Subject and discipline-specific publication trends in South African medical research, 1996–2011

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Medical and health sciences institutions and organisations are faced with challenges in resource allocation for research and publishing. The aim of this study was to retrospectively analyse South African publication trends in medicine to provide guidance for future strategic planning in academic medicine. We used the *Scimago* database spanning the years 1996–2011 to analyse South African publication outputs in a number of categories in medicine, as defined in the *Scopus* database. The data reveal a number of significant growth areas but also reveal areas that should potentially be growing but remain static. In some areas, growth has aligned with the expectations of health and disease trends, but other areas, in which growth would have been expected, have remained static. Interesting features are also revealed when the data are compared with those of other developed and developing countries. For 1996–2011, South African medical publication output ranked 33 in the world based on the number of publications, but 28 based on the h-index. Interestingly, whilst South Africa produced less than 25% of the output of India, the h-index for South Africa is 153 compared with 145 for India. South Africa's medical publication output has steadily increased over the 14-year period but the number of citations per document has declined. This analysis provides a useful strategic overview for medical institutions and government funding organisations to guide the allocation of research budgets and resources in a discipline- or category-specific manner to influence research outputs.

Introduction

Medical and health sciences institutions and government funding organisations responsible for funding medical scholarly output are frequently faced with the challenge of resource allocation for research and publishing and for enhancing institutional productivity in research-led settings. A number of universities have developed strategies to improve international rankings. The purpose of this study was to analyse South African medical publication outputs using data available in scientific databases which hold deposits of publications. There are a number of databases holding publications in medicine, including the National Library of Medicine (*PubMed*)[1], *Google Scholar*, *Scopus* and *Web of Science.*[2] South African medical research is an important contributor to the total body of research in continental Africa, as well as internationally.

Methods

The country-specific data for South Africa were extracted from the *Scimago*[3] database and are summarised within clinical areas. For the purpose of this analysis, the data were categorised into: Basic and Preclinical Sciences, Pathology and Laboratory Medicine, Public Health and Health-care Policy, Clinical Sciences, and Pharmacology and Complementary Medicine. These categories are based on the pre-existing categories in the *Scopus* database and therefore some of the groupings are ad hoc and artificial but are arranged for the purpose of illustrating the trends. The *Scopus* database was also interrogated to analyse institution specific trends in the eight medical/health science faculties in the country.

Results

The world rankings in medical research, based on total output, are illustrated in Table 1. Over the period 1996–2011, South Africa ranked 33 with 23 000 documents compared with the USA with 1.6 million documents, ranked at 1, and the UK with 500 000 documents ranked at 2. Within the so-called BRICS group, China ranked 8 with 205 000 documents, India ranked 12 with 111 000 documents, Brazil ranked 15 with 97 000 documents and the Russian Federation ranked 38 with 18 000 documents. The number of documents includes citable and non-citable documents. South Africa produced 0.24–0.43% of the world's output in medical research in the period 1996–2011. The *Scimago* journal and country rank database[3] is derived from the *Scopus* database and uses the *Google* page rank algorithm. The h-index of each country is also shown in Table 1. The h-index measures the productivity and impact of the country and is based on the citation rate. Based on the h-index (derived from the citation rates) for medical publication outputs, South Africa ranked 28 in the world, compared with the ranking of 33 based on the total number of documents.

Table 1: Ranking of medical scholarly output for selected countries, 1996–2011

Country	World rank	Number of published documents	Citations	h-index	Rank by h-index
USA	1	1 689 512	33 558 566	857	1
UK	2	509 393	8 658 531	557	2
China	8	205 487	852 539	176	25
Australia	10	165 744	2 552 942	349	10
India	12	111 730	552 970	145	32
Brazil	15	97 913	721 441	195	20
Israel	22	55 781	855 705	241	16
New Zealand	29	28 201	426 744	200	19
Iran	28	29 681	102 118	74	53
Ireland	32	24 064	347 696	180	23
South Africa	33	23 534	279 856	153	28
Russia	38	18 286	143 379	125	37

From 1996, there has been a progressive increase in the total number of documents from South Africa as well as the total number of citable documents, with an almost quadrupling of output (Figure 1). This increase is paralleled by a twofold increase in international collaborations. However, there has also been a progressive decrease in the number of citations per document (Figure 2).

