

SURGE IN BIOMEDICAL PUBLICATIONS FROM THE UNITED ARAB EMIRATES (2005–14)

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ABSTRACT

Background & Objective: Since it achieved nationhood in 1971, the United Arab Emirates (UAE) has experienced rapid growth in the development of its educational institutions and healthcare systems. The objective of this study was to investigate whether these developments had an impact on the growth of biomedical research and publications originating from the UAE.

Methods: Several online resources, such as PubMed, EMBASE, and the ISI's Web of Knowledge, were searched to obtain records related to the UAE and its biomedical research. All records were scrutinized to remove erroneous records or duplications, resulting in a total of 4,971 papers published during 2005–14.

Results: The College of Medicine and Health Sciences of the United Arab Emirates University continues to lead in biomedical publications (25% share in 2014). However, the share of its overall contribution reduced, with increased publications from newer medical schools (34% in 2014) and hospitals (28% in 2014).

Conclusion: The UAE is continuing to rapidly develop universities, hospitals, and research centers after stagnation during 1998–2004, leading to a surge in biomedical publications. These studies are starting to emerge from several newly established institutions.

Keywords: Biomedical research, United Arab Emirates, universities and medical colleges, hospitals and healthcare systems

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INTRODUCTION

Since its birth as a nation in 1971, the United Arab Emirates (UAE) has witnessed rapid expansion in numerous facets of its society, which is evidenced by significant growth of its cities, housing, infrastructure, population, and healthcare facilities. This development includes the establishment of five medical schools, of which three actively promote and practice medical research¹. Moreover, similar health science-related development has occurred in neighboring countries that form the Gulf Cooperation Council (GCC), as well as in

Turkey and Iran^{2, 3}. Several publications have described this surge in research as heralding a 'renaissance' in science and technology in the Arab world⁴. Recently, there was an additional attempt by the Obama administration in the US to bolster science and technology in the Arab world with the appointment of three science envoys to the region⁵. All these developments are expected to foster an atmosphere that encourages and supports an increase in the overall scientific productivity of the region, including the UAE.

By harnessing the discovery power of the PubMed search engine to find relevant biomedical databases maintained by the United States National Library of Medicine (NLM) and citation indexing services, such as the ISI's Web of Knowledge, it is possible to monitor growth

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in publications from particular areas of the world, as previously done for the Near East⁶⁻⁹. However, just two such studies have focused solely on detailing the growth of biomedical publications originating from the UAE^{10, 11}. Moreover, no study has focused on describing further possible growth in publications since 2005 from the UAE, despite the creation of new medical schools, research laboratories, and health-related facilities during 2005–14. Therefore, the current study was initiated to ascertain and document the institutional origins of biomedical papers published by medical schools, hospitals, dedicated research laboratories, and other institutions in the UAE during 2005–14.

METHODS

The procedures used to retrieve biomedical papers published during 2005–14 were similar to those previously employed¹¹. Literature searches were conducted using the PubMed search engine and three online citation indexing services – EMBASE, Scopus, and the ISI's Web of Knowledge – which primarily contain medical and scientific information. After the broad searches were completed, the bibliographic management tool EndNoteWeb was used to identify and remove any duplicated records. The resulting 5,056 original records were then entered into an MS Excel spreadsheet for analysis.

After their retrieval and deduping, all remaining records were scrutinized for relevance of content, publication date, confirmation of the author's location, and confirmation that the content of the article related broadly to the field of medicine. The records that were eligible for inclusion in this study were papers on clinical medicine, preclinical sciences, veterinary medicine, environmental health, allied health disciplines, and the social aspects of health sciences. The title and, if necessary, abstract were reviewed to determine a given record's pertinence to this study. In addition, only records that listed at least one author affiliated with an institution located in the UAE were included. The records

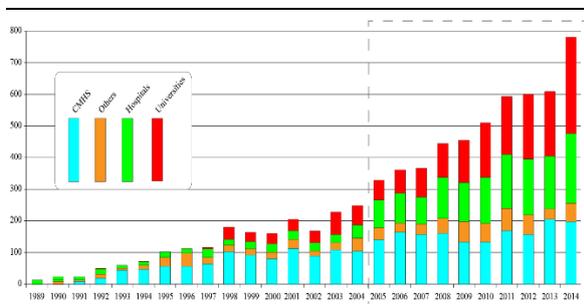
were excluded if the affiliation could not be determined or if only post office boxes had been listed as the addresses of all purported UAE authors named in the record. After the completion of this second elimination process, a total of 4,971 valid records remained to be analyzed.

