The scope and impact of original clinical research by Hong Kong public healthcare professionals

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ABSTRACT

Introduction: This study reviewed the landscape of clinical research conducted by public hospital clinicians in Hong Kong. It also explored whether an association exists between academic productivity and clinical performance.

Methods: This was a territory-wide retrospective study of peer-reviewed original clinical research conducted by clinicians providing acute medical care at non-university public hospitals between 2016 and 2021. Citations were retrieved from the MEDLINE biomedical literature database. Scientometric analysis was performed by collecting journal-level, article-level, and author-level performance indicators. Clinical performance was assessed using crude mortality rate, inpatient hospitalisation duration, and the number of 30-day unplanned readmissions.

Results: In total, 3142 peer-reviewed studies were published, of which 29.3% (n=921) were conducted by non-university hospital public healthcare professionals. The most productive specialty was clinical oncology, with 0.56 articles published per clinician. The overall mean journal impact factor and Eigenfactor score were 2.34 ± 3.72 and 0.01 ± 0.07, respectively. At the article level, the mean total number of citations was 6.33 ± 24.17, the mean Field Citation Ratio was 3.37 ± 2.04, and the mean Relative Citation Ratio (RCR) was 0.82 ± 3.32. A significant negative correlation was observed between crude mortality rate and RCR (r=-0.63; P=0.022). A negative correlation was also identified between 30-day readmissions and RCR (r=-0.72; P=0.006).

Conclusion: Clinicians in Hong Kong's public healthcare system are research-active and have achieved a substantial degree of influence in their respective fields. Research performance was correlated with hospital crude mortality rates and 30-day unplanned readmissions.

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New knowledge added by this study

- More than 10% clinicians at non-university public hospitals in Hong Kong have engaged in original clinical research as principal investigators.
- In total, 29.3% of clinical research published in Hong Kong was conducted by professionals from non-university public hospitals.
- The quality of the research undertaken was encouraging. All medical specialties achieved a Field Citation Ratio greater than 1.00, indicating that their article citation rates exceeded those of counterparts in the same research field.

Implications for clinical practice or policy

- Clinical research activity is correlated with reductions in hospital crude mortality rates and 30-day unplanned readmissions.
- The establishment of a research-supportive infrastructure and dedicated funding for non-university public hospitals may contribute to improved patient outcomes.

香港公共醫療專業人員原創臨床研究的範圍和影響

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引言：本研究綜覽香港公立醫院臨床醫護人員進行臨床研究的整體情況，並探討學術產出與臨床表現之間是否存在關聯。

方法：這項全港性回顧性研究分析了2016至2021年間非大學附屬公立醫院急症醫療臨床醫護人員發表的同行評審原創臨床研究。論文引用數據取自MEDLINE生物醫學文獻數據庫，通過收集期刊層面、文章層面及作者層面的績效指標進行科學計量分析。臨床表現則以粗死亡率、住院日數及30日非計劃再入院率作為評估標準。

結果：期間共發表3142篇同行評審研究，其中29.3%（n=921）由非大學醫院醫療專業人員完成。臨床腫瘤科為產量最高的專科，平均每位臨床腫瘤科醫護人員發表0.56篇論文。整體期刊影響因子與Eigenfactor評分的平均值分別為2.34 ± 3.72與0.01 ± 0.07。文章層面分析顯示，平均總引用次數為6.33 ± 24.17次，領域標準化引用率均值為3.37 ± 2.04，相對引用率均值為0.82 ± 3.32。研究發現粗死亡率與相對引用率呈顯著負相關（r=-0.63；P=0.022），30日再入院率與相對引用率亦呈負相關（r=-0.72；P=0.006）。

結論：香港公立醫療系統的臨床醫護人員積極參與研究，並在其專業領域取得相當影響力。研究表現與醫院粗死亡率及30日非計劃再入院率相關。

Introduction

Clinical research is fundamental to the advancement of medicine. More than a quarter of a century on, evidence-based medicine—which began as a nascent movement in the early 1990s—has revolutionised healthcare by producing trustworthy observations that support better-informed clinical decision-making and health policy.[1,2] Research forms the foundation of evidence-based medicine and plays an important role in understanding disease, thereby contributing to the development of novel therapeutic strategies.[3] This contribution has translated into quantifiable outcomes: participation in clinical research can lead to significant reductions in patient mortality and inpatient length of stay (LOS).[4-9] Clinical research benefits individual patients and drives socio-economic growth. The UK National Institute for Health and Care Research (NIHR) observed that every 1.0 GBP invested in clinical trials yielded a return of up to 7.6 GBP in economic benefit.[10] However, a substantial proportion of frontline clinicians typically do not engage in research activities relevant to their daily practice. A cross-sectional survey in North America revealed that 32% of respondents did not know how to participate in research.[11] A similar study among Hong Kong family physicians indicated that 27% had no previous experience.[3] Hong Kong is an ideal location for conducting clinical research due to its world-class universal healthcare infrastructure, electronic medical records system, use of English in medical documentation, and the presence of a pool of internationally reputable investigators.[12,13] Additionally, the Hospital Authority (HA)—a statutory body responsible for managing all public hospitals in the city—provides more than 90% of all inpatient bed-days, and the patient follow-up rate is comparably high.[14] Regardless of these favourable factors, according to the Our Hong Kong Foundation—a non-governmental, non-profit public policy institute—the number of clinical trials conducted in Hong Kong declined by 22% between 2015 and 2021, compared with a mean increase of 48% in developed countries and 285% in Mainland China.[15] No comprehensive review of the clinical research activity of Hong Kong public healthcare professionals has been conducted. Apart from the UK and Spain, no other region has evaluated the influence of clinician engagement in research on key performance indicators within a universal healthcare system.[4-6] This study was performed to determine Hong Kong's research productivity in terms of peer-reviewed published clinical studies, its scholarly impact, and its influence on outcomes for hospitalised patients—including LOS, crude mortality, and 30-day unplanned readmission. A comparative analysis of research productivity and quality across medical disciplines was also performed. Findings from this review could inform health policy by providing a stronger foundation for the evidence-based allocation of resources to support an efficient and sustainable research ecosystem within the HA.

