

Analysis of Health Management Information: A Decision Support Tool for the Health Sector in Jordan

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Abstract: This paper presents an analysis of Jordan's health sector requirements in terms of medical staff and health establishments. The development of medical staff and health establishments is discussed. The regression analysis tool is used to analyze present situation and to predict future requirements. The health service level in Jordan appears to compare rather acceptably with developed countries, but compares favourably with most developing countries. Projections for the year 2007 indicate the need for higher numbers of medical staff and establishments. Recommendations are given to satisfy future needs and to further bring the health service in line with developed countries.

Key Words: Health Management Information, Regression Analysis, Health Sector, Jordan

Introduction

Analytical tools are of immense importance in providing management, staff, researchers and academics with the needed information to support their activities and decision-making (Alter, Steven, 1999; Raymond and George, 2001). Health service information is vital in establishing a balance between demand and supply of medical personnel and establishments (Marion and Judith, 1999). In deciding to establish such a balance, there appears to be a need to rely on projected information (Osborn, Carol, 2000). In this paper, an analysis of Jordan's health sector requirements in terms of medical staff and health establishments is given based on the notion of regression analysis.

The data collected and analyzed covers the period from 1993 to 2001. This data is divided into two sections. First, data relating to medical personnel recorded for the period 1993 to 2001. Second, data relating to health establishments recorded for the period 1993 to 2001 (Department of Statistics, Statistical Yearbooks, 1994-2002). The two sets of data are shown in (Tables 1 and 2) respectively.

Table 1: Medical Staff for the Period 1993-2001

Year	Physicians	Dentists	Pharmacists	Nurses	Midwives
1993	7303	1371	2826	3250	780
1994	6596	1598	3026	3753	822
1995	6839	2015	3118	4304	861
1996	7320	2179	3265	4875	903
1997	7618	2253	3559	5404	976
1998	7889	2501	3600	5799	1027
1999	9686	2710	3826	6249	1096
2000	9575	2885	4329	6742	1215
2001	10627	2869	4987	7290	1291

A projection for the demand for physicians, dentists, pharmacists, nurses and midwives for the years 2002-2010 is made. As for medical establishments, a projection for the demand for health centers, maternity and childhood centers, dental clinics, pharmacies, and beds, for the years 2002-2010 is also made. The projected figures for the years 2002-2010 are shown in (Tables 3 and 4) respectively.

The satisfaction of the projected demand levels for the year 2007, as an example, will only keep Jordan at favorable levels in comparison with developing nations. However, Jordan must further improve upon those projected demand levels if it were to compare favorably with the developed nations.

The study period, 1993-2001 was decided upon for the following reasons:

1. Data after 2001 was not available at the time of preparing this study.
2. The data presented allows for the treatment of nine years for health establishments, and for medical staff, both of which are considered satisfactory for statistical analysis (Brown, 1963; Makridakis and Wheelwright, 1978).

Regression Analysis: The regression analysis was done using the software package SPSS for Windows (SPSS, 1999). A scatter diagram of the data shows the relationships between each of the medical staff and establishments with respect to time. All relationships show that a straight-line equation is the best fit for such relations. Fig. 1 shows the scatter diagram for the number of physicians and time. Table 5 gives the regression analysis treatment of such relationship. The linear equation is: $Y = -940280 + 475 X$, where -940280 is the intercept of the straight-line on the Y axis and 475 is the slope of the straight-line, which represent the amount of change of Y for each unit of X. The value .824 of "r-squared" shows that the model could be relied upon in over 82% of cases to predict the number of physicians for a certain year. The higher the value of "r-squared" the better the fit of the model. The regression analysis show that values for "r-squared" for almost all relationships are above 0.90. The regression analysis treatment was used for each of the medical staff and health establishments mentioned above.

Medical Staff: Medical staff figures analyzed are for physicians, dentists, pharmacists, nurses and midwives. The figures for nurses include both male and female nurses, as no separate figures are available.

