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# The MRC/Wits Dental Research Institute: its publication record 1954–2004

E.S. Grossman<sup>\*†</sup>, M. Mogotsi<sup>\*</sup> and P.E. Cleaton-Jones<sup>\*</sup>

**A**LL 625 SCIENTIFIC PAPERS PUBLISHED BY the Dental Research Institute (DRI) during its life between 1954 and 2004 were examined and categorized according to publishing journal, article content and author, with the aim of obtaining information on research collaboration, quality, productivity and author representivity. Currently, 11% of authors are from disadvantaged backgrounds and 32% are women. Collaborators make up half of co-authors and presently are South African academics (31%) or from the associated dental school (19%). In the period 1985–1994, 28% of collaborators were from abroad. Research quality as assessed by journal impact factor, experimental method, research design and ethical protocols shows improving scientific rigour, adherence to international scientific standards and publication in well-regarded journals. This analysis provides a unique opportunity to assess research output against the challenging and changing backdrop of the local and global dental research environment. In addition, this is the first detailed record of a South African research entity which jointly reflects both university and statutory body research trends over 50 years. In this alone, the DRI database provides a unique historical record that shows how the institute has been transforming for the past half-century.

## Introduction

Past performance of South African science and technology research sectors has been the subject of analyses by government,<sup>1,2</sup> research centres<sup>3,4</sup> and individual researchers<sup>5,6</sup> to gather information and plan strategic initiatives for their future management. Comparative historical data seem to be drawn, at best, from the 1980s<sup>5</sup> and trends are generalized to national or broad disciplinary categories. Consequently, long-term perspectives are wanting and specific drivers which direct the course of particular research fields have not been addressed. The Dental Research Institute (DRI) of the Medical Research Council/University of the Witwatersrand (Wits) has a complete record of its research contributions since its establishment in 1954: this includes all printed outputs, details of higher degree candidates and their subsequent research careers as well as scientific presentations at the annual conferences (1967–2004) of

the South African Division of the International Association for Dental Research (SA IADR). This information has been consolidated into a database which provides a unique historical record of the functioning of a dental research entity in South Africa. The history of the DRI and the highlights of its research contributions have been published in this journal.<sup>7</sup>

Some details relevant to the interpretation of the data presented here, however, need highlighting. Full-time staffing in 1954 consisted of the director and a research technician; at the end of 2004 it comprised a director, senior researcher and two research technicians. For a period in the early 1980s, staff peaked with one director, one senior researcher, two junior researchers and four research technicians. Over the years eight 'honorary researchers', mainly private dental practitioners with research interests, have done research and published with the DRI for varying times. Throughout the momentous social and political changes of the past 50 years, the DRI has maintained a steady, unbroken research output, which provides unique information on a statutory body/university research unit in a particular field.

We examine and describe trends in the published, peer-reviewed, research papers of the DRI over its lifespan: other printed outputs are mentioned for completeness.

## Methods and materials

Each output item in the DRI database (peer-reviewed papers and other printed contributions, conference presentations and postgraduates) was classified according to 38 categories. Four categories used in this article need mention:

- The 2000 version of the International Association for Dental Research (IADR) descriptor list ([www.dentalresearch.org](http://www.dentalresearch.org)), which contains more than 300 coded key words to describe aspects of dental research, was used to describe the research content of each output. Five codes were assigned to each publication to describe the research field, in accordance with IADR-recommended policy.
- In line with the CENIS report,<sup>3</sup> each item was grouped according to the research and development (R&D) research categories of basic, participa-

tory, applied or strategic.

- Study design<sup>8</sup> was categorized as review, experimental, developmental validation, descriptive or correlational.
- Finally, 'local' implies journals published, or researchers from, within the borders of South Africa; 'abroad' or 'foreign' is used for journals and researchers from elsewhere.

Each output was obtained, scrutinized and flagged for identifiers. The coded information was evaluated using SAS for Windows (Version 9.1, SAS Institute Inc., Cary). This paper deals only with the printed outputs. Conference presentations and higher degrees will be mentioned only briefly.

