





## REVIEW

# A benchmarking scoping review of research output from hospital pharmacy departments in Australia

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## Abstract

**Aim:** To benchmark annual research output from hospital pharmacy departments in Australian principal referral hospitals.

**Data sources:** Embase, Medline, and Scopus.

**Study selection:** All 29 principal referral hospitals listed by the Australian Institute of Health and Welfare were searched using the institution field from 2018–2020. Articles were included if an author was affiliated with a hospital pharmacy department. Conference abstracts, letters, narrative reviews, opinions, commentaries, or editorials were excluded.

**Results:** A total of 261 research articles were identified from 27 principal referral hospital pharmacy departments from 2018–2020. Median research output over 3 years was five (interquartile range, 3–9) articles. In terms of annual research, hospital pharmacy departments in the 50th and 90th percentile for total publication output published two and ten original research articles every year, respectively. Overall, 56% ( $n = 145$ ) of the published studies were observational, 35% ( $n = 90$ ) had a first author with a pharmacy department affiliation, 97% ( $n = 252$ ) had at least one author with a university affiliation, and in 5% ( $n = 12$ ) of the articles there was more than one hospital pharmacy department affiliation.

**Conclusion:** On average, hospital pharmacy departments in Australian principal referral hospitals publish two original research articles every year. Nearly all of these articles are published in collaborations with universities.

**Keywords:** hospital pharmacy, research, publication, publishing, review.

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## INTRODUCTION

It is widely accepted that a strong research culture in hospitals is beneficial.<sup>1</sup> At an institutional level, greater

hospital research engagement has been associated with improved healthcare performance.<sup>2</sup> The mechanism of this association is complex. It may be because of direct effects on patient care as new services and therapeutics are evaluated, or as a by-product of improved processes of care during clinician engagement with research.<sup>2</sup> However, the benefits may extend beyond patient care by also improving staff satisfaction and

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reducing workforce turnover.<sup>1</sup> It is expected that a similar construct would apply to hospital pharmacy departments.

According to The Society of Hospital Pharmacists of Australia (SHPA) standards of practice, involvement in research is considered to be a core pharmacy practice activity.<sup>3</sup> The *National Competency Standards Framework for Pharmacists in Australia*<sup>4</sup> and the International Pharmaceutical Federation<sup>5</sup> also have performance criteria related to research participation and involvement. At the advanced level of practice, performance criteria include an expectation of research output in the form of peer-reviewed publications.<sup>4,5</sup> In 2019, SHPA developed a Research Stream within the Specialty Practice program, to acknowledge and support research as a core hospital pharmacist role. As part of the Research Leadership Committee of the SHPA Research Specialty Practice group, we were interested in the current research output of hospital pharmacy departments in Australia. However, the extent of such research output is unknown. There are also no international benchmarks from other developed countries. Benchmarking research output in the Australian context is important to guide future improvements. It will help hospitals prioritise resources to facilitate and encourage research.

The objective of this scoping review is to benchmark annual research output from hospital pharmacy departments in Australian principal referral hospitals.

## METHODS

### Protocol and Registration

The scoping review protocol was developed prior to the start of the first search and registered on Open Science Framework (<https://osf.io/yagqt>). Protocol registration number: YAGQT.

### Eligibility Criteria

Articles were included in the study if they were a peer-reviewed research publication, produced by a pharmacy department in an Australian principal referral hospital from 1 January 2018 to 31 December 2020. Conference abstracts, letters, narrative reviews, opinions, commentaries, and editorials were excluded from the study.

### Information Sources

Embase, Medline, and Scopus were searched using a date range from 1 January 2018 to 31 December 2020. The search was conducted on 18 October 2021.

## Search

All 29 principal referral hospitals listed by the Australian Institute of Health and Welfare (AIHW)<sup>6</sup> were included as these would be expected to have the highest research output. An electronic search was conducted for both Embase and Medline using the Ovid interface. The Scopus interface was used when searching Scopus. No language restrictions were applied. Limits were placed to exclude publications that were only abstracts. The full search for Medline is provided in Appendix S1. The institution field was used to capture research output from pharmacy departments for each hospital. Furthermore, each retrieved article was checked manually to ensure institutional affiliation was accurate. The search was run for each hospital to retrieve articles for that hospital pharmacy department.