Table 2: Health Establishments for the Period 1993-2001

Year	Centers	Maternities	Dental-Clinics	Pharmacies	Beds
1993	595	253	131	922	6130
1994	606	268	146	1042	6801
1995	620	287	166	1101	7340
1996	638	307	188	1253	7891
1997	642	316	203	1344	8129
1998	646	322	212	1442	8565
1999	647	337	226	1470	8726
2000	645	345	237	1533	8705
2001	643	351	240	1564	8982

Table 3: Forecasting Statistics for Medical Staff for period 2002 – 2010

Year	Physicians	Dentists	Pharmacists	Nurses	Midwives
2002	10536	3228	4807	7791	1315
2003	11011	3421	5046	8290	1378
2004	11486	3614	5284	8789	1442
2005	11961	3807	5522	9288	1506
2006	12436	3999	5761	9787	1569
2007	12911	4192	5999	10286	1633
2008	13386	4385	6238	10785	1697
2009	13861	4578	6476	11284	1760
2010	14336	4770	6714	11783	1824

Table 4: Forecasting Statistics for Health Establishments for Period 2002 – 2010

Year	Centers	Maternities	Dental-Clinics	Pharmacies	Beds
2002	662	371	265	1711	9633
2003	668	383	280	1794	9975
2004	675	396	294	1876	10318
2005	681	408	308	1959	10661
2006	687	420	322	2042	11004
2007	693	433	337	2125	11346
2008	699	445	351	2208	11689
2009	706	457	365	2290	12032
2010	712	469	379	2373	12375

The figures given indicate an increase in the numbers of all types of medical staff. Regression analysis shows that all relationships against time are positive and linear.

The number of physicians increased from 7303 in 1993 to 10627 in 2001: an increase of 45.5% over the 9-year period. The relationship for physicians is expressed as follows:

$$Y = -940280 + 475 X$$

Assuming 1993 as base year ($X = 0$ at 1993), the above relation can be expressed as:

$Y = 6261.7 + 475 X$, where $X = \text{year} - 1993$. This treatment is applied to all following relationships.

The number of dentists increased by 109% over the same 9-year period. The value of "r-squared" is .962 and the relationship for dentists to time is:

$$Y = 1493.6 + 192.75 X$$

The number of pharmacists increased by 2161 from 2826 in 1993 to 4987 in 2001; an increase of 76%. The value of "r-squared" is .902 and the fitted line for the number of pharmacists is given by:

$$Y = 2661.5 + 238.4 X$$

For nurses, the increase in numbers between 1993 and 2001 was 124%. The value of "r-squared" is .998 and the relationship for nurses with respect to time, is shown by the following straight-line:

$$Y = 3300 + 499 X$$

The number of midwives increased by 511, which represents a 65.5% increase over the same 9-year period. The value of "r-squared" is .971 and the straight-line equation for midwives is expressed as:

$$Y = 724.3 + 63.6 X$$

Medical Establishments: As can be seen from (Table 2), the number of health establishments in Jordan has increased over the period from 1993 to 2001. The table shows a small increase of 8% in the number of health centers. The value of "r-squared" is .757 and the fitted curve of health centers is expressed by the following straight-line equation:

Sadeq Al-Hamouz et al.,: Analysis of Health Management Information

Table 5: Regression Analysis for Physicians for the Period 1993-2001

Descriptive Statistics

	Mean	Std. Deviation	N
PHYSICIA Physician	8161.44	1432.45	9
YEAR	1997.00	2.74	9

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.908 ^a	.824	.799	641.61

a. Predictors: (Constant), YEAR

b. Dependent Variable: PHYSICIA Physician

ANOVA^b

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	13533700	1	13533700.27	32.875	.001 ^a
	Residual	2881662	7	411665.994		
	Total	16415362	8			

a. Predictors: (Constant), YEAR

b. Dependent Variable: PHYSICIA Physician

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-940280	165415.2		-5.684	.001
	YEAR	474.933	82.832	.908	5.734	.001

