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Predicting Future Health Demands in United Arab Emirates

Ghassan Al-Utaibi, Ahmad Albloush*, Sadi Taha,
Abdelrahim Nassoura, Omar Albasheer, Najeb Masoud and
Mona Awwad Mohamed

Abstract--- *This research suggests an information system for improving the health sector in United Arab Emirates (UAE). A structure for the information system is proposed using regression analysis. Projections for the year 2028 highlight the need for further improvement of health care services in the UAE. This article highlights aspects aiming to improve health care and it suggests significant actions that could be implemented in the context of the UAE health sector. This study is valuable because it could inspire researchers, practitioners, and policymakers to expand and initiate innovative interventions in the health sector in the UAE*.

Keywords--- *UAE, Regression Analysis, Health Sector, Decision Makers*.

I. INTRODUCTION

Providing management, staff, practitioners, researchers and academics with the needed information can be achieved through important tools such information systems. Such information is required to develop strategic plans and support corrective actions and decision making.

Health service information plays a key role in creating a balance between demand and supply of medical personnel and establishments. One achieving such balance, there seems to be a need to depend on projected information. According to Koornneef, Robben, and Blair (2017), the United Arab Emirates has passed through the epidemiological transition with impressive reductions in health loss from infections and neonatal and nutritional disorders, non-communicable disease (NCD) notably cardiovascular disease (CVD), diabetes and road injury. During the past ten years, the (UAE) government has been implementing a comprehensive reformation aiming to build a world class health system and to ensure high quality of healthcare for its population. Some studies investigated the nature and success of these reforms, but these studies did not predict and suggest projections to improve the health care for the year 2028. In this paper, a suggested information system for improving the health sector is presented using regression analysis (Haag, and Cummings 2010). In this field, Al-Utaibi (2013) study shows that the level of health service in Jordan compares favorably with developing countries. 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 (Al-Utaibi, 2013). Therefore, this study aims to provide decision maker with the needed forecast information to help them plan for a better health service in the UAE.

Ghassan Al-Utaibi, School of Business Administration, AlDar University College, Dubai, United Arab Emirates.
Ahmad Albloush, School of Business Administration, AlDar University College, Dubai, United Arab Emirates.*
E-mail: ahmad.bloush@aldar.ac.ae
Sadi Taha, School of Business Administration, AlDar University College, Dubai, United Arab Emirates.
Abdelrahim Nassoura, School of Business Administration, AlDar University College, Dubai, United Arab Emirates.
Omar Albasheer, School of Business Administration, AlDar University College, Dubai, United Arab Emirates.
Najeb Masoud, School of Business Administration, AlDar University College, Dubai, United Arab Emirates.
Mona Awwad Mohamed, School of Arts and Social Science, AlDar University College, Dubai, United Arab Emirates.

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The data was collected and analyzed through the period 2012 to 2020. The data was consisted of two parts; the first belonged to medical personnel and the second belonged to health establishments. Both of two parts were recorded from Ministry of Health, United Arab Emirates (UAE) (Ministry of Health, 2020) shown in (Table 1& 2).

Table 1: Medical Staff for the Period 2012-2020

Year	*No of Physicians*	*No of Dentists*	*No of Pharmacists*	*No of Nurses and midwives*
2012	2075	950	2850	3292
2013	2144	981	2855	3305
2014	2212	905	2924	3360
2015	2263	965	2984	3428
2016	2309	1025	3044	3497
2017	2566	1207	3009	3759
2018	3206	1503	3415	4785
2019	3300	1550	3487	4321
2020	3366	1581	2556	4407

Table 2: Health Establishments for the Period 2012-2020

Year	*No of Hospitals*	*No of Health Centers*	*No of Maternity Clinics*	*No of Dental Clinics*	*No of Hospital Beds*
2012	18	65	70	69	1950
2013	18	65	70	69	1975
2014	18	68	73	69	2025
2015	18	70	74	69	2066
2016	19	71	76	78	2276
2017	17	74	77	79	2034
2018	17	77	80	80	2526
2019	17	77	80	80	2526
2020	17	77	80	80	2526

The satisfaction of the levels of projected demand levels for the year 2020 would make UAE to be at promising levels comparing with developing nations. Nevertheless, UAE should do further enhancements concerning those projected demand levels in order to be equal with the developed nations.

