ORIGINAL ARTICLE

Total research productivity in a pathology discipline

A S Wierzbicki, T M Reynolds

J Clin Pathol 2002;**55**:495–498

See end of article for authors' affiliations

Correspondence to: Dr A S Wierzbicki, Department of Chemical Pathology, St Thomas's Hospital, Lambeth Palace Road, London SE1 7EH, UK; Anthony.Wierzbicki@kcl.ac.uk

Accepted for publication 28 February 2002

Aims: To investigate the research productivity of all staff in chemical pathology.
Methods: Chemical pathologists or biochemical scientists were identified from publicly available sources. All journals, their impact factors (IFs), and individual publications over the period of 1995 to 1999 were identified from electronic databases. Each publication was subclassified with respect to type of publication, number and position of author, and subspecialty to which the article referred.
Results: Research output over the period comprised 6162 articles, originating from 1399 individuals, 264 of whom were medically qualified. Specialty initiated research accounted for 26% of the total publications and 80% of the research was performed in teaching hospitals. Research output was highly skewed because 49% of individuals published a letter or more, 20% published one original piece of research over five years, but only 4% were research active, as defined by one publication each year. International standard research, defined as one paper each year in journals with IF > 4, was achieved by 1% of the profession, mostly aged > 55 years. Skewed distributions of publication rates were found in all age deciles. The possession of higher research degrees correlated with higher output in all age deciles.
Conclusions: Those working in chemical pathology are active in initiating and conducting research, although at a low level. Because longterm activity in research correlates with the possession of higher research degrees and the opportunity to carry out research from early in career pathways, priority should be given to encouraging research in training, given the small and ageing profile of international quality research in the profession in the UK.

Pathology in the UK is often said to be in academic crisis. Research is stated to be a key function of the National Health Service (NHS) and is assessed by returns to the NHS executive.[1] Research in academic departments is formally assessed every five years through a research assessment exercise (RAE).[2] Our audit study was designed to examine research in chemical pathology nationwide.

METHODS

The discipline of chemical pathology (clinical chemistry) comprises three groups of staff: medical, scientific, and technical. Staff were identified from the handbooks (1999 editions) of the Royal College of Pathologists, Association of Clinical Biochemists, or Association of Clinical Pathologists. Dates of qualification, other degrees, and previous appointments were obtained from the Medical Directory, Medical Register, and *Who's who* (1999 edition) for medical staff.[3] Merit award holders were identified from the Advisary Committee on Distinction Awards.[3a]

Publications were identified using the Ovid search engine.[4] All searches were carried out for the period 1966 to 1999, selecting for the period 1 January 1994 to 31 December 1998. Searches were conducted using first and multiple initials and were evaluated manually for attribution based on hospital site. All entries were coded as full papers, review articles, research letters, comment letters, editorials, and editorial comments; number and position of author(s); and by research field. The "quality" of research was assessed by journal impact factor (IFs), defined as the ratio of total article citations to the total number of articles published over the previous two years, using the Science Citation Index (SCI) 1999.[5]

Statistical analysis was performed by multiple linear regression after log transformation of skewed data for the determination of factors contributing to a high publication rate and by Spearman rank correlation for comparison of league table data.

RESULTS

Baseline data sources identified 1264 clinical chemistry staff and 243 federation members. A further 135 individuals were identified from other sources. The complete publication database comprised 6162 entries from 766 journals, 743 of which had citation IFs listed in the SCI index. Analysis of the database showed that 1211 publications (21.6%), accounting for 19.8% of the IF points (IFPs), came from district as opposed to teaching hospitals. The league table for total publications was dominated by teaching hospitals, with the first district hospital in 27th place.

The survey identified 267 medically qualified chemical pathologists of whom 264 were active in pathology, 10 had transferred from other specialties, and 197 were of consultant grade. This group included 49 (18%) with MDs, 54 (20.2%) with PhDs, and six (2.2%) with MD PhDs. In the group with higher degrees, 32 (65%) produced one publication each year and all had at least one publication over the census period.

The database included 282 PhD qualified clinical scientists with 238 (84.4%) working in departments of chemical pathology, 41.3% of whom worked in district general hospital departments. Of this total group, 237 (84%) were research active, based on one publication during the survey period. Research productivity was less among non-medical doctoral staff than their medical colleagues (publications: mean, 5.84; median, 2 *v* mean, 9.50; median, 4; $p = 0.01$).