Methods

This was a territory-wide retrospective observational study of peer-reviewed original clinical research conducted by HA medical staff at general acute care hospitals, in which the staff member served as principal investigator. The review included articles published in the biomedical literature from 1 January 2016 to 30 April 2021. Research articles from non-university institutions—comprising 30% (13/43) of all HA hospitals—were included. Citations covering this 5.5-year period were retrieved from MEDLINE, the United States National Library of Medicine's bibliographic database. The database was queried via the PubMed Advanced Search Builder for all studies published within the review period, where the first author's stated affiliation was a Hong Kong hospital. The internet-based library search package RISmed was used to extract author affiliation data from the PubMed search results into R, an open-source statistical software tool.[16,17] The list of citations was then manually reviewed to confirm that the study had been conducted by a clinician from an HA hospital. Published abstracts were categorised according to study design, article type, and corresponding medical specialty (Table 1).[18] Systematic reviews performed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) 2020 statement were regarded as original research.[19,20] Articles not subject to peer review—such as academic conference proceedings, trial protocols, editorials, letters to the editor, and erratum or corrigendum statements—were excluded. Preclinical studies and secondary research articles, including clinical practice guidelines, position statements, book chapters, and narrative topical reviews, were also excluded. Finally, collaborative studies in which the principal investigator was not employed by the HA were excluded.

The primary study endpoint was research productivity, measured by the total number of original research studies published, with comparisons made between university- and non–university-affiliated HA hospitals. The hypothesis was that university-affiliated hospitals would produce more original clinical research studies than non-university hospitals because of their access to tertiary education institution resources. Secondary endpoints included research productivity across medical specialties. To control for workforce discrepancies across medical disciplines, the mean number of full-time clinicians for each specialty from 2016 to 2021 was determined. The number of articles per clinician and the proportion of the workforce acting as principal investigator for each specialty were then established. The quality of the research, as reflected by the scientometric performance of each published article, was also assessed. It was hypothesised that research quality from university-affiliated hospitals would be superior to that of their non-university counterparts.

TABLE 1. Clinical research publication categories

Original research	Randomised controlled trial
	Quasi-experimental study[1]
	Non-trial study
	Retrospective
	Prospective
	Case report, case series, technical note
	Systematic review[2]
	With meta-analysis[3]
	Without meta-analysis
	Qualitative study
Other	Letter to the editor (including corrigendum and erratum articles)
	Editorial
	Trial protocol
	Clinical practice guidelines
	Narrative review
	Pre-clinical research

Another secondary endpoint was patient outcomes for each non–university-affiliated acute care hospital from 2016 to 2021: crude mortality rate per 100 000 hospitalised patients, length of inpatient stay, and annual number of unplanned readmissions within 30 days of discharge. It was hypothesised that increased research productivity would translate to improved patient outcomes, and an inter-hospital comparison of these key performance indicators was performed. Patient outcome data were collected from the HA's Clinical Data Analysis and Reporting System and the HA Management Information System.

To evaluate research quality, a multi-level scientometric approach was utilised by collecting journal-, article-, and individual author-level data. For journal-level scientometric assessment, two indices were determined: the journal's mean impact factor (IF) and Eigenfactor score (ES) from 2016 to 2021. These indices were obtained from Clarivate (London, UK), a bibliometric analytics company that manages the Science Citation Index, an online indexing database containing academic journal citation data.[1] A journal's IF is a scientometric index reflecting the mean number of citations received per article in that journal during the preceding 2 years.[21] This metric constitutes a reasonable indicator of research quality for general medical journals.[22] The ES ranks journals using eigenvector centrality statistics to evaluate the importance of citations within a scholarly network.[23] Utilising an algorithm similar to Google's PageRank (Alphabet Inc, Mountain View [CA], US), the ES considers the number of citations received and the prestige of the citing journal. For article-level metrics, the total number of citations per article (TNC), Relative Citation Ratio (RCR), Field Citation Ratio (FCR), and National Institutes of Health (NIH) percentile attained were documented (Table 2). Author-level data were collected by determining the h-index of the principal investigator (Table 2).[24] All scientometric data were censored on 30 June 2023.