One of the problems the authors faced in determining the total number of institutions, which had published biomedical literature during the period covered by the current study, was the inconsistent manner in which institutional names were identified in the records. For instance, the Sheikh Khalifa Medical City was spelled in several different ways and sometimes referred to as "Centre" instead of "City". Moreover, English translations of the Arabic name of a given institution caused frequent problems, with some including "Al" and/or a hyphen(s) in the translated name and others not. In addition, during the period covered by this study, several institutions changed their names. For example, Gulf Medical College changed its name to Gulf Medical University, Al Wasl Hospital to Latifa Hospital, and the United Arab Emirates University's Faculty of Medicine and Health Sciences to the College of Medicine and Health Sciences. Due to the multiplicity of name changes and alternate spellings, it was necessary to create a name-authority file to standardize the names of the institutions against which accurate metrics could be conducted to determine their respective published output.

RESULTS

A total of 4,971 records, obtained for the period 2005–14, were extracted and analyzed. Moreover, the number of publications increased 136% to 781 in 2014 from 330 in 2005. Of the 109 institutions that produced this output, 30 (28%) produced five or more publications during this period (Table 1). Figure 1 shows growth in biomedical publications, along with the publication data obtained from previous studies, starting from 1989^{6, 10-13}.

Figure 1. The number of biomedical publications originating from the UAE increased from 13 in 1989 to 781 in 2014. In the first 20 years, this growth was mainly led by publications from the CMHS, which has since stabilized at about 200 publications/year. In the last 10 years (dashed rectangle), the contribution from other universities and hospitals has increased.

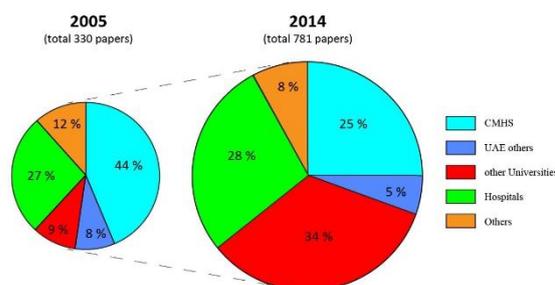


As in the previous survey, the publications were sorted according to the five categories of origin¹¹:

- The College of Medicine and Health Sciences (CMHS) of the United Arab Emirates University (UAEU);
- Other UAEU colleges;
- All other colleges and universities in the nation;
- Hospitals, health institutes, and health clinics;
- Governmental authorities, research centers, and other such institutions.

Figure 2 displays the major changes in 2005 and 2014 in these categories, and shows that the publications from other universities and colleges increased substantially during the period (up 377% from 64 to 305). However, the publications from all hospitals and other health institutions rose at a slower pace during 2005–14 (up 150% from 88 to 220), while those from the CMHS recorded only a marginal gain (up 39% from 141 to 196).

Figure 2. Pie chart of the source of papers produced in 2014 compared with that in 2005. In 2005, the CMHS produced nearly 50% of the total number of papers, but this contribution reduced to 25% in 2014. In contrast, the contribution from all other universities increased substantially in the same period from 9% to 34%.



The extracted records were further analyzed to determine those institutions that had five or more papers published during 2014. Table 1 lists these institutions, their total respective number of publications, and share of the total publications for that year. In 2014, the CMHS, with a share of 25.1%, still led in the number of published biomedical papers. Although other UAEU colleges continued to make significant contribution (5.4%), New York University Abu Dhabi (NYAD) overtook them in 2014 with a share of 6.7%. Other significant contributors were Gulf Medical University in Ajman (5.0%), the University of Sharjah (4.9%), and Masdar Institute of Science and Technology in Abu Dhabi (2.7%).

