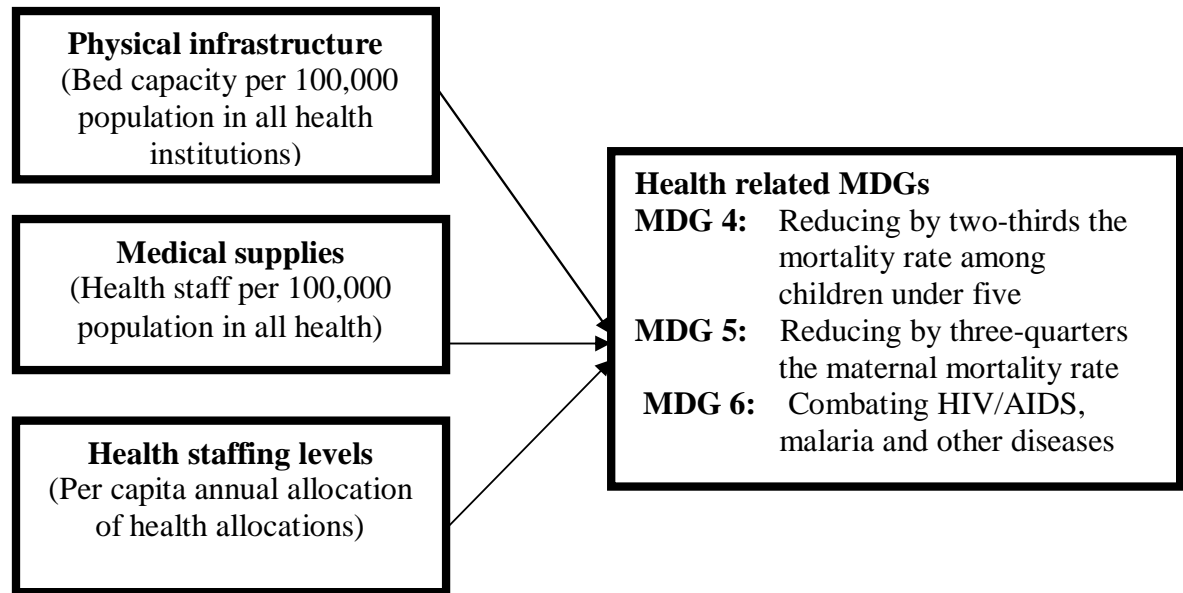
2.2.2 Health staffing levels

As observed by Hongoro, and McPake (2004), health workforce is a vital, yet historically overlooked, component of any health system. Draper *et al* (2008) further noted that because medical personnel are the key caregivers in hospitals, they could significantly influence the quality of care and treatment provided. Mullan *et al* (2010) in their study noted that Africa suffered 24% of the world's total burden of disease but had only 3% of the world's health workforce. According to Njongwe *et al* (2010) Sub-Saharan Africa had an estimated 145 000 physicians which was 5% of the 2 877 000 practicing physicians in Europe to serve a population of 821 million which was more than the population in Europe. This resulted to physician to population ratio of 18/100,000, as compared to other countries, such as India with 60/100,000, Brazil with 170/100,000 and the United States with 270/100,000. Studies by USAID and Capacity Kenya (2011) revealed that Kenya's human resources for health (HRH) was characterized by a severe shortage of health workers, with an average of 1.3 health workers per 1,000 population which was 43% below the WHO benchmark of 2.3 due.

2.2.3 Medical Supplies

Riungu (2009) noted that efficient public health supply chain performance was essential for assuring access to health supplies and for achievement of positive health outcomes. TI (2010) further noted that the failure of several public health supply chain organizations in sub-Saharan Africa could be attributed to weaknesses in their supply chain design and planning. TI (2010) observed that an acute shortage of medicines and other essential supplies in public hospitals was creating a trail of misery for patients across Sub Saharan region. he Kenya health policy framework of 1994 identified drugs and pharmaceutical supplies as the most critical area requiring policy reforms. MOMS (2008) in its strategic plan noted harmonization and standardization of all the specifications for procurement of medical equipments as crucial to ensure quality service delivery with adequate technical skills for routine maintenance.