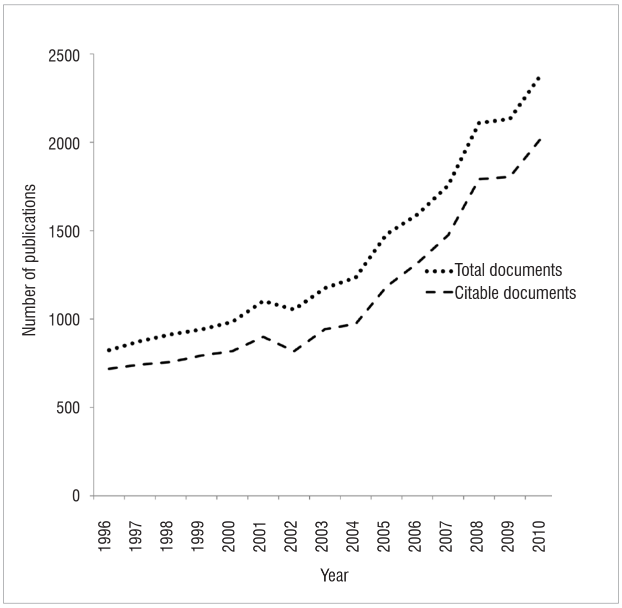


Figure 1: Growth in the total number of documents published and the total number of citable documents published on medical research in South Africa during 1996–2010.

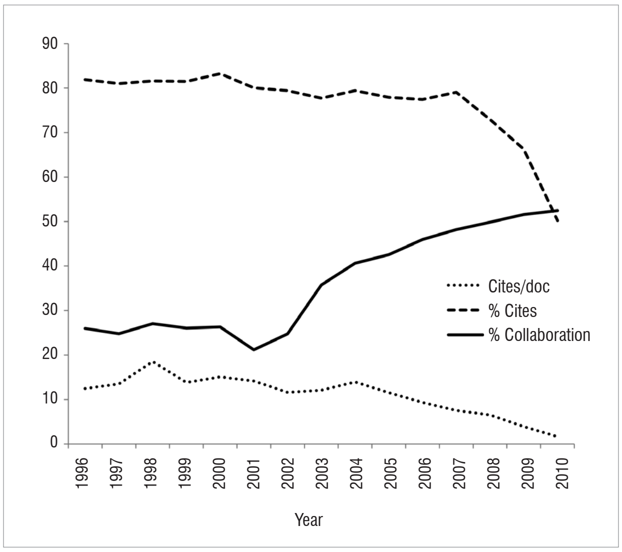


Figure 2: Changes in South African medical scholarly output – measured by the number of citations/document, percentage citations and percentage of international collaboration – during 1996–2010.

Basic and Preclinical Sciences

In the category of Basic and Preclinical Sciences (Figure 3), the area that shows the most growth is Genetics. This growth is probably the result of advances in genetic screening technology and molecular biological methods, advances in genetics, and greater accessibility of institutions to patient material and methods. Molecular medicine also shows a steady increase in the number of publications. The growth of Genetics should be contrasted with that of Clinical Genetics, which has only shown a moderate increase (Figure 4).

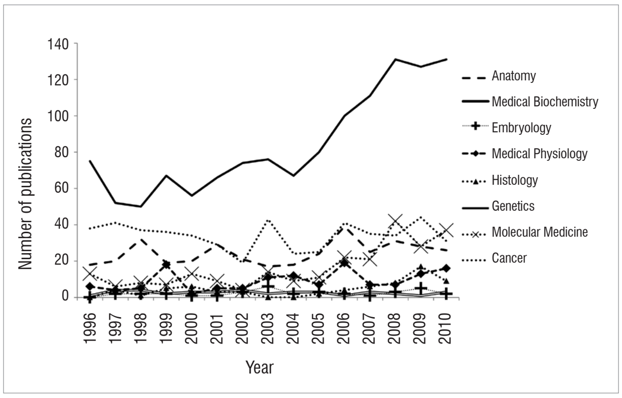


Figure 3: Number of publications from South Africa in Basic and Pre-clinical Science disciplines during 1996–2010.

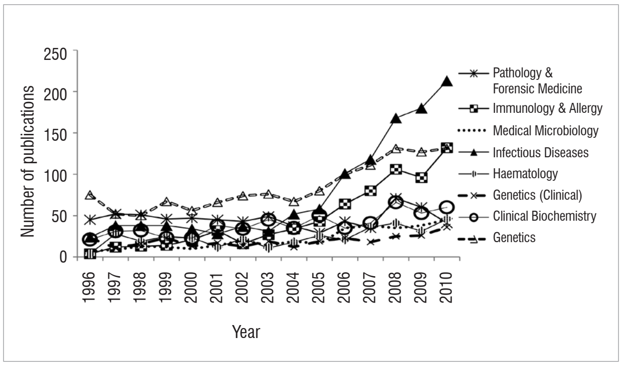


Figure 4: Number of publications from South Africa in Pathology and Laboratory Medicine disciplines during 1996–2010.