Data on total publications, original papers, or IFPs showed a clear exponential distribution, with 90% of publications arising from 237 (20.8%) individuals. Using total IF, the 90th centile was achieved by 237 individuals (16.9%). Overall, 26%

Abbreviations: IF, impact factor; IFP, impact factor point; NHS, National Health Service; RAE, research assessment exercise; SCI, Science Citation Index

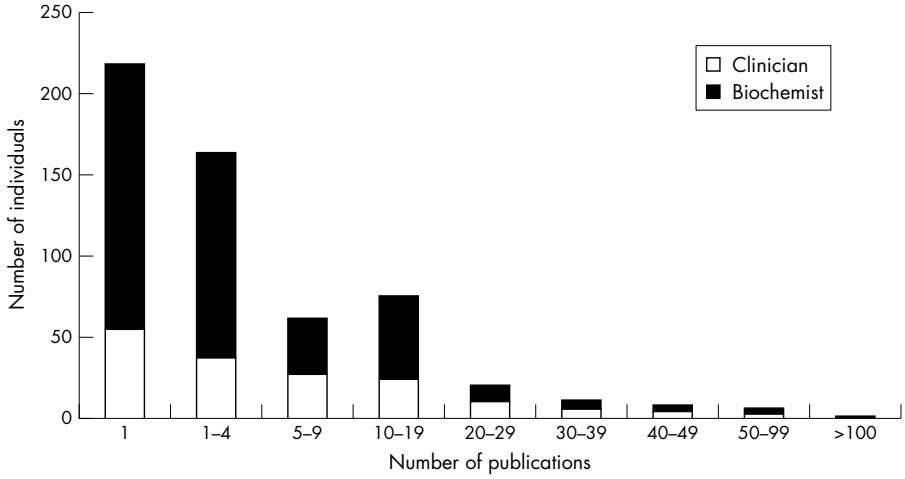

Figure 1 Distribution of chemical pathologists (clinicians) and clinical scientists (biochemists) with one or more publications by number of publications during the period 1994–9.

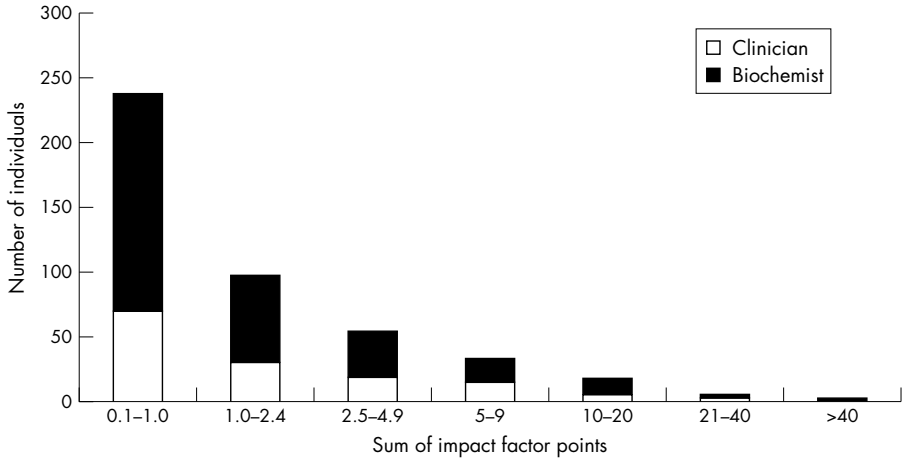

Figure 2 Distribution of chemical pathologists (clinicians) and clinical scientists (biochemists) with one or more publications by sum of impact factor points of the relevant journals during the period 1994–9.

of publications were initiated within the specialty—a clinical chemist was first author in 19.7 % and last author in 16%. Analysis showed that 49% of individuals had no publications over the census period, 20% had published one original piece of research over five years, and 4% achieved one publication each year (figs 1,2). Yearly publication in high IF (> 4) journals was achieved by 14 individuals (1%), 11 of whom were aged over 55 years. Individual peak output was 117 publications (402 IFPs). The highest non-medical scientist achieved 75 publications (235 IFPs).

Analysis of publications by decades after qualification showed a skewed distribution in all categories. Multiple regression analysis identified teaching hospital status and possession of a higher degree as significant factors contributing to an age adjusted higher publication rate.

Data for merit award holders showed that "B" award holders published a median of seven papers (11 IFP; ranges, 2–49 papers; 2.5–222 IFPs) whereas "A" award holders published 10 (range, 0–22) papers, totalling 23 IFPs (range, 0–63), and "A+" award holders published 30 papers (122 IFPs; ranges,

Table 1 Ranking of departments of chemical pathology in the period 1994–8 by number and sum of impact factors of publications

University	Publications		
	Number	Sum of impact factor	Mean impact factor
Glasgow	436	1242	2.84
Cambridge	234	1017	4.35
UMDS Guy's and St Thomas's	318	942	2.96
King's College London	300	901	3.00
Oxford	163	576	3.53
Cardiff	126	553	4.38
Royal Postgraduate Medical School	147	544	3.70
Sheffield	174	541	3.11
Manchester	190	515	2.71
National Hospital, London	159	435	2.73

Designations of schools reflect the system before the mergers of medical schools in London during 1997 to 1998.