2.4 Conceptual framework

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┌─────────────────────────┐
│  Physical infrastructure│
│ (Bed capacity per 100,000│
│  population in all health│──────┐
│      institutions)      │      │
└─────────────────────────┘      │        ┌──────────────────────────────┐
                                 │        │ Health related MDGs          │
┌─────────────────────────┐      ▼        │ MDG 4:  Reducing by two-thirds the│
│    Medical supplies     │               │         mortality rate among │
│ (Health staff per 100,000│──────────────▶│         children under five  │
│  population in all health)│              │ MDG 5:  Reducing by three-quarters│
└─────────────────────────┘      ▲        │         the maternal mortality rate│
                                 │        │ MDG 6:  Combating HIV/AIDS,  │
┌─────────────────────────┐      │        │         malaria and other diseases│
│   Health staffing levels│      │        └──────────────────────────────┘
│ (Per capita annual allocation│──┘
│   of health allocations)│
└─────────────────────────┘
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2.3 Research gap.

Literature has pointed to the effect that access to healthcare is affected by a myriad of supply side factors that include infrastructural and facility, medical supplies and staffing levels. Literature has also indicated that the health related MDGs are yet to be realized considering the factors and variables in question. This study has identified individual effects of the variables under consideration but a gap exists since no study has been identified that links simultaneous effects of the factors either as pairs or as a pack.

3.2 Research Design

This study employed quantitative research methods. Smith (1988) noted that quantitative research involves counting and measuring of events and performing the statistical analysis of a body of numerical data.

3.3 Empirical Model Specifications

In our attempt to analyze the factors affecting the realization of health related millennium development goals in Kenya we formulate three empirical models with each capturing different health related dependent variable with the regressors remaining unchanged for all the models.

Specifically, we specify our models as follows:

$$LnCMR = \alpha + \beta_1 LnBEDCAP + \beta_2 LnSTAFFING + \beta_3 LnHEALTHEXP + \varepsilon_t ....\,.................\,...............(1)$$
$$LnMMR = \alpha + \beta_1 LnBEDCAP + \beta_2 LnSTAFFING + \beta_3 LnHEALTHEXP + \varepsilon_t ....\,.................\,..............(2)$$
$$LnADB = \alpha + \beta_1 LnBEDCAP + \beta_2 LnSTAFFING + \beta_3 LnHEALTHEXP + \varepsilon_t ....\,.................\,..............(3)$$

Where:

CMR   –   Is the Registered Child Mortality Rate.
MMR   –   Is the Registered Maternal Mortality rate.
ADB   –   Annual Disease Burden
BEDCAP –   Is the annual bed capacity per 100000 populations.
STAFFING – Is the total number of medical staff employed per 100000 populations.
HEALTHEXP – Is the per capita expenditure.

We use the linear in logs function to reduce disparities in variables and enables use of linear equations. Logs also enables ease of interpretation of results since parameters are interpreted as elasticities.

3.4 Sources of Data

The study utilizes secondary times series annual data for the1980 – 2011 period hence totaling to 32 data points. The data was obtained the Ministry of Health, Kenya Open Data Source, Economic abstracts and surveys published by the Kenya National Bureau of Statistics, the Kenya Health Demographic Survey of 2009 reports and the World Bank Development Indicators datasets published by the World Bank in 2012.

3.5 Data analysis

Before carrying out regressions we tested for stationarity of the variables. Further upon running the OLS we tested for co integration among the variables using the Johansen test to determine whether there is long run relationship among the variables. In addition we tested for autocorrelation and multi-collinearity among variables

4.1 Descriptive Statistics

The time series data sets for all the variables which ranged from 1980 to 2011 with 32 observations and had characteristics as summarized in table 4.1

Table 4.1: Descriptive statistics

	Mean	Median	maximum	minimum	Std. dev	skewness	Kurtosis	Jarque-Bera	Probability	observations
Child mortality rate	99.7	100.9	166.7	72.8	11.8	-0.78	2.57	1.78	0.2	32

Maternal mortality rate	427.6	419.5	501.0	360.0	38.6	0.56	2.06	1.53	0.26	32
diseases burden	1.58	1.61	2.03	1.19	0.24	-0.16	1.85	1.89	0.19	32
Bed capacity	175.5	175.5	236.0	138.0	26.2	-0.47	2.54	1.45	0.28	32
Annual health staff	172.2	165.9	267.0	119.8	40.0	0.94	3.26	4.77	0.09	32
Per capita expenditure	19.7	18.0	36.0	9.8	7.35	1.14	3.2	7.02	0.03	32