Pathology and Laboratory Medicine

Within the group of Pathology and Laboratory Medicine (Figure 4), Genetics has been grouped again, for comparison purposes, especially as Genetics in some institutions is housed within Schools of Pathology and there is substantial overlap of genetics with the traditional pathology disciplines. The rise in the number of publications in Infectious Diseases reflects the growing clinical encounters and the increasing burden of disease seen in this arena. Strikingly, this situation is not paralleled by publications originating in the discipline of Medical Microbiology. In fact, publication rates from the Pathology disciplines remain fairly static, perhaps reflecting the investment in research, in the form of either personnel or research funding, within these disciplines. Whether this change in investment is a result of the parallel restructuring of pathology services into the National Health Laboratory Services or a coincidence, is a matter for debate. However, one can argue that research investment usually produces parallel increases in productivity, in most instances. The increased burden of disease should, in theory, be paralleled by an increase in scholarly output in Pathology and Laboratory Medicine, but, as with other clinical areas, the increase in disease burden has increased the demand for service delivery and investment in research has remained proportionally static or has decreased. Comparison of Immunology with Microbiology, Parasitology and Virology reveals Immunology as a major growth area of publication outputs (Figure 5).

Public Health and Health-care Policy

With ongoing changes and developments in health policy and implementation, it is surprising that publications in Health Policy do not show dramatic increases in the 14-year period (Figure 6) compared with Public Health, Environmental and Occupational Health. Moreover, research into health policy does not require the same investment as biomedical research does. Interestingly, the number of publications in epidemiology has remained fairly static, again potentially revealing the amount of investment in academic epidemiology. Only a few institutions have departments or disciplines devoted to the study of epidemiology and it is probably assumed that epidemiology is a broadly overlapping discipline that impacts all clinical research.

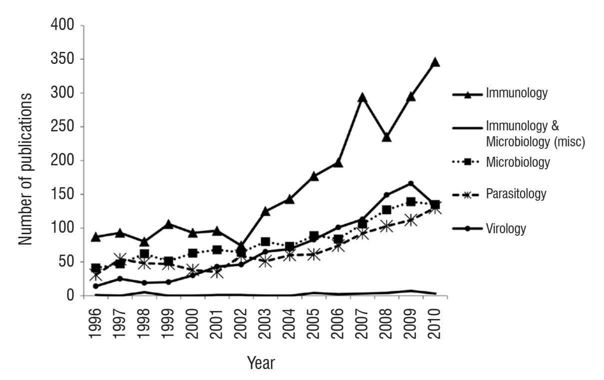


Figure 5: Number of publications from South Africa in the Microbiology/Immunology disciplines during 1996–2010.

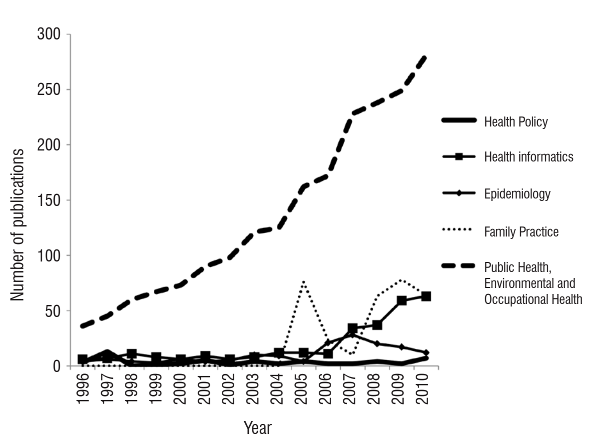


Figure 6: Number of publications from South Africa in Health Policy, Epidemiology and Public Health disciplines during 1996–2010.

Major clinical domains

Within the major clinical domains (Figures 7 and 8), the number of publications listed in the category Medicine (miscellaneous) predominates and shows a steady increase over the 14-year period. Publications in the surgical domains do not show the same increases as those disciplines in Internal Medicine.