Independent-samples t tests and Chi squared tests were conducted to compare variables. Spearman's rank analysis was performed to assess correlations between research and hospitalised patient outcomes. P values of less than 0.05 were considered statistically significant. All statistical tests were performed using SPSS (Windows version 21.0; IBM Corp, Armonk [NY], US) and R (version 4.5.0; R Foundation, Vienna, Austria).[17]

Results

Overall original clinical research productivity in Hong Kong

During the 5.5-year period, 4511 peer-reviewed articles were published by Hong Kong medical researchers from acute care public hospitals. Of these, 3142 (69.7%) were original clinical research studies. In total, 29.3% (n=921) of the articles were authored by non-university hospital investigators—a significantly smaller proportion than that published by their university hospital counterparts (independent-samples t test, $P<0.001$) [Fig 1a]. Throughout the review period, the annual number of publications by non-university hospital investigators remained consistent, with a mean of 167 ± 8 per year (t test, $P=0.24$) [Fig 1b]. Overall, the medical specialties that

TABLE 2. Multi-level scientometric assessment of original clinical research

	Definition	Calculation and data source	Interpretation
Journal-level			
Impact factor	Yearly mean number of publication citations received in the preceding 2 years for a given journal	Number of citations received in that year for a journal's publications divided by the total number of journal publications during the preceding 2 years https://mjl.clarivate.com/	Higher impact factor indicates greater journal prestige within its field
Eigenfactor score	Number of publication citations a journal received in the preceding 5 years, weighted by the citing journal's PageRank network standing	Eigenvector centrality statistic algorithm http://www.eigenfactor.org/	Higher score indicates greater journal prestige within its field (maximum score: 100)
Article-level			
Total number of citations	Total number of citations a publication received	https://icite.od.nih.gov/	
Field Citation Ratio	Citation performance of a publication compared with others in the same field and year	Number of citations received divided by the mean number of citations received by all publications in the same research field and year https://app.dimensions.ai/	Value >1.0-1.5 indicates above-average citation performance in the same field
RCR	Time- and field-normalised citation rate, benchmarked to 1.0 for a median NIH-funded paper in the same year	Actual citation rate/expected citation rate https://icite.od.nih.gov/	Value >1.0 indicates an above-average citation rate
NIH percentile	Percentile rank of an article's RCR relative to all NIH publications	https://icite.od.nih.gov/	Example: 95% indicates the article's RCR is higher than 95% of all NIH publications
Author-level			
h-index	Scientific productivity and impact of the principal author	Highest number *h* such that *h* articles have at least *h* citations each for an individual researcher https://scholar.google.com/	Higher index indicates greater researcher productivity and scholarly impact

Abbreviations: NIH = National Institutes of Health; RCR = Relative Citation Ratio

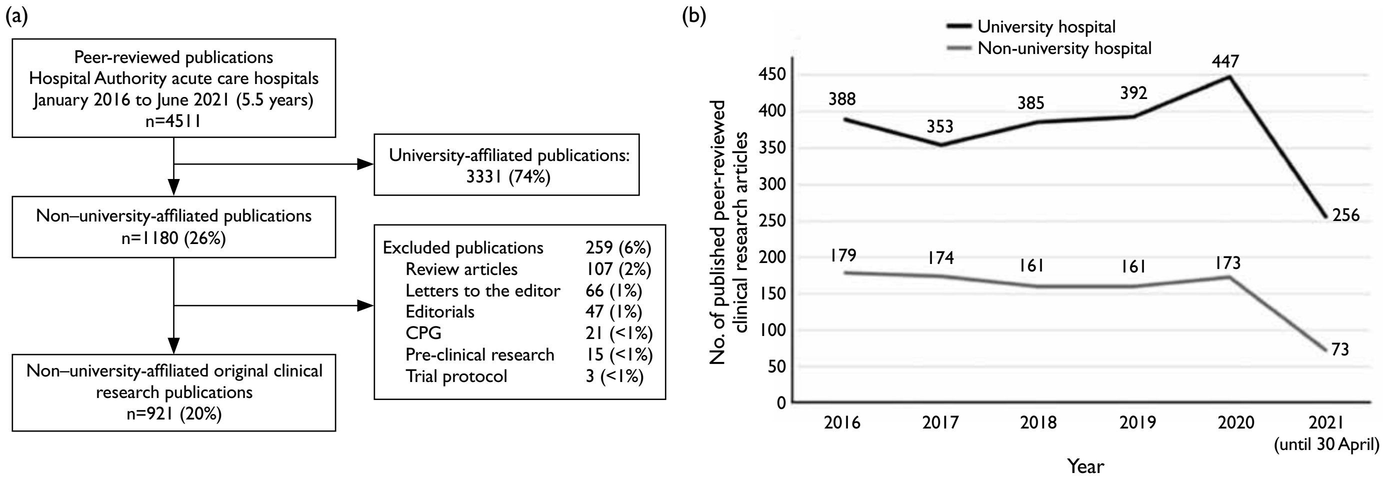

FIG 1. (a) MEDLINE-cited medical research articles by Hong Kong acute care public hospital staff between 2016 and 2021. (b) Comparison of the annual number of original clinical research articles published between university and non-university public hospitals
Abbreviation: CPG = Clinical Practice Guidelines

produced the most articles were internal medicine, representing 23.4% (n=735) of published studies, and general surgery, representing 16.5% (n=520) [Fig 2].

The majority of excluded articles were narrative reviews that did not meet PRISMA criteria, followed by letters to the editor and editorials (Fig 1a). Regarding study design, most research articles were case reports, followed by retrospective cohort and prospective cohort studies (Fig 3). A significantly larger proportion of case reports were published by non-university hospital staff compared with university hospital staff (P<0.001). In addition to retrospective studies, university hospital investigators were significantly more likely to publish higher level-of-evidence research articles (Table 3).