## Results

In total, 700 printed items were produced between 1954 and 2004 by 354 authors. This consisted of 625 scientific papers, 16 letters to scientific journals, 15 book chapters, 15 technical reports, 10 books and booklets, 10 editorials and 9 'other' items. Only the evaluation of the 625 scientific papers by 306 authors will be described in detail, the specifics of which, arranged by decade, can be found in Table 1 as supplementary material online. Total printed output has fluctuated from year to year with a peak in 1978, when 26 papers and one each of an editorial, technical report and letter appeared (Fig. 1).

## Journals/proceedings

In total, 131 journals carried items from the DRI. Scientific papers appeared in 23 local and 102 foreign journals; the remainder of the journals (2 local; 4 foreign) have published an editorial, letter, commentary and so on. By reference to the Thomson-Institute for Scientific Information (ISI) journal impact factor (IF) (JCR, <http://0-isi10.isiknowledge.com>), together with the CJM score,<sup>9</sup> the DRI has published in quality journals (Table 2 as supplementary material online).

*Local:* Forty-seven per cent of papers appeared in local journals, with publication peaking in 1973. The top three most frequently used periodicals accounted for approximately three-quarters of the local publications, or 36% of the total scientific paper output (Table 2). The *South African Dental Journal* dominated with 171 publications (this journal does not have an ISI impact factor).

*Foreign:* From 1985, foreign publications predominated: the top ten overseas journals accounted for 43% of all foreign publications or 23% of the overall total (Table 2). Preferred journals depended on the interests of the director at the time:

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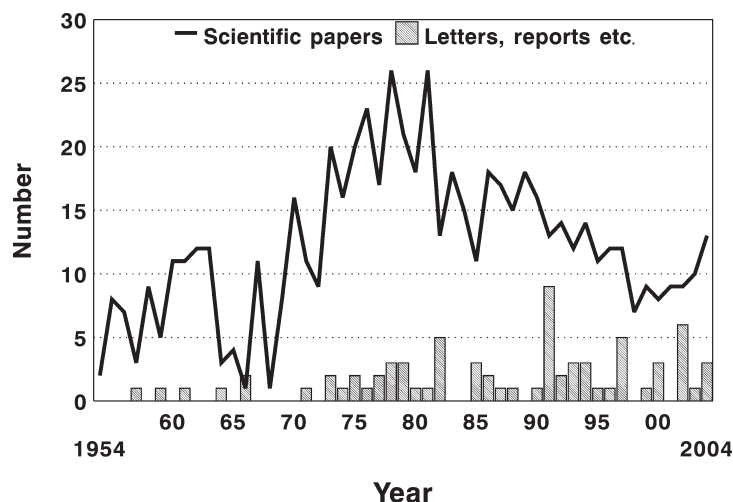


Fig. 1. Frequency distribution of total printed output, by year of publication and type of contribution 1954–2004.

*Nature* was most used by James Irving (1954–1959); the *Journal of Dental Research* was favoured by Hugo Retief (1970–1976), while *Community Dentistry and Oral Epidemiology*, with 24 papers, reflects the current director's, Peter Cleaton-Jones' (1977–2006), main research interests.

#### Article content

Research has been undertaken in many aspects of dentistry, both general and clinical. Research field has not influenced journal selection: papers have been published, locally or abroad, on all topics except for educational research, where 26 out of 29 were published for specific local relevance.

Research at the DRI has moved from basic research in the first 20 years to applied and participatory more recently. Only two items have been truly strategic, a technical report prepared for a Commission of Enquiry into Fluoridation<sup>10</sup> and an ethics guideline for the Department of Health.<sup>11</sup>

Experimental studies and those undertaken to validate a procedure were so similar that the two types were grouped together. The trend over time is towards logical scientific design with descriptive studies remaining a sizeable portion of output.