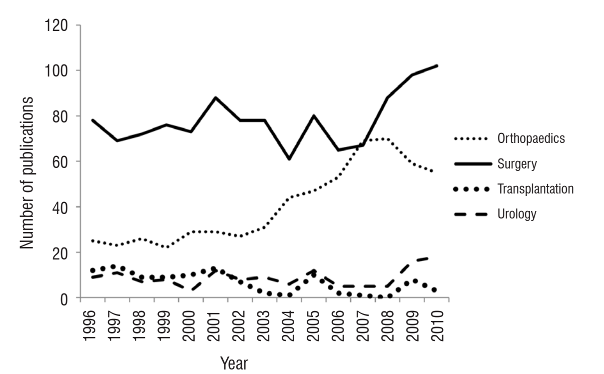


Figure 7: Number of publications from South Africa in Surgery and surgical specialties during 1996–2010.

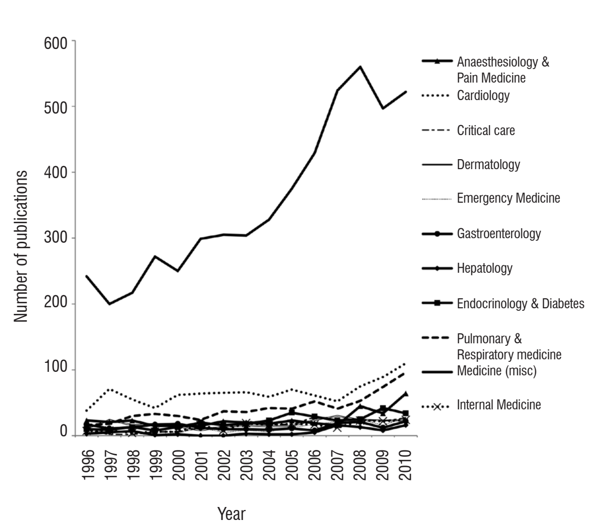


Figure 8: Number of publications from South Africa in Internal/General Medicine and its subspecialties during 1996–2010. Publication outputs in Anaesthesiology and Pain Medicine have been included for comparison.

Pharmacology and Complementary Medicine

Research publications in Complementary Medicine (Figure 9) show a dramatic and steady increase after 2005, whilst publications in Pharmacology show a less dramatic, but nevertheless constant, increase after 2002. This change reflects an investment and expansion of research activity in Complementary Medicine across a number of institutions as well as from the Department of Science and Technology, the Department of Health and the Medical Research Council.

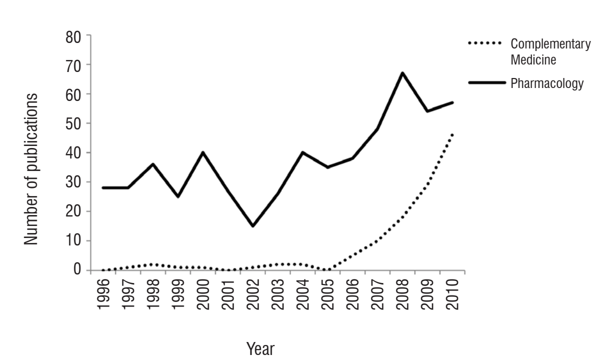
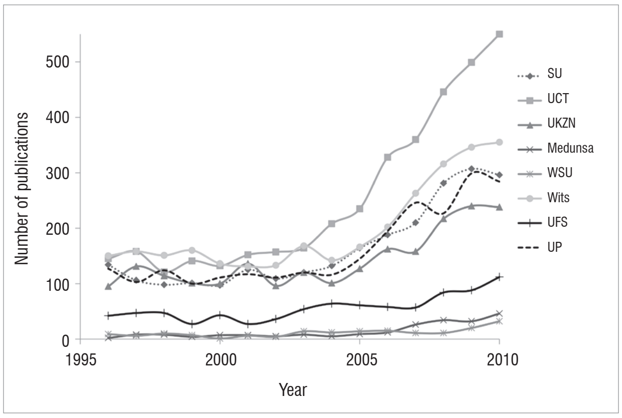


Figure 9: Number of publications from South Africa in Pharmacology and Complementary Medicine during 1996–2010.

Institutional output

On the basis that the output of medical articles would primarily emanate from the large research-led universities, it was also noteworthy to analyse the output from the eight medical teaching/training institutions in the country based on an affiliation-specific interrogation of the *Scopus* database. The results of this analysis are possibly not surprising, in of itself, but the analysis reveals a tiered result (Figure 10). It is tempting to speculate that, in South Africa, there are indeed three tiers of medical scholarly output with one university dominant, a second tier of four universities and a third tier of three universities. The slope of the rise in output and the sustainability is also another feature that should be noted.