In the hospital group, Shaikh Khalifa Medical City (SKMC) was the leader with 3.3% share, followed by Cleveland Clinic (2.9%) and Rashid Hospital (2.9%). Interestingly, Tawam Hospital, which was the leading hospital in the previous period, fell to the fourth position in 2014¹¹. The contribution from the fifth category, “Others,” remained essentially the same as during 1998–2004.

Many of the listed institutions in Table 1 either did not exist 10 years ago or were only minor contributors to the total publication output from the UAE. Therefore, the 10-year growth patterns of these institutions were also examined, with the results displayed for the leading universities in Figure 3 and leading hospitals in Figure 4.

As shown in Figure 3, three educational institutions – the University of Sharjah (located in the Emirate of Sharjah), Gulf Medical University (Emirate of Ajman), and NYAD – witnessed a significant rise in the number of

publications during 2005–14, with NYAD experiencing rapid growth in biomedical publications from zero in 2009 to 52 in 2014. In addition, Zayed University, the Masdar Institute of Science and Technology, and Khalifa University were other institutions with significant contribution.

Figure 3. Graphs displaying growth in biomedical publications from six universities and institutions in the UAE during 2005–14.

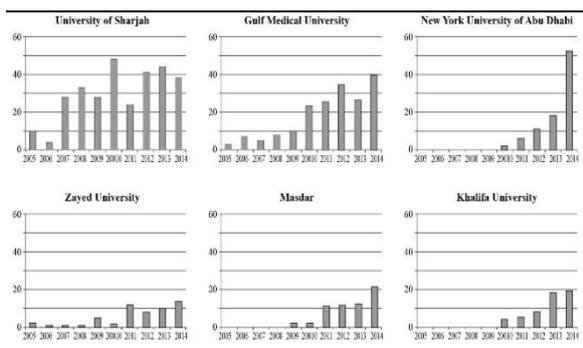
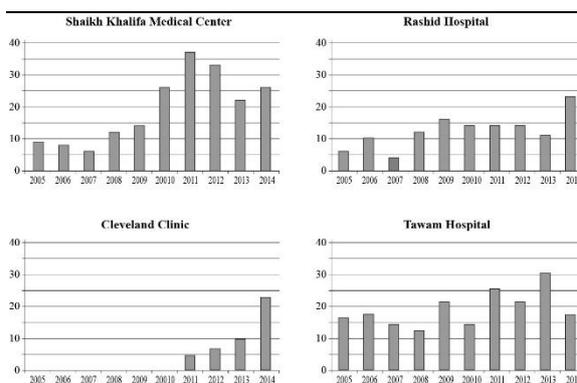


Figure 4. Graphs displaying the number of biomedical publications from four major contributing hospitals in the UAE during 2005–14.



In the hospital group (Figure 4), the Shaikh Khalifa Medical Center (Emirate of Abu Dhabi) and Cleveland Clinic (Emirate of Abu Dhabi) witnessed the highest growth in the number of publications during 2005–14, while the contribution from Rashid Hospital (Emirate of Dubai) and Tawam Hospital (Emirate of Abu Dhabi) remained relatively stable.

Table 1. List of major contributors of biomedical publications from Universities, Hospitals, and Others in 2014