Table 2 Distribution and relative quality of research in subspecialties or fields of interest in chemical pathology

Field of interest	Number	Impact factor points			
		Sum	Mean	Lowest	Highest
Cardiology/lipids	787	2121	2.70	0	27.8
Endocrinology	628	1861	2.96	0	38.9
Diabetes	362	1192	3.29	0	38.9
Immunology	359	1137	3.17	0.11	38.9
Oncology	323	1113	3.45	0.24	38.9
Enzymology	334	947	2.84	0.24	16.1
Gastroenterology	295	851	2.88	0.19	27.8
Paediatrics	277	722	2.61	0.35	38.9
Nutrition	294	690	2.35	0.30	16.5
Obstetrics	174	433	2.49	0.30	16.1
Toxicology	167	337	2.02	0.39	16.1
Drug monitoring	84	195	2.32	0.11	16.1

20–60 papers; 54–192 IFPs). IFP score correlated inversely with the prevalence of merit award only for A/A+ award levels. No corrrelation was seen between research productivity and the frequency of B grade awards.

The rank order for departments (table 1) as determined by total publications, total original work by number of IFPs, or best four publications as selected by journal IFP showed no significant difference in overall rank score using the different rating methods. Analysis of the survey by 12 major fields of interest (table 2) showed no difference in average or peak IFs. Median IF was similar for all fields and in the range 1.13 to 1.36, although the skewed nature of the data gave rise to higher mean values.

DISCUSSION

Research assessment methods are used in many countries to evaluate the appropriateness of funding allocation.[1 2] The systems used vary between those counting total income and numbers of postgraduate students (for example, Australia),[6] to systems assessing academic prestige by journal of publication, in addition to source of income, patents, and number of students, such as the UK. The systems can be advisory, as in Holland, or proscriptive, as in the UK, where the RAE is used to allocate resources to academic departments.[2 7] Research activity is used to allocate NHS research and development funds to district general hospitals,[1] and many teaching hospitals allocate their funds internally by reference to the RAE score. Research is also a component in the criteria for awarding merit awards. The RAE (1996) method uses the four best publications for each individual, in addition to grant and other income and number of postgraduate PhD studentships over the census period to decide university funding levels. This has been criticised on the grounds that journal IFs (calculated over two years) are specific to journals and not individual articles, differ substantially between basic and clinical science disciplines, and between clinical subspecialties.[8 9] The RAE (1996) methodology was used here to give quantitative data and the period 1994–8 was chosen to obtain an unbiased overall view of total research. The RAE (2001) system of assessing a self selected best four publications by a central peer review group is likely to show a similar bias towards better known, higher IF journals.[8–10]

> "Research activity is used to allocate NHS research and development funds to district general hospitals, and many teaching hospitals allocate their funds internally by reference to the RAE score"

Research productivity across a whole medical specialty has not previously been investigated. Although laboratory input is required for many clinical studies, it is often not acknowledged,[11 12] and there is concern about the academic future of chemical pathology and clinical scientists in general.[13]

Chemical pathology contains a mixture of medical and non-medical graduates and 54% of posts are located in district general hospitals. Overall, 22% of publications arise from district hospitals and the specialty appears to be active because 26% of publications originate in the specialty. The data were non-normally distributed and most publications were in low IF journals. The 90th centile of research output was accounted for by 21% of the specialty. Of the whole database, 49% had no input in any form to a journal, whereas 20% had published one original piece of work (research paper) over five years and 4% had published one paper each year. Among senior staff, defined as clinically medically qualified or PhD biochemists, 49% published an item in a research journal in the past five years, whereas 20% produced one paper each year. The data gathered 30 years ago from senior staff based on available time also showed only 50% could contemplate doing research because of workload constraints.[14] Yearly publication in high impact factor (IF > 4) journals was achieved by 14 individuals (1%), 11 of whom were aged over 55, implying that the profession may be faced with rapid academic decline in the near future.

Mean values were used deliberately to bias the data towards higher impact publications, which have been encouraged by institutions since RAE 1992. Holders of PhDs show a previous interest in research, as demonstrated by higher degree qualifications, and achieve one publication/year irrespective of age decile. Non-medically qualified doctoral staff showed a slightly lower research productivity than their medical colleagues. This bias in research productivity arises early in clinicians, where previous employment histories are available, because clearly skewed distributions are visible in all age deciles after medical qualification. This distribution suggests that differences in aptitude, opportunity, and support are likely to translate quickly into permanent career advantages.