UP, University of Pretoria; UFS, University of the Free State; Wits, University of the Witwatersrand; WSU, Walter Sisulu University; Medunsa, Medical University of South Africa/ University of Limpopo; UKZN, University of KwaZulu-Natal; UCT, University of Cape Town; SU, Stellenbosch University

Figure 10: Medical-related publication output from the eight medical institutions in South Africa during 1996–2010.

Discussion and conclusions

Data analysis of the discipline-specific publication trends will be of value in determining trends and weaknesses in scholarly output from various medical subjects and disciplines. The changes in discipline-specific output not only reflect changes in health care and disease burden over the 14-year period under review, but also changes in priorities in academic institutions, given that the major portion of scholarly output emanates from these institutions. However, the relatively static profiles in some areas are of concern, given the expected trends that should have been evident from changes in disease patterns. Whilst some of the trends may be masked as a result of the classification used within the *Scopus* database, it is noteworthy that the scholarly output in areas such as Pathology and Laboratory Medicine and Surgery is not showing the same increases evident in other areas of medicine, despite the changes in the burden of disease over the 14-year period. Another limitation of this study, arising from a shortcoming of the *Scopus* database, is the lack of any data on outputs in medical education, which is not represented as a separate category or is not counted in the *Scopus* database. There is scope for this category to be reflected in *Scopus* to account for changes and innovations in the landscape of medical education. Furthermore, within the pre-defined categories, further breakdown is required to analyse the relative contributions of subspecialties.

Another potential limitation is the type of article that was extracted in this study. The numbers reflect the total numbers of articles – the database does not allow for easy extraction of article type within disciplines, e.g. original research versus review articles. However, when one does a global analysis and breakdown using *Scopus*, research articles make up 70% of the total number of articles, reviews 11% and letters 8%, with the remainder being notes, editorials and conference papers. *Scimago* does not distinguish between these within disciplines and these global figures are based on the *Scopus* database. Therefore, the reader needs to recognise the possible proportions of article types reflected in the data.

Whilst bibliometric databases can often classify journals in more than one category, meaning that a journal article could potentially be counted twice, comparison of the journal lists between categories revealed a limited number of journals that were counted in more than one category. Replication would affect the total number when comparing between disciplines but not within a category. In some subject areas, such as Medicine(misc) there are 1563 journals listed. A limitation of the study is therefore that in the large subject areas such Medicine(misc), there will be substantial overlap with the subdisciplines; for example, an article in Immunology may also be counted in Medicine. However, the reverse is less often the case. This limitation needs to be taken into account when counting a large area such as Medicine(misc), in comparison with, for example, Infectious Diseases. Again, this merely means that there is likely to be a marginal overestimation of counts between disciplines, but not within the disciplines. Again, if replication were taken into account, the magnitude of the figures would not change substantially, nor would the overall interpretation within a discipline.

In the report on clinical research published by the Academy of Science of South Africa (ASSAf)[4], a similar analysis of health-related articles was undertaken. However, the ASSAf study analysed all health-related articles and therefore included the allied health professions and dentistry in the analysis. If one compares the annual numbers of articles described in the years 1996–2005 in the ASSAf study with the current analysis, the figures from the ASSAf study are higher but within a comparable order of magnitude, with similar trends in the totals being evident. Moreover, the ASSAf study focused on a global analysis of clinical research, with some breakdown into fields or disciplines, but not in the same way as described in the current study. It should also be noted that the data in this current study focused primarily on medicine and not the allied health sciences.

Interestingly, in the period after 2004, there is a perceptibly sharper rise in the number of publications. This increase is most probably attributable to the changes in the funding formula of the Department of Higher Education and Training,[5] which, since 2004, began to subsidise the publication of journal articles from universities, based on a list of accredited journals. Institutions distribute this subsidy differently, with some incentivising publication by authors directly more substantially than others, whilst some institutions have presumably redistributed the enhanced funding to provide for more staff and enhanced infrastructure in different proportions.

In conclusion, whilst the limitations of the study and the database subclassifications need to be recognised and these have been dealt with in the rest of the article, the data provide a noteworthy overview of the evolution of medical scholarly output and raise a number of questions that are worthy of future investigation.

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