Original clinical research productivity among non-university general acute care hospitals and comparisons between medical specialties

The majority of non-university hospital principal investigators were clinicians, with 3.7% (n=34) of studies conducted by nurses or allied healthcare professionals. Among the 887 articles authored by clinicians, 544 individuals were identified, yielding an author-to-article ratio of 1:1.6. These researchers comprised 10.8% of the 5056 full-time non-university hospital clinicians employed during the study period. The most research-productive specialties among non-university hospitals were orthopaedics, followed by internal medicine and obstetrics and gynaecology (Table 4). Among all the medical specialties, the mean number of articles per clinician (×100) was 17.5 ± 22.3 (range, 1.8-56.4). After controlling for workforce discrepancies between disciplines, clinical oncology, orthopaedics and traumatology, and obstetrics and gynaecology constituted the most productive specialties in terms of the mean number of articles published per clinician (Table 4). Collectively, these three specialties published significantly more studies than the other disciplines (independent-samples *t* test, P<0.001) [Table 4]. The most research-active specialty was obstetrics and gynaecology, where one-third of clinicians acted as principal investigators—this proportion was significantly larger relative to other medical disciplines (*t* test, P=0.03) [Table 4].

Original clinical research quality among non-university general acute care hospitals and comparisons between medical specialties

Regarding scientometric performance, the overall mean journal IF and ES were 2.34 ± 3.72 and 0.01 ± 0.07, respectively. No statistically significant difference was observed between the principal investigator's medical specialty and the journal IF (independent-samples *t* test, P=0.31). However, with respect to the ES, clinical oncologists published their research in journals with a significantly higher

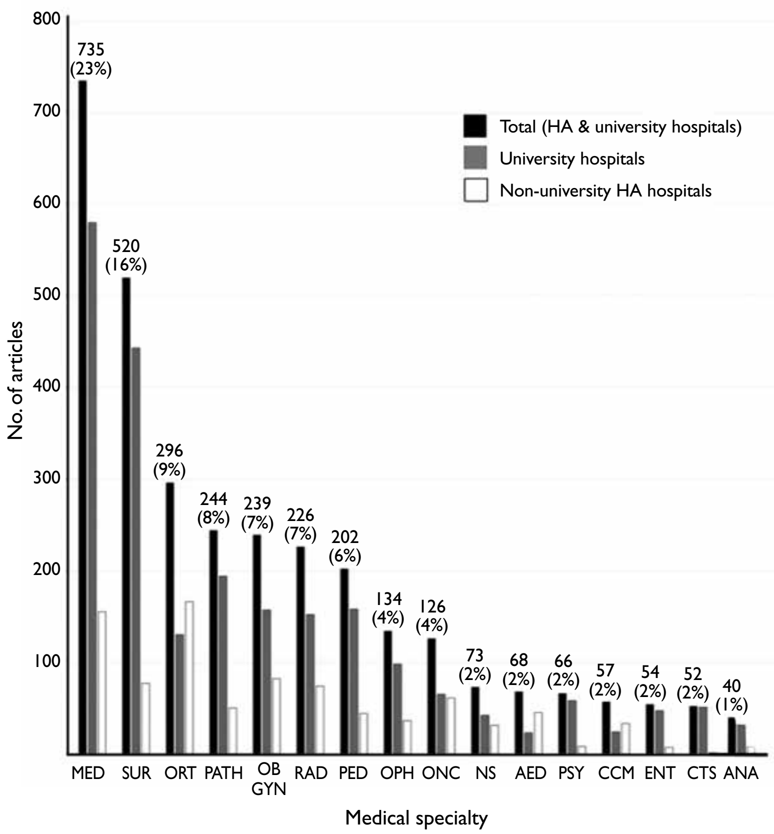

FIG 2. Distribution of original clinical research articles published by clinicians in Hong Kong acute care public hospitals across 17 medical specialties (2016-2021)*

Abbreviations: AED = accident and emergency medicine; ANA = anaesthesiology; CCM = critical care medicine; CTS = cardiothoracic surgery; ENT = otorhinolaryngology; HA = Hospital Authority; MED = internal medicine; NS = neurosurgery; OBGYN = obstetrics and gynaecology; ONC = clinical oncology; OPH = ophthalmology; ORT = orthopaedics and traumatology; PATH = pathology; PED = paediatrics; PSY = psychiatry; RAD = radiology; SUR = general surger

* Data are shown as No. (%)

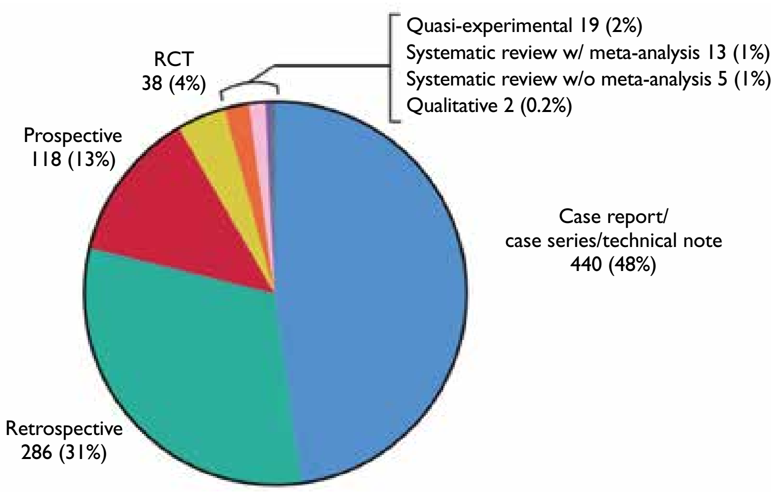

FIG 3. Distribution of original clinical research study designs adopted by non-university public hospital investigators (n=921)*