The analysis of total publications by field of interest showed little difference in average IFs for each field, implying that topical work from all fields was published in highly rated journals. Several groups in the fields of bone metabolism, endocrinology, immunology, and lipids could clearly be identified as being of international standard.

The principal purpose of the RAE is to rank departments for available research funds. Different results would have been obtained for the top 10 schools using different ranking systems (table 2). Although the total number of publications does not reflect the quality of each publication, it probably reflects the total number of individuals employed in research, and thus indirectly grant income.[6] Although individual

Take home messages

- Approximately half of those working in chemical pathology had no input to a journal in any form in the five year study period (1995–9)
- Forty nine per cent of individuals published a letter or more, 20% published one original piece of research over the five years, but only 4% were research active, as defined by one publication each year
- International standard research, defined as one paper each year in journals with an impact factor > 4, was achieved by 1%, most of whom were aged > 55 years
- Only 20% of the research was performed in district general hospitals
- The possession of higher research degrees correlated with higher output in all age deciles
- Given the small and ageing profile of international quality research in the profession in the UK, priority should be given to encouraging research in training

department scores are not available, the highest scores in the RAE (1996) for clinical laboratory science follow the average IF for each publication data, as would be expected.

Despite claims of superspecialist areas being unable to publish in widely read and therefore high IF journals, the mean IF was broadly similar between subspecialties, ranging from 2.02 to 3.45 even using mean values, which would exacerbate any bias to higher rated journals (table 2). The median values were not significantly different between categories.

The survey comprised 300 man hours of work, whereas 16 hours was required for a teaching hospital departmental RAE return and 30 hours for a district general hospital. Internet sources are a more efficient method of determining research output.

> "The profession may be faced with rapid academic decline in the near future"

Those working in chemical pathology are active in research but at a low level. Some research is being done in district hospitals (20%) and 26% of work is initiated in the specialty. Some teaching hospital individuals are of international quality, but most of the academic leaders in the profession are aged > 55 years. Because differences in research productivity appear early and the possession of a higher degree encourages both scientists and clinicians to remain research active, irrespective of their location in the NHS or academia, the profession faces rapid academic decline unless the process is reversed.

DECLARATIONS OF INTEREST

The authors are included in this study database.

Authors' affiliations
A S Wierzbicki, St Thomas's Hospital, Lambeth Palace Road, London SE1 7EH, UK
T M Reynolds, Queen's Hospital, Burton on Trent, Staffordshire DE13 0RB, UK

REFERENCES

1 **National Health Service Executive**. *National Research Register FAQ*. http://www.update-software.com/National/nrr-frame.html.
2 **Department of Higher and Further Education**. *Research assessment exercise (RAE) 2001*. http://www.rae.ac.uk.
3 Who's who 1999. London: Who's Who publications, 1999.
3a Advisory Committee on Distinction Awards. http://www.doh.gov.uk/nhsexec/acda.htm.
4 **British Medical Association Library**. http://ovid.bma.org.uk.
5 **Science Citation Index**. http://jcrweb.com.
6 **Hinda J**. Aussies to sidestep Pommy "pitfalls". *Times Higher Education Supplement*, October 15, 1999.
7 **Masser I**. Editorial. A valuable Dutch lesson in research assessment. *Times Higher Education Supplement*, 7 July, 1995.
8 **Williams G**. Misleading, unscientific, and unjust: the United Kingdom's research assessment exercise. *BMJ* 1998;**316**:1079–82.
9 **Seglen PO**. Why the impact factor of journals should not be used for evaluating research. *BMJ* 1997;**314**:498–502.
10 **Howie JG**, Stott NC. The Universities' research assessment exercise 1992; a second opinion. *Lancet* 1993;**342**:665–66.
11 **Wierzbicki AS**. W(h)ither academic pathology? *Association of Clinical Pathologists News*, Autumn 1998;**3**:12–13.
12 **Dominiczak MH**. Laboratory medicine: the need for a broader view: the "multiple bundle" model of clinical laboratory function. *Clin Chem Lab Med* 1999;**37**:97–100.
13 **Rosenberg LE**. The physician-scientist: an essential—and fragile—link in the medical research chain. *J Clin Invest* 1999;**103**:1621–6.
14 **Lathe GH**, Mitchell FL. Staffing of clinical biochemistry laboratories serving the National Health Service. *Lancet* 1966;i:1413–15.