a. Dependent Variable: PHYSICIA Physician

Casewise Diagnostics^a

Case Number	Std. Residual	PHYSICIA Physician	Predicted Value	Residual
1	1.623	7303	6261.71	1041.29
2	-.219	6596	6736.64	-140.64
3	-.581	6839	7211.58	-372.58
4	-.571	7320	7686.51	-366.51
5	-.847	7618	8161.44	-543.44
6	-1.165	7889	8636.38	-747.38
7	.896	9686	9111.31	574.69
8	-.018	9575	9586.24	-11.24
9	.882	10627	10061.18	565.82

a. Dependent Variable: PHYSICIA Physician

$$Y = 606.6 + 6.2 X$$

As for the maternity and childhood centers, the percentage increase over the 9-year period is 39. The value of "r-squared" is .969 and the maternity and childhood centers relationship is given as:

$$Y = 260.4 + 12.3 X$$

The number of dental clinics has increased by 83% over the period from 1993 to 2001. The value of "r-squared" is .971 and the straight-line equation for dental clinics relation is shown as:

$$Y = 965.6 + 14.2 X$$

The number of pharmacies increased by around 70% over the same period. The value of "r-squared" is .965 and the pharmacies regression equation is:

$$Y = -164055 + 82.8 X$$

The number of available beds is an important health indicator. This number increased by 46.5% over the period from 1993 to 2001. The value of "r-squared" is .922 and the number of beds straight-line relation is:

$$Y = 6547.7 + 342.8 X$$

Health Service Demand in the Year 2007: In order to establish health service demands for the year 2007 (as an example), the population of Jordan for that year has to be estimated. The following is used to calculate Jordan's population in year 2007:

$$P_{2007} = P_{2001} (1 + G)^6$$

Where:

P_{2007} = estimated population in the year 2007.

P_{2001} = population in the year 2001.

G = growth rate.

The population of Jordan for the year 2001 was estimated at 5,182,000 and the annual rate of growth of the Jordanian population in 2001 was 2.8% (Department of Statistics, Statistical Yearbooks, 1994-2002; United Nations, 2001). It is assumed that this growth rate will remain constant during the period 2001 - 2007. Using the above equation yields an estimated population of 6,114,760 for the year 2007.

Two major health indicators that are used worldwide to analyze future health demands are population per physician and population per bed. By using the projected figures for physicians and beds for the year 2007 shown in (Table 3 and 4), we can calculate the figures for population per physician and population per bed for the year 2007. Population per physician and population per bed for Jordan for years 1985, 1992, 1996, 2001 and 2007 are given in Table 6.

Table 6: Population Per Physician and Population Per bed for Jordan for Years 1985, 1992, 1996, 2001, 2007

Year	Population per physician	Population per bed
1985	837	514
1992	573	642
1996	607	563
2001	488	577
2007	474	539

The figures in the table indicate an improved population per physician ratio. However, the trend for

population per bed is fluctuating, indicating the need to increase the number of beds in order to maintain a comparable level to that of 1985.

As can be seen from (Table 3), the demand for physicians in the year 2007 is 12910. As the figure for 2001 is 10627, a new demand of 2283 physicians is needed over a 9- year period. This averages 254 per year. If it is assumed that a constant turnover rate of 10% is applied to both new recruits and the original population of physicians, then during 2002, the average annual turnover will be 1088. Therefore, demand in 2002 becomes 254 + 1088 = 1342 physicians. In order to satisfy this new demand a need arises to recruit physicians both locally and from abroad.

Graduates from medical schools in Jordan for 2001 totaled 149 (Ministry of Higher Education and Scientific Research, 2002 and Ministry of Higher Education and Scientific Research, 2002). This figure includes both Jordanian and non-Jordanian students. As for Jordanian medical students studying abroad, their number totaled 389 for the year 2000-2001 (Ministry of Higher Education and Scientific Research, 2002 and Ministry of Higher Education and Scientific Research, 2002). This will give an average of 65 graduates per year assuming a six-year period for earning the first university degree. If it is assumed that all graduates (local and from abroad) are recruited to work in Jordan, this will give a total number of 214 physicians every year. This is well below the projected yearly demand of 1342.