Universities/Colleges	Number of publications	% of total
1 CMHS (formerly FMHS)	196	25.1%
2 New York University Abu Dhabi	52	6.7%
3 Other UAEU colleges	42	5.4%
4 Gulf Medical University	39	5.0%
5 University of Sharjah	38	4.9%
6 Masdar Institute of Science and Technology	21	2.7%
7 Khalifa University	19	2.4%
8 American University of Sharjah	15	1.9%
9 Zayed University	13	1.7%
10 Ajman University of Science & Technology	11	1.4%
11 Petroleum Institute Abu Dhabi	8	1.0%
12 Al Ain University of Science and Technology	7	0.9%
13 Dubai Pharmacy College	5	0.6%
14 Hamdan Bin Mohammed e-University	5	0.6%
15 RAK Medical and Health Sciences University	5	0.6%
16–28 12 other universities and colleges < 5	25	3.2%
Hospitals and Health Centers		
1 Shaikh Khalifa Medical City	26	3.3%
2 Cleveland Clinic	23	2.9%
3 Rashid Hospital	23	2.9%
4 Tawam Hospital	17	2.2%
5 Dubai Hospital	16	2.0%
6 Mafrqa Hospital	12	1.5%
7 Zayed Military Hospital	10	1.3%
8 Dubai Health Care City	7	0.9%
9 Al Ain Hospital	5	0.6%
10 Al Qassemi Hospital	5	0.6%
11 Burjeel Hospital	5	0.6%
12 Emirates Hospital	5	0.6%
13–57 41 other hospitals and health centers < 5	66	8.5%
Others (Authorities, Research Centers, Ministries, Police)		
1 Central Veterinary Research Laboratory, Dubai	15	1.9%
2 Dubai Health Authority	11	1.4%
3 Giome Institute, GIOME FZE, RAK	5	0.6%
4–30 26 Others < 5	29	3.7%
Total	781	100.0%

DISCUSSION

This study is a continuation of previous publications in which we reported the gradual increase in biomedical publications from the UAE and the region^{6, 10–13}. In our last study, we indicated a surge in the establishment of new research laboratories in the UAE, which could potentially lead to a “new Arabian renaissance”¹¹. In the current study, we confirm that several of these new institutions contributed to the substantial 136% increase in biomedical publications from the UAE during 2005–14.

The findings of this study are contrary to those of related articles, which claim that the number of biomedical papers from the Gulf region papers has stalled. For example, in Saudi Arabia, Tadmouri *et al.* signaled that the previous rise in biomedical publications had leveled off^{14, 15}. Similarly, a flat trend was observed in the number of publications from the UAE¹¹. However, in our last study, we found a sharp increase in the establishment of new research facilities, which contributed significantly to a surge in the number of biomedical publication output of several institutions (see Figures 3 and 4). The exception to this uptrend was a decrease in the output from the UAE’s leading research body, the CMHS of UAEU in Al Ain (Emirate of Abu Dhabi). Although the CMHS is still the most active source of biomedical publications in the country, and possibly in the Gulf region, its growth rate of 39% during 2005–14 was well below that of several newer institutions.

There could be several reasons for this slow growth in the number of biomedical papers from the CMHS, such as a limit to the number of publications that can be achieved with a given number of researchers and research laboratories, or a stagnant budget. As there is no information available regarding the number of active researchers, research laboratories, or research budget from any institution in the UAE, it is difficult to determine the limiting factors. However, if the new laboratories were to achieve the same level of productivity

achieved by the CMHS in the past three decades, it would substantially increase the overall output of the nation. As shown in Table 1, there are 79 institutions with less than five publications in the past 10 years. In other words, the UAE still has significant unused research potential.

Based on the results of this study, some institutions were found to be more productive in their research output than others; hence, it would be fair to conclude that the majority of new institutions have yet to make a noticeable impact in terms of the number of published papers. The reasons for these differences are not clear. In this context and despite some serious attempts to develop national initiatives, such as a national grants agency, there is little or no collaboration between or among the country’s medical schools. Several of these schools organize their own research days or fairs, student-led or otherwise, without involving or informing other medical schools. Thus, there is an urgent need to develop means and ways to promote research collaborations in a relatively small nation such as the UAE. One of the means to foster such development would be to develop a nationwide database of biomedical researchers, which would also promote inter-laboratory communications and collaborations. In addition, this database would be an asset for the education of students in the country, who are keen to participate in biomedical research¹⁶.

Another avenue to encourage research collaborations would be to develop Biomedical Research Open Days, which would not only open up new possibilities for researchers and students but also involve the population at large. To the best of our knowledge, there has only been one Open Day for Research at the CMHS, which was conducted in 2002.