The first paper that gave details of ethics approval appeared in 1976.<sup>12</sup> The percentage of instances where ethics approval would be required, yet was not reported, has declined steadily over the years, complying with international ethical practice and meeting journal requirements. Ethics approval has been reported where necessary in 86% of studies in the last five years. Studies with no ethical requirement have remained steady at about one quarter of all papers since 1965.

The human component in DRI studies

covers a broad spectrum of involvement ranging from clinical investigations, surveys of child dental health and the use of human tissue, in our case mainly extracted teeth, for restorative materials studies. This diversity has given combined publication coverage for human studies of 62% in the last decade, double the figure for 1954–1964. Animal use in DRI research has been laboratory based or for clinical testing; this shows a marked drop between the first three decades and the last two.

The trend in data reporting has moved away from studies without quantitation, despite the study's appropriateness for some form of measurement (39%), towards rigorous statistical testing of data (78%). Arithmetic listing of results, without statistical analysis, has formed less than 10% of all studies for the past 30 years. Investigations which were inappropriate for any form of quantitation have steadily declined from 20% in the period 1954–1964 to the current level of 11%.

Since 1967 (the inception of the SA IADR), 537 papers have been published, of which 295 (55%) have had part or all of the work presented at one or more of the SA IADR annual conferences. Up to four presentations have contributed towards a single paper, thus 359 oral presentations at the SA IADR have contributed towards the 295 papers, giving a ratio of 1.2 conference presentations per paper.

#### Authorship

The 625 papers were produced by 306 individuals. Double authorship has been a feature since the outset but multi-authorship has increased slowly over the years: the first three-author publication was in 1960,<sup>13</sup> the first four-author paper in 1968,<sup>14</sup> five in 1972<sup>15</sup> followed by six-,<sup>16</sup> seven-<sup>17</sup> and eight-author<sup>18</sup> papers in

1977, 1980 and 1994, respectively.

DRI staff formed half of all authors (research staff 42% and technical staff 7%), with staff numbers fluctuating over the years. Overall, local collaboration was with the Wits School of Oral Health Sciences (25%) followed by private practitioners (24%) and academics (22%). Just under 10% of local research collaboration was with other members of the Medical Research Council. The eight honorary research fellows comprised 7% of author totals yet participated in 124 publications (20% of output). Foreign collaboration was at its peak in 1992 with 18 co-authors: 94% were dental academics or professional scientists, the remainder providing technical support. The decline in foreign collaboration over the last ten years is due to the careers of many DRI co-researchers coming to an end. Author ratios for papers (with the sequence being DRI staff: local collaborator: foreign collaborator) appearing in local journals were 14:9:1 and 5:4:1 for overseas journals. This indicates that foreign collaborators were less inclined to publish joint research locally than abroad.

Postgraduates have authored 163 papers arising from their work for higher degrees. Nine papers were produced for each of the years 1965–1974 and 1975–1984 based on work done by 14 and 15 undergraduates, respectively. This has dropped steeply with two publications produced by 7 students in 1985–1994 and one publication in 1985–2004 completed by two undergraduates.

There have been eight MRC post-BDS scholarship candidates appointed to the DRI since the inception of the programme in 1986. Thirty-nine papers have arisen from the work they completed during their scholarship year. The 625 papers produced by 306 individuals gives an arithmetic average of 2.0 papers per person. Some of these authors have contributed towards more than one article per year. Total co-authorship for these papers numbers 1595, giving an average of 2.6 authors per article. Most publications are produced by a minority of researchers as shown in Table 3 as supplementary material online contrasted as to first author and overall authorship.

Men continue to dominate publication lists although their representivity has declined for each successive 10-year increment (Table 1). The first woman DRI co-author published in 1954,<sup>19</sup> the second in 1961,<sup>20</sup> the third in 1969.<sup>21</sup> From then on, women have featured in publication lists each year. Overall, 22% of authors have been female; women have been first author on 19% of papers. Ratios between

male and female have declined over the decades, because the number of male researchers has decreased; female researchers have maintained a steady presence of between 10 and 20 since 1976 (Fig. 2). Women authors do not have the same status as males: women in 'technical' positions comprise 38% of female authors with the corresponding percentage for men being 0.5%. Males in 'academic/professional' groups make up 78% of authors, similarly grouped women are 46% of the female total.