Abbreviations: RCT = randomised controlled trial; w/ = with; w/o = without

* Data are shown as No. (%)

TABLE 3. Comparison of original clinical research study designs produced by non-university and university hospitals*

Study design†	University hospitals (n=2187)	Non-university hospitals (n=916)	OR (95% CI)
Case report, series, technical note	449 (20.5%)	440 (48.0%)	0.3 (0.2-0.3)
Retrospective	748 (34.2%)	286 (31.2%)	NS
Prospective	685 (31.3%)	118 (12.9%)	3.3 (2.7-4.1)
Quasi-experimental	66 (3.0%)	19 (2.1%)	1.8 (1.0-3.3)
RCT	156 (7.1%)	38 (4.1%)	2.0 (1.4-2.9)
Systematic review with meta-analysis	47 (2.1%)	13 (1.4%)	2.5 (1.4-4.4)
Qualitative	1 (<0.1%)	2 (0.2%)	NS

Abbreviations: 95% CI = 95% confidence interval; NS = not statistically significant; OR = odds ratio; RCT = randomised controlled trial

* Data are shown as No. (%), unless otherwise specified

† Excluding systematic reviews without meta-analysis: university hospitals, n=34; non-university hospitals, n=5

TABLE 4. Original clinical research productivity across medical specialties among non-university hospital clinicians (2016-2021)

	Mean No. of FTE clinicians	No. of peer-reviewed published articles	Published articles/ clinician (×100)	Proportion of workforce as principal investigator*
AED	454	45	9.9	36 (7.9%)
ANA	337	8	2.4	8 (2.4%)
CTS	20	1	5.0	1 (5.0%)
ENT	75	7	9.3	6 (8.0%)
FM	498	9	1.8	7 (1.4%)
CCM	118	33	28.0	14 (11.9%)
MED	1205	155	12.9	89 (7.4%)
NS	78	31	39.7	9 (11.5%)
OBGYN	162	82	50.6	52 (32.1%)
ONC	108	61	56.5	31 (28.7%)
OPH	140	36	25.7	26 (18.6%)
ORT	316	166	52.5	62 (19.6%)
PED	326	44	13.5	37 (11.3%)
PATH	177	50	28.2	35 (19.8%)
PSY	336	8	2.4	8 (2.4%)
RAD	249	74	29.7	59 (23.7%)
SUR	457	77	16.8	64 (14.0%)
Total	**5056**	**887**	**17.5**	**544 (10.8%)**

Abbreviations: AED = accident and emergency; ANA = anaesthesiology; CCM = critical care medicine; CTS = cardiothoracic surgery; ENT = otorhinolaryngology; FM = family medicine; FTE = full-time equivalent; MED = internal medicine; NS = neurosurgery; OBGYN = obstetrics and gynaecology; ONC = clinical oncology; OPH = ophthalmology; ORT = orthopaedics and traumatology; PATH = pathology; PED = paediatrics and adolescent medicine; PSY = psychiatry; RAD = diagnostic and interventional radiology; SUR = surgery

* Data are shown as No. (%)

score relative to other medical disciplines (P<0.001) [Table 5].

For studies performed by non-university clinicians during this period, at the individual article level, the mean TNC per study was 6.33 ± 24.17, the mean number of citations per year was 1.81 ± 9.52, mean RCR was 0.82 ± 3.32, the mean FCR was 3.37 ± 2.04, and the mean NIH percentile achieved was 28.73 ± 25.85. Combined, radiology and otorhinolaryngology research articles had a significantly higher TNC per study (P<0.01) and a higher total number of annual citations (P<0.001) compared with other medical disciplines (Table 5). Articles in anaesthesiology, ophthalmology, otorhinolaryngology, and radiology had a mean RCR exceeding 1.00, indicating that their articles received a higher citation rate than their co-citation network. In particular, anaesthesiology and ophthalmology, studies achieved the highest mean NIH percentile rankings: their research outperformed 47% of all NIH-associated publications. Combined, anaesthesiology and ophthalmology studies also had a significantly higher NIH percentile ranking than other medical disciplines (P=0.001). All medical specialties had an FCR exceeding 1.00, indicating that their article citation rates were higher than those of their counterparts in the same research field. Oncology research had a significantly higher mean FCR (5.82 ± 2.41) compared with other disciplines (P<0.001) [Table 5].

In terms of author-level scientometric performance, 18.0% (98/544) of authors did not have a documented *h*-index. The mean *h*-index for the remaining researchers was 7.54 ± 10.98. Anaesthesiologists had a significantly higher *h*-index relative to other specialties (independent-samples *t* test, P=0.01) [Table 5]. A comparison of scientometric outcomes between university and non-university clinical research also demonstrated uniformly superior performance by academic institution investigators (Table 6).