Some countries have several initiatives to boost medical research, ranging from governmental federal grants to private initiatives, which are often focused on a particular disease or affliction such as diabetes or Alzheimer’s. In the UAE, the only example

of such a private initiative is the annual Terry Fox Run, which provides a token amount of funding for the research laboratories at the CMHS. Despite several assurances, a nationwide research agency funded and overseen by the federal government has never really materialized. The only notable exception is the Sheikh Hamdan Bin Rashid Al Maktoum Awards Center, which has been funding a medical-research grant program since 1999. The drawback of this program is that it is a bi-annual system with a two-year cycle, which is very slow if one has to compete with international colleagues.

Another key message from this study is the importance of collaboration between the UAE's medical schools and its universities. In other global regions, there is evidence of the beneficial effects that collaborations have on research productivity^{17, 18}. For example, collaborations with research groups in countries with advanced research & development (R&D) capabilities produce more high impact papers than collaborations with groups in low R&D-intensive countries¹⁸. Furthermore, collaborations at the national level have shown to boost research performance, as evidenced from the positive impact of science parks in the UK, especially if these parks include a neighboring research intensive university¹⁹. Rahman and Fukui investigated several factors that promote research productivity across several countries, and concluded that gross national product (GNP) and R&D expenditure emerged as significant factors in boosting research²⁰. In a study related to the Middle East, research productivity was found to be the highest in Israel, Iran, and Turkey, with Israel's success due in part to the high degree of collaboration it has and funding it receives from the US²¹. The high productivity of Israel, Turkey, and Iran was also linked to the presence of several top ranked universities in those countries, with Israel having seven, Turkey four, and Iran six²². Of all the other countries in the region, only Saudi Arabia has two top ranked universities.

Another limiting factor in the UAE was the shutting down of the Emirates Medical Journal (EMJ), which was the nation's premium medical publication. The EMJ, in which we also reported several of our previous studies, apparently ceased publication, as searches in the international union catalog WorldCat® failed to retrieve any evidence of an issue published after 2009. Although there has been an attempt by the Hamdan Foundation to fill this publication gap with the introduction of the Hamdan Medical Journal (HMJ), it is yet to reach the level of popularity and international recognition formerly accorded to the defunct EMJ. This limiting factor in the UAE is in contrast to the ongoing success of national medical journals published in other Gulf countries, such as Saudi Arabia (two medical journals), Oman (two), and Qatar.

In conclusion, this study shows that the individual emirates have continued to increase their publication record in the field of biomedical research. This trend was anticipated by several optimistic publications^{23, 24}. This uptrend was mainly due to the persistent work of administrators, individual researchers, and students laboring across a wide field of domains, ranging from high-tech laboratory environment to rural-type community medicine clinics. Finally, although there are indications of continuing growth in publications, there is ample scope to remove obstacles that currently and severely impede optimal growth in biomedical research in the UAE. These obstacles include, but are not limited to, complicated institutional and/or governmental procurement rules, the lack of collaboration among institutions, and lack of an overarching national health authority under which research efforts could be efficiently coordinated, promoted, and financially supported. The emergence of the occasional center of excellence in a specific field demonstrates that there are numerous opportunities for performing meaningful research in the UAE²⁵⁻²⁷. A recent report in a local newspaper describing attempts at developing collaborative efforts between universities located in Abu

Dhabi, Dubai, and Sharjah may indicate that the nation is finally opening up for further enhancement of its research efforts²⁸.