White researchers published exclusively until 1978, when the first black appeared as co-author.<sup>22</sup> The first Indian published in 1981,<sup>23</sup> followed by the first Chinese in 1982.<sup>24</sup>

While people of colour have accounted for only 5% of overall DRI authors, this has increased to 15% over the past five years. Local Indian researchers have dominated the publication statistics, being 16 out of a total of 27 co-authors from among the previously disadvantaged.\*

## Discussion

Author representivity reflects societal conditions with publishing authors being overwhelmingly male and exclusively white for the first two decades. The 2002 national figure of 11% of authors coming from disadvantaged race groups (J. Mouton, pers. comm.) is less than the equivalent DRI percentage of 17%. This latter figure does not reflect in any way the changing racial proportions apparent in the undergraduate years of the BDS course at Wits, where for the past five years 15% of the class was white.<sup>25</sup>

Women are better represented at the DRI than the national norm. In 2002, women produced 22% of South African research publications (J. Mouton, pers. comm.) whereas the DRI's corresponding figure is 38%. The number of women participating in research has remained static (between 10 and 20 authors per year) since 1976 and in terms of status they remain at a lower level than males. It seems that women remain the 'forgotten disadvantaged' in dental research.

Scientific rigour of research design is used as an indicator of research quality. This covers experimental method, statistical testing of data, and social and ethical considerations in research. The proportion of all three indicators has improved over the years (ethics reporting, experimental/validation/correlational studies, and

\*Meaning those handicapped educationally, economically and in other respects under the apartheid legislation of the previous government: they represent a wide spectrum of people including blacks, Asians, coloureds, Indians, Chinese, and women.

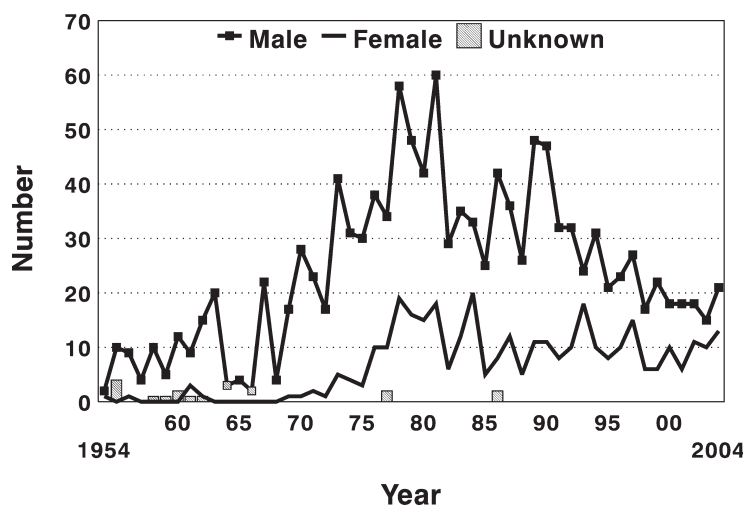


Fig. 2. Gender of authors producing scientific papers by year of publication.

statistical testing of results has increased). This suggests that the DRI has moved with global research trends and improved the scientific rigour of published studies. However, descriptive studies remain a sizeable portion at 26%, implying that this form of research still plays a large role in dental health.

One of the central issues in the development of a post-1994 South African science system is to produce a research framework more relevant to national priorities. The past five years has seen a move away from the historically predominant 'basic' research towards a more 'applications'-driven research, which is considered better to meet national needs.<sup>26</sup> While this move has been applauded in some quarters, it has created tensions within higher education institutions, putting basic research under severe strain, which could seriously constrain the growth of this knowledge base.<sup>26</sup> The DRI has pre-empted this national strategy by more than 30 years and our current balance of research categories satisfies both academic and national needs.