Original clinical research and patient outcomes

For non-university-affiliated hospitals, the overall mean crude mortality rate per 100 000 hospitalised patients was 27 722 ± 5208. Spearman's rank analysis identified significant negative correlations of mortality rate with TNC (r=-0.69; P=0.01) and RCR (r=-0.63; P=0.022). The overall annual mean number of unplanned readmissions within 30 days of discharge was 1408 ± 756. Similarly, there were significant negative correlations of readmissions with TNC (r=-0.76; P=0.02) and RCR (r=-0.72; P=0.006). The overall mean LOS was 11.7 ± 3.1 days. No significant correlations between LOS and TNC (r=-0.32; P=0.29) or LOS and RCR (r=-0.36; P=0.23) were detected. None of the other scientometric

TABLE 5. Original clinical research quality by scientometric indices across medical specialties among non-university hospital clinicians (2016-2021)*

	Journal-level metric		Article-level metric					Author-level metric
	IF	ES	TNC	Citations per year	FCR	RCR	NIH percentile	*h*-index†
AED	2.53 ± 1.28	0.01 ± 0.02	5.53 ± 7.12	1.06 ± 1.28	3.23 ± 1.85	0.58 ± 0.69	25.62 ±2 4.56	8.00 ± 12.07
ANA	3.01 ± 3.29	0.01 ± 0.01	9.38 ± 8.14	2.49 ± 2.34	3.59 ± 1.49	1.19 ± 0.94	46.66 ± 28.54	13.40 ± 23.86
CTS	0	0	3.00 ± 0	0.75 ± 0	3.77 ± 0	0.37 ± 0	19.60 ± 0	1.00 ± 0
ENT	3.34 ± 0.94	0.02 ± 0.01	13.29 ± 20.70	3.45 ± 6.00	3.31 ± 2.41	1.24 ± 1.88	35.06 ± 38.99	6.0 ± 2.74
FM	0.61 ± 1.09	0	2.56 ± 2.24	0.61 ± 0.59	3.66 ± 1.99	0.25 ± 0.19	12.88 ± 10.55	3.80 ± 4.15
CCM	3.51 ± 5.56	0.01 ± 0.03	5.00 ± 7.51	1.18 ± 1.49	3.65 ± 1.48	0.57 ± 0.70	25.17 ± 26.06	3.67 ± 3.23
MED	3.17 ± 3.77	0.02 ± 0.10	8.90 ± 16.41	1.69 ± 2.73	4.04 ± 1.93	0.70 ± 1.07	26.47 ± 27.35	9.23 ± 11.11
NS	2.11 ± 1.40	0.01 ± 0.01	6.20 ± 5.35	1.42 ± 1.08	3.77 ± 2.17	0.71 ± 0.46	34.73 ± 20.12	4.57 ± 3.60
OBGYN	1.94 ± 1.63	0.01 ± 0.01	4.72 ± 4.64	1.02 ± 0.58	3.51 ± 1.97	0.56 ± 0.54	26.77 ± 22.27	9.83 ± 11.92
ONC	5.22 ± 8.18	0.06 ± 0.22	11.74 ± 16.21	2.52 ± 2.79	5.82 ± 2.41	0.84 ± 0.96	34.85 ± 26.79	5.86 ± 7.58
OPH	2.18 ± 1.57	0.01 ± 0.02	11.89 ± 17.02	2.30 ± 2.59	2.79 ± 1.08	1.37 ± 1.36	47.72 ± 29.74	10.04 ± 9.32
ORT	0.39 ± 0.95	0	5.14 ± 7.30	0.99 ± 1.47	1.92 ± 0.86	0.69 ± 0.89	29.60 ± 23.95	4.83 ± 5.12
PED	2.75 ± 2.25	0.01 ± 0.01	7.57 ± 10.86	1.93 ± 3.52	3.72 ± 1.56	0.84 ± 1.35	29.79 ± 27.20	9.44 ± 15.03
PATH	3.16 ± 3.42	0.01 ± 0.04	8.52 ± 20.47	2.37 ± 6.78	4.88 ± 2.36	0.83 ± 2.01	26.43 ± 26.11	4.83 ± 5.12
PSY	1.38 ± 1.49	0	7.50 ± 11.51	1.33 ± 1.93	2.94 ± 1.25	0.65 ± 0.88	26.51 ± 29.12	4.13 ± 5.52
RAD	2.51 ± 5.09	0.01 ± 0.02	13.45 ± 93.70	4.20 ± 31.25	2.53 ± 1.89	1.59 ± 10.85	17.61 ± 21.13	4.46 ± 7.69
SUR	1.77 ± 1.78	0.01 ± 0.01	8.11 ± 18.26	1.95 ± 5.60	2.78 ± 1.55	0.92 ± 1.75	32.13 ± 26.61	8.20 ± 14.00

Abbreviations: AED = accident and emergency; ANA = anaesthesiology; CCM = critical care medicine; CTS = cardiothoracic surgery; ENT = otorhinolaryngology; ES = Eigenfactor score; FCR = Field Citation Ratio; FM = family medicine; IF = impact factor; MED = internal medicine; NIH = National Institutes of Health; NS = neurosurgery; OBGYN = obstetrics and gynaecology; ONC = clinical oncology; OPH = ophthalmology; ORT = orthopaedics and traumatology; PATH = pathology; PED = paediatrics and adolescent medicine; PSY = psychiatry; RAD = diagnostic and interventional radiology; RCR = Relative Citation Ratio; SUR = surgery; TNC = total number of citations

* Data are shown as mean ± standard deviation

† 82.0% (446/544) of individual authors had a documented *h*-index

indices were associated with the crude mortality rate, number of unplanned readmissions, or LOS.