REFERENCES

1. Hamdy H, Telmesani AW, Al Wardy N, Abdel-Khalek N, Carruthers G, Hassan F et al. Undergraduate medical education in the Gulf Cooperation Council: a multi-countries study (part 1). *Med Teach*. 2010;32(3):219–24.
2. Tadmouri GO, Bissar-Tadmouri N. Biomedical publications in an unstable region: the Arab world, 1988-2002. *Lancet*. 2003;362(9397):1766.
3. Giles J. Islam and Science: oil rich, science poor. *Nature*. 2006;444(7115):28.
4. Masood E. Arab science: blooms in the desert. *Nature*. 2002;416(6877):120–2.
5. Zewail AH. Science in diplomacy. *Cell*. 2010;141(2):204–7.
6. Lammers WJ, Tahir A. Profile of medical research publications from the GCC countries, 1990-1994. *Ann Saudi Med*. 1996;16(6):666–9.
7. Deleu D, Northway MG, Hanssens Y. Geographical distribution of biomedical publications from the Gulf Corporation Council countries. *Saudi Med J*. 2001;22(1):10–2.
8. Shaban SF, Abu-Zidan FM. A quantitative analysis of medical publications from Arab countries. *Saudi Med J*. 2003;24(3):294–6.
9. Tadmouri GO. Biomedical science journals in the Arab world. *Saudi Med J*. 2004;25(10):1331–6.
10. Lammers WJEP, Gaffar MS. National and international medical publications from the United Arab Emirates (1989-1998). *Emirates Medical Journal*. 2000;18:235–8.
11. Neves K, Lammers WJ. Growth in biomedical publications and scientific institutions in the Emirates (1998-2004): an Arabian renaissance? *Health Info Libr J*. 2007;24(1):41–9.
12. Lammers WJEP, Gondek V. Medical publications from the United Arab Emirates: Emerging impact of a new school? *Emirates Medical Journal*. 1994;12:54–8.
13. Lammers WJEP, Tahir A, Garner A. Biomedical research publications from the United Arab Emirates during 1995. *Emirates Medical Journal*. 1996;14:200–2.
14. Tadmouri GO, Tadmouri NB. Biomedical research in the Kingdom of Saudi Arabia (1982-2000). *Saudi Med J*. 2002;23(1):20–4.
15. Bissar-Tadmouri N, Tadmouri GO. Bibliometric analyses of biomedical research outputs in Lebanon and the United Arab Emirates (1988-2007). *Saudi Med J*. 2009;30(1):130–9.
16. Afghan BF, Fathima B, Afghan N, Subramanya S, Lammers W. An experimental infectious diarrhoea model to assess intestinal myoelectrical activity. *Hamdan Medical Journal*. 2014;7(2):271.
17. Bordons M, Gomez I, Fernandez MT, Garcia MAZ, Mendez A. Local, domestic and international scientific collaboration in biomedical research. *Scientometrics*. 1996;37(2):279–95.
18. Bordons M, Gozalez-Albo B, Aparicio J, Moreno L. The influence of R&D intensity of countries on the impact of international collaborative research: evidence from Spain. *Scientometrics*. 2015;102(2):1385–400.
19. Minguillo D, Tijssen R, Thelwall M. Do science parks promote research and technology? A scientometric analysis of the UK. *Scientometrics*. 2015;102(1):701–25.
20. Rahman M, Fukui T. Biomedical research productivity: factors across the countries. *International Journal of Technology Assessment in Health Care*. 2003;19(1):249–52.
21. Gul S, Nisa NT, Shah TA, Gupta S, Jan A, Ahmad S. Middle East: research productivity and performance across nations. *Scientometrics*. 2015;105(2):1157–66.
22. Ranking Web of Universities [Internet] (2014). Spain: CSIC. c2014 [cited 2016 Dec 30]. Available from: http://www.webometrics.info/en/Asia_Pacific/Middel_East
23. The road to renewal: after centuries of stagnation science is making a comeback in the Islamic world. *The Economist*. 2013 Jan 26.

24. Zewail AH. Dire need for a Middle Eastern science spring. *Nat Mater.* 2014;13(4):318–20.
25. Al-Maawali A, Al Busadi A, Al-Adawi S. Biomedical publications profile and trends in Gulf Cooperation Council countries. *Sultan Qaboos Univ Med J.* 2012;12(1):41–7.
26. Sweileh WM, Zyoud SH, Al-Jabi SW, Sawalha AF. Bibliometric analysis of diabetes mellitus research output from Middle Eastern Arab countries during the period (1996-2012). *Scientometrics.* 2014;101(1):819–32.
27. Zeraatkar K, Ayatollahi H, Havlin T, Neves K, Şendir M. International Trends in Health Science Librarianship Part 18: The Middle East (Iran, Qatar and Turkey). *Health Info Libr J.* 2016;33(2):156–60.
28. Swan M. UAE universities urged to join forces. *The National.* 2015 Dec 6.