Research collaboration enhances information flow, thereby benefiting South Africa's local research community and extending their participation in global science.<sup>27</sup> A previous report<sup>3</sup> avers that '... many South African scientists had little scientific contact with their international colleagues during the seventies and eighties. More seriously, however, is the lack of contact within the scientific community in South Africa .... the academic science system in South Africa [was] *isolationist*'. The DRI numbers for co-authors do not support the latter contention. The historical effect of the academic boycott can be seen in the upswing of 'other' author nationalities. As anti-South African sentiment increasingly isolated the

DRI researcher in the 1980s, it became easier to obtain funding from university and statutory bodies for collaborative visits to South Africa, to counter the dearth of research cooperation initiated abroad. The burgeoning 'other' component of co-authors (28% non-South African, 45% academic), which peaked between 1985 and 1994, is a manifestation of this policy.

Undeniably, the DRI has been productive over the half-century under review and is well over the current target of 1.25 publications per annum per full-time university academic (Wits Research Officer, pers. comm.). Of the four issues under discussion, productivity is the variable most influenced by external factors: two examples will suffice. Peak output in the third decade coincided with the highest staff complement and the greatest number of postgraduates coming forward to complete research degrees. The latter corroborates other findings,<sup>3</sup> which suggest that output increases when student co-authors increase the research team. The sharp dip in productivity in 1998 was as a result of the relocation of the DRI to the medical school campus: the move effectively closed laboratories for 6 months. This illustrates the extent to which factors beyond institute control can affect research output, as well as the time needed to return to optimum productivity.

How representative are these figures and can one extrapolate the conclusions to the wider South African scientific community? We consider that results drawn from the dental research environment is particularly suited to serve as a proxy for such comparisons because of its stability and uniqueness. Advances in dental research have been characterized by steady and continuous progress

towards improved oral health. Changes within the discipline are largely due to the desire for improved research quality and to keep pace with international norms and standards. Dental research is not prone to fads and heroics and it does not have the income-generating potential of other branches of scientific research. Consequently, discipline-specific peaks and troughs are absent and research output in dentistry is characterized by long-term, purposeful, progress along a stable continuum creating an excellent yardstick. The changes within the DRI record reflects commonalities which have been shared by the South African scientific community as a whole: such as the effect of social, economic and political forces. This implies that this retrospective on the DRI has applications beyond the field of dental research.

We have deliberately avoided discipline-specific pointers and have concentrated on analysing issues which are currently being debated in higher education and research institutions in South Africa. Our 50-year record has been able to show that, in our case, few of the current notions on historical research collaboration, productivity, representivity and quality apply. Furthermore, we have been able to identify, and mention only a few of, the drivers and motivators which have directed the course of our research. Additionally, it shows that some segments of the national science landscape have been transforming for the past 50 years.

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## Supplementary material to:

Grossman E.S., Mogotsi M. and Cleaton-Jones P.E. (2006). The MRC/Wits Dental Research Institute: its publication record 1954–2004. *S. Afr. J. Sci.* **102**, 371–374.

**Table 1.** Research outputs and authors in the period 1954–2004, in terms of decades, subject matter and particulars of authors.