Discussion

This study reviewed the breadth and quality of original clinical research conducted by Hong Kong's public healthcare professionals. It is encouraging to observe that, despite the heavy workload of frontline clinicians employed in non-university public hospitals, more than 10% of the workforce engaged in original research as principal investigators. Their endeavours contributed to nearly one-third of peer-reviewed publications produced in the territory. A multi-level scientometric approach was adopted to assess research quality, and our findings indicate that the studies undertaken met the standards of their respective fields. Although the IF and ES values of the published research were not high, all medical specialties achieved a mean FCR of over 1.00. Notably, anaesthesiology, ophthalmology, otorhinolaryngology, and radiology articles attained an RCR exceeding 1.00.

TABLE 6. Comparison of scientometric performance of clinician-led research articles (2016-2021) between university and non-university hospitals*

	University hospital (n=1902)	Non-university hospital (n=887)	Independent-samples *t* test, P value
Journal-level			
IF	5.04 ± 5.71	2.34 ± 3.72	<0.001
ES	0.051 ± 0.19	0.01 ± 0.07	<0.001
Article-level			
TNC	12.41 ± 52.28	6.33 ± 24.17	0.001
Citations per year	3.94 ± 17.56	1.81 ± 9.52	0.001
RCR	1.53 ± 5.87	0.82 ± 3.32	0.001
FCR	4.66 ± 2.27	3.37 ± 2.04	0.002
NIH percentile	41.70 ± 29.07	28.73 ± 25.85	<0.001
Author-level			
h-index	14.95 ± 12.52	7.54 ± 10.98	<0.001

Abbreviations: ES = Eigenfactor score; FCR = Field Citation Ratio; IF = impact factor; NIH = National Institutes of Health; RCR = Relative Citation Ratio; TNC = total number of citations

* Data are shown as mean ± standard deviation, unless otherwise specified

Assessing research impact: the Relative Citation Ratio

Introduced in 2016, the RCR is a relatively novel article-level metric that measures a publication's relevance within the biomedical literature.[24] It was developed in response to the limitations of conventional indicators of scientific quality, such as the IF[25] and *h*-index.[26] For example, as multidisciplinary collaborations have become more common, researchers in disparate fields may have unequal access to high-profile journals, undermining the IF as a reliable reflection of a study's performance.[21,24,25] Conversely, the *h*-index does not consider an author's total number of citations and instead reflects cumulative output, which can disadvantage early-career researchers. Despite their limitations, the IF[25] and *h*-index[26] remain pivotal scientometric indices in decisions related to funding and career progression. Given that citations are widely recognised as a form of acknowledging a researcher's contribution to the field, efforts have been made to formalise this practice into a quantifiable metric. Endorsed by the NIH, the RCR harnesses an article's co-citation network, normalising the number of citations received according to the article's publication time and field of expertise. It is calculated as the ratio of the article's actual citation rate—derived from the FCR—to the expected rate, benchmarked against NIH-funded publications issued in the same year and specialty.[24] In recent years, the RCR has gained recognition as a more reliable indicator of an article's performance within its peer comparison group and is increasingly cited in research grant applications.[27-29]

Comparisons with university-affiliated hospitals

The present study showed that university hospitals not only outperformed non-university hospitals in terms of research productivity, but also demonstrated greater influence across all scientometric outcomes. In addition to resource consolidation and the employment of clinician-scientists, another reason for this discrepancy might be the type of studies produced. Approximately half of the articles from non-university hospitals were case reports or technical notes, which provide a lower level of evidence in the evidence-based medicine hierarchy and consequently tend to receive fewer citations. Nonetheless, this form of research is more accessible to junior clinicians and can serve as a gateway to medical writing in resource-limited settings.[30] Case reports offer valuable insights into the real-world implications of clinical practice—findings that well-designed randomised controlled trials may fail to capture. They can also stimulate others to report similar observations, serving as a hypothesis-generating opportunity for subsequent systematic enquiry.[31]

Translating research impact into real-world patient outcomes

Few studies have tested the hypothesis that research activity results in improved patient outcomes.[4,5,7,8,32] We observed that non-university hospitals whose staff engaged in clinical research had lower crude mortality rates and annual 30-day unplanned readmissions. These findings are supported by reports that patients treated at hospitals participating in clinical trials fared better in terms of 30-day post-intervention mortality and overall survival, relative to those treated at hospitals without such arrangements. This trend has been observed for conditions including acute myocardial infarction, small-cell lung cancer, colorectal cancer, breast cancer, and ovarian cancer.[5,33-37] The possibility of a trial effect was reinforced by a systematic review of 13 studies, which attributed this phenomenon to healthcare providers' greater adherence to clinical practice guidelines and their inclination to adopt evidence-based practices.[8] A subsequent systematic review of 33 studies further demonstrated that research activity improved healthcare system performance—reflected by reductions in LOS and risk-adjusted mortality, as well as improvements in patient satisfaction.[9] In contrast, few studies have quantitatively analysed peer-reviewed scientometric data and its relationship with patient outcomes. For specific disease conditions, a negative correlation was observed between acute myocardial infarction–related risk-adjusted mortality and a weighted citations ratio among 50 Spanish hospitals.[7] A review of 147 National Health Service trusts in the UK demonstrated a negative correlation between the number of research article citations per admission and standardised mortality ratios.[5] Econometric modelling using data from 189 Spanish hospitals detected a significant reduction in LOS among institutions that published more clinical research articles or had a higher TNC per article.[6]