II. REGRESSION ANALYSIS

The regression analysis was done by using the software package SPSS.20. A scatter diagram of the data shows the relationships between each of the medical staff and establishments with respect to time.

2.1 Medical Staff

Table 3 declares the results of simple linear regression for predicting the numbers medical staff for the period 2012 – 2020. The relationships are assumed to be linear with time. The values of R^2 (called the coefficient of determination) considered as one basic and major aspect to describe the goodness of the predictor variables to predict a dependent one, the value expresses how much do the predictors explain the variability that could be noticed in the dependent variable (numbers of Physicians, Dentists, Pharmacists and Nurses and midwives). This value ranges between zero and one (0 – 1) so the closer the value to one the better the model is. According to the mentioned R^2 values, it can be seen that the value reported by the No. of Pharmacists (0.076) was very small while the other values are considered to be high. On the other hand, the statistical model's significance is determined by

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the significance value of f test (one way ANOVA) such that the Sig value is compared to the 0.05 level ; if the Sig value was less than 0.05 the model is considered to be statistically significant accordingly only one sig value was > 0.05 pertaining the prediction of the No of Pharmacists; telling that the model is not accepted from the statistical point while the other three sig values were less than 0.05 suggesting statistical significance.

Table 3: Linear Regression for Medical Staff for the Period 2012 – 2020

Dependent variables	***Model fitting indicators***			***Coefficients***			
	R^2	***f***	***Sig f***	***B***	***t***	***Sig***	***Constant***
No of Physicians	0.873	48.02	0.000	182. 050	6.94	0.000	- 364408.244
No of Dentists	0.836	35.69	0.001	94.483	5.96	0.001	- 189293.178
No of Pharmacists	0.076	0.57	0.474	28.783	0.75	0.474	- 55013.422
No of Nurses and midwives	0.750	21.01	0.003	178.150	4.58	0.003	- 355355.511

Table 3 provides the impact values expressed by the B coefficients which represents the coefficients that multiplied by the independent variable and adding the outcome to the value presented by the last column in the table (constant) which reflects the (intercept of the straight line on the y axis)

The coefficients are used to form a linear equation as the following:

No of Physicians = 182. 050 (X) - 364408.244

No of Dentists = 94.483 (X) - 189293.178

No of Pharmacists = 28.783 (X) - 55013.422

No of Nurses and midwives = 178.150 (X) - 355355.511

Based on the equation above, the forecasting statistics for medical staff (No. of physicians, Dentists, Pharmacists, and Nurses and midwives) for the period of 2021 – 2028 are as in table 4.

Table 4: Forecasting Statistics for Medical Staff for the Period 2021-2028

Year	***Physicians***	***Dentists***	***Pharmacists***	***Nurses and Midwives***
2021	3515	1657	3157	4686
2022	3697	1751	3186	4864
2023	3879	1846	3215	5042
2024	4061	1940	3243	5220
2025	4243	2035	3272	5398
2026	4425	2129	3301	5576
2027	4607	2224	3330	5755
2028	4789	2318	3359	5933

2.2 Medical Establishments

Table 5 declare the results of simple linear regression for predicting the numbers of medical establishments for the period of 2021 – 2028. The relationships are assumed to be linear with time. The values of R^2 (called the coefficient of determination) considered as one basic and major aspect to describe the goodness of the predictor variables to predict a dependent one, the value expresses how much do the predictors explain the variability that could be observed in the dependent variable (numbers of Hospitals, Health Centers, Maternity Clinics, Maternity Clinics and Hospital Beds). Generally, this value ranges between zero and one (0 – 1) so the closer the value to one the better the predictors explain the variability in the dependent variable. According to the mentioned R^2 values it

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can be seen that the value reported by the No. of hospitals (0.417) was the smallest being reported while the other values are considered to be high. On the other hand the statistical model's significance is determined by the significance value of f test (one way ANOVA) such that the sig value is compared to the 0.05 level ; if the sig value was less than 0.05 the model is considered to be statistically significant accordingly only one sig value was > 0.05 pertaining the prediction of the No of hospitals; telling that the model is not accepted from the statistical point while the other sig values were less than 0.05 suggesting statistical significance.