4.3 Stationarity Tests

Table 4.2: Test for Stationarity – Dickey – Fuller Test (DFT)

Variable	At Level			At 1st Difference			Order of Integration
	Constant With no Intercept no Trend			Constant With no Intercept no Trend			
	t-stat	5%	1%	t-cal	5%	1%	
LNCMR	-1.20	-2.97	-3.69	-3.37*	-2.97	-3.79	**I(1)**
LNMMR	-1.98	-2.97	-3.66	-4.42**	-2.94	-3.64	**I(1)**
LNADB	-0.64	-2.96	-3.68	-4.01**	-2.97	-3.61	**I(1)**
LNBEDCAP	0.13	-2.96	-3.68	-6.12**	-2.96	-3.69	**I(1)**
LNHEALTHEXP	-3.44	-2.96	-3.67	-8.19**	-2.99	-3.87	**I(1)**
LNSTAFFING	0.15	-2.95	-3.61	-6.06**	-2.93	-3.67	**I(1)**

Note: The 5% significant level is denoted by ** while 10% significance by *

From our all variables are integrated of order one; - I (1). This implies that all the variables become stationary upon first differencing with most of them being significant at 5 percent except child mortality rate which is significant at 10 percent. This implies that since all variable are integrated of the same order we can go ahead and regress them without necessarily having to difference them. Therefore our estimations are free from spurious regression problem as well as inconsistence problem.

4.4.1 Ordinary Least Squares Regression Results.

Summary of regression of child mortality rate, maternal mortality rate, annual disease burden rate on the beds capacity, health staffing levels and per capita expenditure:

Table 4.3 : Estimated Model 1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.62	0.82	6.82	0.00
LNBEDCAP	-0.21	0.25	-0.85	0.40
LNSTAFFING	-0.16	0.16	-1.04	0.31
LNHEALTHEXP	0.62	0.61	1.01	0.32
R-squared	0.19	Mean dependent var		4.58
Adjusted R-squared	0.10	S.D. dependent var		0.12
S.E. of regression	0.11	Akaike info criterion		-1.38
Sum squared resid	0.37	Schwarz criterion		-1.20
Log likelihood	26.10	F-statistic		2.21
Durbin-Watson stat	0.18	Prob(F-statistic)		0.11

The results for model 1 where child mortality rate is regressed on annual beds capacity, annual health staffing levels and per capita expenditure clearly imply that none of the regressors in significant in explaining the deaths for children under the age of five years. This is further supported by a very low coefficient of determination that asserts that only 19.14 percent of changes in the children mortality rate are explained by the aforementioned explanatory variables hence 80.16 percent of changes in children mortality rate are determined outside the model. This model is therefore weak and we cannot make meaningful inferences from it.

Table 4.4 : Estimated Model 2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.96	0.67	8.96	0.00
LNBEDCAP	-0.16	0.20	-0.80	0.43
LNHEALTHEXP	0.51	0.49	1.04	0.31
LNSTAFFING	0.04	0.13	0.28	0.78
R-squared	0.04	Mean dependent var		6.05
Adjusted R-squared	-0.06	S.D. dependent var		0.09
S.E. of regression	0.09	Akaike info criterion		-1.81
Sum squared resid	0.24	Schwarz criterion		-1.63
Log likelihood	32.98	F-statistic		0.43
Durbin-Watson stat	0.22	Prob(F-statistic)		0.73

The results for model two where maternal mortality rate is regressed on annual beds capacity, annual health staffing levels and per capita expenditure clearly imply that none of the regressors in significant in explaining maternal deaths as evidenced by probability values higher than 1%, 5% and 10% significance levels. The F-statistic and its respective probability value which measures the joint significance of the estimated parameters indicates that the estimated parameters are jointly insignificant in explaining maternal deaths for 2009 – 2011 period in Kenya.