Encouraging public hospital healthcare professionals to become principal investigators

There is increasing evidence that clinical research engagement improves patient outcomes, but several barriers to participation remain. First, clinicians have demanding responsibilities that often prohibit involvement in this time-consuming and resource-intensive activity.[38-40] Clinicians are under-recognised for their overtime efforts—when such work is typically undertaken—and are overburdened with administrative procedures. Research-supportive policies that provide protected time or incentivise clinicians through career advancement could help foster a more scholastic environment.[40] Second, Hong Kong has a lengthy and duplicative clinical trial approval process. In a survey of 250 clinician-researchers, 90% reported that approval for a phase I first-in-human study certificate from the Hong Kong SAR Government's Department of Health required over 3 months.[15] Additionally, for HA Clinical Research Ethics Committee study approvals, 50% of respondents reported that the process typically lasted more than 3 months, whereas multi-centre trials frequently required over a year to begin recruitment.[15] The establishment of a primary review authority for investigative drug registration—similar to the United States Food and Drug Administration, European Medicines Agency, or China's National Medical Products Administration—could help streamline regulatory pathways. Third, most funding agencies favour academician-led research over community clinician-led efforts.[38] For example, the existing Hong Kong SAR Government's Health and Medical Research Fund and the Health Care and Promotion Fund—with a combined annual budget of US$530 million—have primarily been allocated to academicians with access to robust research infrastructure. The lack of financial support for community hospitals to develop research capabilities can have clinical implications.[4,38-40] A review of funding allocations from the NIHR revealed that National Health Service trusts receiving relatively lower levels of research funding had higher risk-adjusted mortality.[4] A survey of healthcare professionals in Ontario, Canada, showed that 46% were dissatisfied with their research involvement, although 83% agreed it benefited their careers.[39] The major barriers identified were a lack of mentorship and institutional stewardship.[39] The establishment of a clinical research institute and academy dedicated to supporting early-career clinician-scientists could help address these challenges.[15] Modelled after the NIHR, the provision of publicly funded administrative services to accelerate translational research—by facilitating grant applications for non–university-affiliated hospitals, offering biostatistical support, training research support staff, and nurturing partnerships in a multi-stakeholder ecosystem—can be transformative.[40] Following the introduction of NIHR services, there was a tenfold rise in publications, accompanied by a significant increase in mean citation ratios.[41] A survey of NIHR stakeholders—including clinicians, nurses, and allied health professionals—also revealed that its training programmes enhanced their research capacity and strengthened individual career development.[42]

Limitations

This study had several limitations. First, we retrieved studies only from the MEDLINE database and not from other sources such as Scopus, Web of Science, Google Scholar, PsycINFO (psychology), CINAHL (nursing and allied health), or HMIC (healthcare management, administration, and policy). MEDLINE was selected because it is the only freely accessible primary source for interrogating the biomedical literature without requiring an institutional user account. While MEDLINE focuses primarily on medicine and the biomedical sciences, other databases cover broader disciplines. Inclusion of these databases would have been ideal, but resource constraints prevented manual review for relevance. Second, a comparison of patient outcomes between university and non-university hospitals was not performed as we were unable to determine whether the principal investigator at teaching hospitals was HA-employed or university-affiliated. Third, only crude mortality rates and LOS were evaluated. A more comprehensive review of public healthcare system key performance indicators—such as risk-adjusted or standardised mortality rates, symptom-to-intervention durations, incremental cost-effectiveness ratios, and patient satisfaction survey results—would have provided greater insight if such data were available.[6,43] Important confounding factors were also not assessed, including each hospital's annual operational income; differences in catchment population size and demographics; and variations in the scope of acute clinical services provided. For example, some institutions are recognised as level-one trauma centres or infectious disease centres. Finally, clinical research from specialties such as psychiatry and family medicine was likely under-represented, as most clinicians in these fields work in dedicated psychiatric hospitals or general outpatient clinics, which are outside the scope of this study focused on general acute care hospitals.

Conclusion

This study revealed that clinicians in Hong Kong's public healthcare system produced nearly one-third of the original peer-reviewed clinical research articles published from the territory. Although the majority of these articles were case reports or retrospective studies, they achieved a relatively high degree of research influence within their respective medical specialties. Research productivity appears to be associated with improved patient outcomes, particularly in terms of crude mortality rates and 30-day unplanned readmissions. Future studies using more refined key performance indicator endpoints and adjustments for confounding factors are necessary to ascertain whether research-active institutions consistently deliver better patient outcomes.

Author contributions

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All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have disclosed no conflicts of interest.

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Ethics approval

The research was approved by the Joint Chinese University of Hong Kong–New Territories East Cluster Clinical Research Ethics Committee, Hong Kong (Ref No.: 2025.256).

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