Table 5: Linear Regression for Health Establishments for the Period 2012 – 2020

Dependent	R^2	*f*	*Sig f*	*B*	*t*	*Sig t*	*Constant*
No of Hospitals	0.417	5.00	0.060	- 0.167	- 2.23	0.060	353.667
No of Health Centers	0.954	146.37	0.000	1.767	12.09	0.000	- 3490.044
No of Maternity Clinics	0.954	145.42	0.000	1.450	12.05	0.000	- 2847.644
No of Dental Clinics	0.813	30.43	0.001	1.817	5.51	0.001	- 3587.622
No of Hospital Beds	0.789	26.20	0.001	82.117	5.11	0.001	- 163335.64

Table 5 provides the impact values expressed by the B coefficients which represents the coefficients that multiplied by the independent variable and adding the outcome to the value presented by the last column in the table (constant) which reflects the (intercept of the straight line on the y axis).

The coefficients are used to form a linear equation as the following:

No of hospitals = - 0.167 (X) + 353.667

No of Health Centers = 1.767 (X) - 3490.044

No of Maternity Clinics = 1.450 (X) - 2847.644

No of Nurses and midwives = 178.150 (X) - 355355.511

No of Pharmacists = 28.783 (X) - 55013.422

Based on the equation above, the forecasting statistics for health establishments for the period of 2021 – 2028 are as in table 6

Table 6: Forecasting Statistics for Health Establishments for the Period 2021-2028

Year	*No of Hospitals*	*No of Health Centers*	*No of Maternity Clinics*	*No of Dental Clinics*	*No of Hospital Beds*
2021	16	81	83	85	2623
2022	16	83	84	86	2705
2023	16	85	86	88	2787
2024	16	86	87	90	2869
2025	15	88	89	92	2951
2026	15	90	90	94	3033
2027	15	92	92	95	3116
2028	15	93	93	97	3198

III. HEALTH SERVICE DEMAND IN THE YEAR 2028

In order to establish health service demands for the year 2028, the population of UAE for that year has to be estimated. The following equation is used to calculate UAE population in the year 2028: $P2028 = P2020 (1 + G)^8$

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Where: P2028 = estimated population in the year 2028. P2020 = population in the year 2020. With population growth rate is represented by G. The annual rate of growth of the UAE population in 2020 was 1.02% and the population of UAE in 2020 is 9,848,218(World Meters, 2020; Government of UAE, 2020). It is assumed that this growth rate will remain constant during the period 2020-2028. Using the above equation yields an estimated population of 10,681,114 for UAE in the year 2028. Two major health indicators which 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 2028 shown in (Tables 4 and 6), we can calculate the figures for population per physician and population per bed for the year 2028. Population per physician and population per bed for UAE for years 2014, 2016, 2020 and 2028 are given in Table 7.

Table 7: Population per Physician and Population per Bed for UAE Years 2014, 2016, 2020 and 2028

Year	***Pop/Phys***	***Pop/Bed***
2014	4068	4444
2016	3950	4023
2020	2925	3898
2028	2230	3339

The figures in the table 7 indicate an improved population per both physician and bed ratio.

As can be seen from Table 4, the demand for physicians in the year 2028 is 4789. As the figure for 2020 is 3366, a new demand of 1423 physicians is needed over an 8 year period. This averages 178 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 2021, the average annual turnover will be 354. Therefore, demand in 2021 becomes 179 + 354 = 533 physicians. In order to satisfy this new demand, a need arises to recruit local physicians and multinational physicians.

Graduates from medical schools in UAE for 2019 total 359 (Ministry of Health, 2019). This figure includes UAE students. This will have assumed that all graduates (local) are recruited to work in UAE. This is well below the projected yearly demand of 533.

IV. CONCLUSIONS AND RECOMMENDATIONS

An information system for the health sector based on the notion of regression analysis is proposed. The aim of the system is to provide decision maker with the needed forecast information to effectively help them in setting successful plans for a better health service. The main findings of this study indicate that the current level of health service in UAE is good. In consistence with these findings, the UAE designed and implemented adequate patient empowerment strategies and reforms to achieve a world-class patient-centered health care in the country (Bodolica & Spraggon, 2019). Concerning the model's effectiveness, it can be concluded 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 in the UAE, much has to be done in terms of increasing the numbers of physicians and other medical staff as well as increasing the number of beds in hospitals. As well as, the new demand for physicians can be met by recruiting local medical graduates to meet the overall demand. To bring UAE in line with developed nations, it is recommended that more investments should be made in order to increase the number of beds in existing hospitals and to increase the number of hospitals. This increase should be far higher than the

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projected figure given for the year 2028.

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