Category	Time period				
	1954–1964	1965–1974	1975–1984	1985–1994	1995–2004
Total print items	87	103	215	173	122
Letters, editorials	4	6	18	25	22
Papers	83	97	197	148	100
<b>Details of papers</b>					
Published locally	37	67	91	51	45
Published abroad	46	30	106	97	55
Main journals/proceedings					
Local (% of local total)	<i>S. Afr. J. Med. Sci.</i> ; <i>SADJ</i> ; <i>S. Afr. Ind. Chem.</i> : 81%	<i>SADJ</i> ; <i>Diastema</i> ; <i>S. Afr. J. Med. Sci.</i> : 95%	<i>SADJ</i> ; <i>Proc. Microsc. Soc. S. Afr.</i> ; <i>S. Afr. Med. J.</i> : 86%	<i>SADJ</i> ; <i>Proc. Microsc. Soc. S. Afr.</i> ; <i>S. Afr. J. Sci.</i> : 76%	<i>SADJ</i> ; <i>Proc. Microsc. Soc. S. Afr.</i> ; <i>S. Afr. J. Sci.</i> : 77%
Foreign (% of foreign total)	<i>Nature</i> ; <i>J. Dent. Res.</i> ; <i>Dent. Practit.</i> : 43%	<i>J. Periodontal. Res.</i> ; <i>J. Dent. Res.</i> ; <i>Archs Oral Biol.</i> : 43%	<i>Community Dent. Oral Epidemiol.</i> ; <i>J. Dent. Res.</i> ; <i>J. Endodont.</i> : 24%	<i>J. Prosthet. Dent.</i> ; <i>Community Dent. Oral Epidemiol.</i> ; <i>J. Periodont.</i> : 19%	<i>Community Dent. Oral Epidemiol.</i> ; <i>Int. Dent. J.</i> ; <i>Oral Surg. Oral Med. Oral Path.</i> : 25%
<b>Paper content</b>					
Research field	Animal; histology & ultrastructure; human; biochemistry; bone: 37%	Dental materials; teeth; animal; human; histology & ultrastructure: 30%	Physical; teeth; animal; human; histology & ultrastructure: 29%	Epidemiology; animal; human; bone; histology & ultrastructure: 33%	Epidemiology; caries; human; dental materials; teeth: 35%
General					
Research field	Pathology; orthodontics, anaesthetics: 13%	Orthodontics, pathology periodontology: 12%	Anaesthetics; restorative dentistry; periodontology: 9%	Oral surgery; restorative dentistry; periodontology: 12%	Oral surgery; restorative dentistry; periodontology: 16%
Clinical					
Ethics					
Required but not reported	86%	73%	70%	43%	40%
Not necessary	12%	26%	25%	27%	28%
Human/Animal: remaining % = 'other'	Human: 31%; animal: 47%	Human:35%; animal: 35%;	Human: 39%; animal: 36%	Human: 45%; animal: 29%	Human: 62%; animal: 28%
Study design	Experiment/validation: 37%; descriptive:46%; review:13%; other:4%	Experiment/validation: 8%; descriptive: 59%; correlational: 8%; review: 25%	Experiment/validation: 38%; descriptive: 35%; correlational:16%; review:10%; other:1%	Experiment/validation: 34%; descriptive: 31%; correlational: 21%; review:14%	Experiment/validation: 38%; descriptive: 26%; correlational: 22%; review: 14%
Data reporting	None: 39%; arithmetic: 41%; inappropriate: 20%;	None: 32%; arithmetic :14%; stats: 22%; inappropriate: 32%;	None:14%; arithmetic :9%; stats: 63%; inappropriate:14%;	None:13%; arithmetic: 9%; stats:64%; inappropriate:14%;	None: 5%; arithmetic: 6%; stats: 78%; inappropriate: 11%
Research category	Basic: 75%; applied: 12%; participation:1%; other:12%	Basic: 75%; applied: 24%; participation:1%	Basic:42%; applied: 23%; participation:25%; strategic:1%; other: 9%	Basic:26%; applied: 25%; participation:33%; other:16%	Basic: 24%; applied: 26%; participation: 35%; other: 15%
<b>Author</b>					
Number of individuals	23	48	118	118	82
DRI staff co-authors	6	10	18	15	7
'Other' co-authors	17	38	100	103	75
Total co-authorships	115	203	538	444	295
Gender (male)	86% (9% unknown)	93%	76%	75%	68%
Race ( white)	100%	100%	97%	94%	89%
Nationality	SA: 87%; other: 5%; unknown: 8%	SA: 96%; other: 4%;	SA: 91%; other: 8%; unknown: 1%	SA: 71%; other: 28%; unknown: 1%	SA: 81%; other: 19%
Co-author status; Remaining % = 'other'	Dental School: 42%; private practitioner: 27%; academic: 17%	Dental School: 34%; academic: 29%; private practitioner: 17%	Private practitioner: 29%; academic: 19%; Dental School: 15%	Academic: 45% Dental School: 13%; private practitioner: 27%	Academic: 31%; Dental School: 19%; postgraduate: 12%