Table 4.3 : Estimated Model 3

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.02	0.69	7.28	0.00
LNBEDCAP	-1.21	0.21	-5.81	0.00
LNHEALTHEXP	-0.02	0.51	-0.03	0.97
LNSTAFFING	0.33	0.13	2.51	0.02
R-squared	0.66	Mean dependent var		0.44
Adjusted R-squared	0.63	S.D. dependent var		0.16
S.E. of regression	0.06	Akaike info criterion		-1.74
Sum squared resid	0.26	Schwarz criterion		-1.55
Log likelihood	31.81	F-statistic		18.49
Durbin-Watson stat	1.98	Prob(F-statistic)		0.00

The results for model 3 in which annual death burden is regressed on annual beds capacity, annual health staffing levels and per capita expenditure presents the most reliable results as far as the factor affecting realization of millennium development goals are concerned. From the results bed capacity and number of staffs significantly impact on the annual disease burden as evidenced by their respective probability values.
According to the results a 1% increase in bed capacity reduces the annual disease burden by 1.21% holding other factors constant.

However, a 1% increase in the number of health staff leads to a 0.33% rise in the annual disease burden. This outcome in counter intuitive since increase in health staff is expected to lower the disease burden.

Model 3 posits that 66.5% of the total changes in the ADB are accounted for by bed capacity, per capita expenditure and staffing with only 33.5% being determined outside the model hence a good fit of our estimated model. The joint test statistic represented by probability of the F- statistics prove

that all the estimated parameters jointly and significantly explain the annual disease burden in Kenya since the p- value of the F- statistics is less than 5 percent.

4.4.2: Cointegration test

We further subject model 3 to cointegration tested to find out whether there exists a long run relationship among the variables and whether there was need to run the error correction model. We therefore carried out the Johansen Cointegration test to determine as to whether the variables are cointegrated or not. Both the trace statistics and the maximum Eigen value statistics imply that there is no cointegration among the variables hence no need to run the error correction model since all the p - values for all the variables are greater than 5 % and 10% significance levels. We can therefore report on the model three which give us the most valid results

The Johansen test results are presented in table 4.4.

Table 4.6 : Johansen Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.43	34.81	47.863	0.46
At most 1	0.31	17.74	29.80	0.59
At most 2	0.18	6.66	15.49	0.62
At most 3	0.03	0.88	3.84	0.35

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.43	17.07	27.58	0.57
At most 1	0.31	11.08	21.13	0.64
At most 2	0.18	5.78	14.26	0.64
At most 3	0.03	0.88	3.84	0.35

5.1 CONCLUSIONS

5.1.1 The effects of physical infrastructure in the realization of health related MDGs in Kenya

Physical infrastructure was found to have mixed effects on the child mortality rate, maternal mortality and annual disease burden though the significant effect was found on the annual disease burden. The effect on the number of staff employed was negative but insignificant.

5.1.2 To examine the effects of medical supplies in the realization of health related MDGs in Kenya.

Per capita expenditure on health care services was found to insignificantly influence all the regressors; - child mortality rate, maternal mortality rate and the annual disease burden. The study revealed positive relationship between Per capita expenditure and child mortality rate, maternal mortality rate with a positive relationship with the annual disease burden.

5.1.3 To examine the effects of health staffing levels in the realization of health related MDGs in Kenya.

Staffing level was found to be negatively related to child mortality rate although insignificant. However, the effect on maternal mortality rate was positive but insignificant too with the effect on the annual disease burden being positive and statistically significant. Therefore, the study concluded that staffing is core in reducing the annual disease burden in Kenya..

5.2 RECOMMENDATIONS

The aspirations of these MDGs have been incorporated in the health policy, new constitution promulgated in 2010 and vision 2030 for continued improvement. The nation therefore requires establishing appropriate policies that will guide investment in the health sector given that an ill-population is an unproductive population. Given that the study found the annual disease burden to be significantly influenced by independent variables, and that child mortality and maternal mortality were to some extent influenced by the independent variables, there is need to review health investment policies so as to allocate more funding to improve the physical infrastructure, staffing levels and medical supplies if at all the MDGS & other health goals will be realized. Sound policy considerations should be made to increase the allocations and to channel funds and efforts to relevant areas and in the right proportions. In this we propose that adequate allocation to expenditure directly linked to maternal and child health if any significant results are to be realized. There is also need to pay attention to technology advancement in the medical field so as to enhance staff skills. Concentration should therefore be on increasing staff productivity rather than merely increasing their numbers.

5.3 SUGGESTIONS FOR FURTHER STUDIES

This study has concentrated on the supply- side factors affecting realization of the Millennium Development Goals. There exist demand-side factors such as socio- economic, demographic and legal-political factors that affect delivery of health services. Studies on these factors are therefore highly recommended so as to give a complete picture of what policies need to be put in place for realization of health related MDGS and improved health care in general.

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