Level of Health Service: In order to establish the level of health service in Jordan in comparison to other countries, two major indicators are used. Those indicators are population per physician and population per bed. Table 7 shows population per physician and population per bed for some selected countries including Jordan (Economic and Social Commission for Western Asia, 2000; Ministry of Health, Annual Statistical Books, 1993-2001; Ministry of Health, 2002; World Health Organization, 2001 and The World Bank Group, 2001).

Table 7: Population Per Physician and Population Per Bed for Selected

Country	Pop / Phys (Year)	Pop / Bed (Year)
Argentina	370 (1998)	303 (1998)
Australia	400 (1999)	118 (1999)
Canada	476 (1999)	238 (1999)
Egypt	625 (1999)	476 (1999)
France	333 (1999)	118 (1999)
India	5000 (1992)	1429 (1993)
Japan	525 (2000)	61 (2000)
Jordan	488 (2001)	577 (2001)
Kuwait	526 (1999)	357 (1999)
Morocco	2500 (1998)	1000 (1998)
Peru	1111 (1998)	667 (1998)
Saudi Arabia	588 (1999)	435 (1999)
Switzerland	526 (2000)	55 (2000)
Syria	769 (1999)	714 (1999)
Thailand	2500 (1997)	500 (1997)
Tunisia	1428 (1998)	588 (1998)
United Arab Emirates	556 (1999)	385 (1999)
United Kingdom	588 (1999)	238 (1999)
USA	370 (1998)	270 (1998)

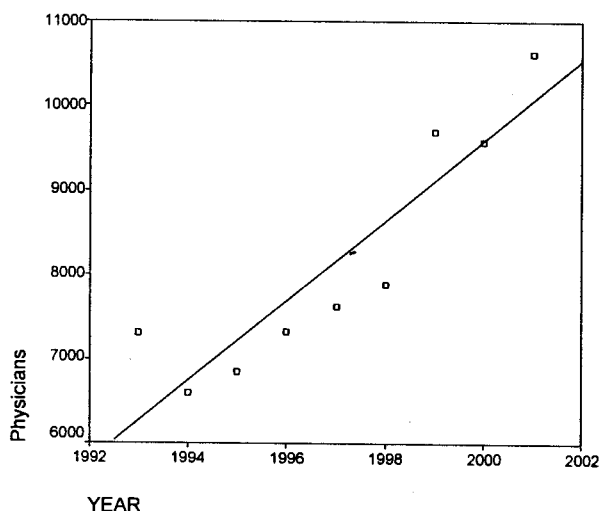


Fig. 1: Number of Physicians for the Period 1993-2001

Conclusion

Analysis of Jordan's health sector requirements in terms of medical staff and health establishments for the health sector based on the notion of regression analysis is presented. This aims at providing decision makers with the needed forecast information to help them plan for a better health service. The main findings of this study indicate that the level of health service in Jordan compares favorably with developing countries, but lags behind in comparison to developed countries especially in terms of population per bed. Also, it is seen from the regression analysis of data that a simple linear regression model is the best fit for all types of medical staff and health establishments. However, in order to raise the level of health service to the levels enjoyed by developed countries, much has to be done in terms of increasing the numbers of physicians and other medical staff as well as significantly increasing the number of beds. Although new demand for physicians can partly be met by recruiting local medical graduates and Jordanian medical graduates from abroad, this is not sufficient to meet the overall demand. It is recommended here that more places are made available at existing medical schools and more schools are opened at universities that do not have medical schools.

More importantly, the figures for population per bed indicate serious decline in that the increase in the number of beds is not in line with the increase in population. It is recommended here that more investment is made to increase the number of beds in existing hospitals and increase the number of hospitals. This increase should be far higher than the projected figure given for the year 2007 so as to at least compare favorably with those of the developed nations.

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