**Table 2.** Journals/proceedings (local and foreign) most often used for publishing DRI papers ( $n = 625$ ).

Journal	Impact factor	CJM score*	Number of publications	% of total output
<b>Local top five journals/proceedings</b>				
<i>South African Dental Journal</i>	No IF	–	171	27.4
<i>Proceedings of the Microscopy Society of Southern Africa</i>	No IF	–	31	5.0
<i>South African Journal of Medical Science</i> (discontinued)	No IF	–	23	3.7
<i>Diastema</i>	No IF	–	15	2.4
<i>South African Medical Journal</i> *	0.989	2/10	14	2.2
<b>Top 10 foreign journals</b>				
<i>Community Dentistry and Oral Epidemiology</i> *	1.100	6/10	24	3.8
<i>Journal of Dental Research</i> *	2.702	10/10	18	2.9
<i>Journal of Prosthetic Dentistry</i> *	0.527	4/10	18	2.9
<i>Journal of Oral Rehabilitation</i> *	0.643	4/10	14	2.2
<i>Nature</i> **	30.979	10/10	13	2.1
<i>Oral Surgery, Oral Medicine, Oral Pathology</i> ***	1.027	6/10	13	2.1
<i>Journal of Periodontal Research</i> *	1.407	7/10	12	1.9
<i>Journal of Dentistry</i> *	1.233	7/10	12	1.9
<i>Archives of Oral Biology</i> *	1.098	6/10	10	1.6
<i>British Journal of Anaesthesia</i> ****	2.365	9/10	8	1.3
Total		396	63.4	

Highest IF in ISI category: \*Dentistry, oral surgery and medicine 2.70; \*\*multidisciplinary science 31.00; \*\*\*medicine, general and internal 38.57; \*\*\*\*anesthesiology 4.56. The CJM score<sup>†</sup> puts papers into 10 categories dependent on IF in an ISI category, thereby permitting cross-disciplinary comparisons.

**Table 3.** Publication output of the 20 most productive authors ( $n = 306$ ) listed in the 625 research papers.

Author	No. of papers (all positions)		No. of papers (first authorship only)	
	Frequency	% of 625 papers	Frequency	% of 625 papers
Author 1	307	19.2	80	12.8
Author 2	74	4.6	10	1.6
Author 3	72	4.5	48	7.7
Author 4	65	4.0	41	6.6
Author 5	47	2.9	0	0
Author 6	41	2.5	30	4.8
Author 7	39	2.4	33	5.3
Author 8	32	2.0	22	3.5
Author 9	31	1.9	24	3.8
Author 10	29	1.8	9	1.4
Author 11	26	1.6	9	1.4
Author 12	25	1.5	1	0.2
Author 13	24	1.5	7	1.1
Author 14	22	1.3	6	1.0
Author 15	22	1.3	17	2.7
Author 16	19	1.1	13	2.1
Author 17	17	1.0	3	0.5
Author 18	17	1.0	14	2.2
Author 19	16	1.0	14	2.2
Author 20	15	0.9	1	0.2
Total % of output		58.0		61.0

In authors such as numbers 1, 2 and 12 there is a large frequency difference between first-author papers and second- (and greater) author papers. Of note is the fifth-most productive author, a statistician, who has never been a first author, yet the role he has played as consultant in the planning and analysis of scientific studies is indicated by his prominent position in the ranking. Authors 3, 11 and 14 are women; authors 7 and 17 are specialist private practitioners, while author 10 is the top-producing foreign collaborator. Productivity depends on length of association with the DRI (authors 1, 3, and 7) and seniority of position as reflected by the directors in positions 1, 4, 6 and 8.

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