## Selection of Sources of Evidence

The screening was conducted by SN and checked for accuracy by JP/SP. Duplicate articles were removed. For each article, both institutional field and author information were manually screened to confirm research output from each hospital. Only original research articles were included as defined by the Centre for Evidence-Based Medicine (CEBM).<sup>7</sup>

## Data Charting Process

The data from each article was entered into a REDCap (Research Electronic Data Capture) form.<sup>8</sup> REDCap is a secure web-based platform to collect data. This information was entered into a data collection instrument that was agreed upon via consensus by the investigators. The data were collected by SN. A random 10% sample was checked for accuracy by JP/SP. Potential outliers were assessed via descriptive statistics (e.g. systematic reviews were categorised as low level of evidence). As errors were identified, the full sample was double checked by two investigators (JP/SP) for accuracy.

## Data Items

Data collected from each article included the institutional names of pharmacy departments involved, year of publication (2018, 2019, and 2020), and study type (systematic review with or without meta-analysis, clinical trial, observational, survey, qualitative, case report, or other). In addition, we identified whether the article met any of the following criteria: first author affiliation was a hospital pharmacy department, at least one

author had a university affiliation, or at least one author had a hospital pharmacy department affiliation and no university affiliation.

### Critical Appraisal of Individual Sources of Evidence

Each article was assessed according to the level of evidence rating according to CEBM by two independent reviewers.<sup>7</sup> Any discrepancies were reviewed by a third independent reviewer until consensus was met. The CEBM ratings range from 1 to 5. These ratings are determined by both study design and research question. For example, studies assessing the impact of an intervention would generally be given a CEBM rating of 1 for systematic reviews, 2 for randomised clinical trials, 3 for cohort studies, 4 for case-control studies/case series, and 5 for mechanism-based reasoning/bench research. Ratings are also downgraded based on factors such as study quality, imprecision, indirectness, inconsistency, or small effect size, and can be graded up with large effect sizes. The full details of the methodology are available from CEBM.<sup>7</sup>

### Synthesis of Results

Descriptive statistics were conducted on the research output. Research output was first summarised overall by year, article type, level of evidence, university affiliation, first author with pharmacy department affiliation, level of collaboration between hospitals, and research output by state. Hospital level analyses were conducted by masking individual hospital name. Thus, hospital name was replaced by a number. This number has no relationship to the hospital's position on the AIHW list. The total number of publications and type of publications were totalled for each hospital. This was summarised across the hospitals and expressed as 10th, 25th, 50th, 75th, and 90th percentiles for benchmarking. Some hospital pharmacy departments have academic staff from universities who are affiliated with the hospital pharmacy department. It was thought that such affiliations would inflate the research output of those hospital pharmacy departments because their research output may include research not conducted by the department. To account for this, we also summarised the data after removing articles that did not include at least one other pharmacist from the hospital pharmacy department who did not have a university affiliation to provide a better representation of research output for that hospital (sensitivity analysis 1). In addition, an analysis was conducted to depict the number of publications

where the first author had a hospital pharmacy department affiliation (sensitivity analysis 2). Proportion of publications were compared between those that had a first author with a hospital pharmacy department affiliation and those without a hospital pharmacy affiliation for study type and level of evidence. These were compared using Fisher's exact test with a p value of less than 0.05 being considered significant. All analyses were conducted in STATA 15 (College Station, TX, USA) and R software (R Foundation for Statistical Computing, Vienna, Austria, version 4.0.3).

## RESULTS

### Overall Research Output

The search yielded 425 articles after duplicates were removed. After articles were assessed for eligibility, 261 research articles from 27 principal referral hospital pharmacy departments in Australia were identified during the 3-year time period. Two principal referral hospitals had no publications from their hospital pharmacy department. The PRISMA flow diagram (Figure 1) depicts the process of article selection. The number of articles in 2018, 2019, and 2020, were 90, 77, and 94, respectively. The study type and level of evidence for each article is in Table 1. Overall, the most common type of study was observational (56%,  $n = 145$ ) and CEBM level of evidence was 3 (50%,  $n = 130$ ).

### Research Output by Hospital

Median research output over 3 years was three (interquartile range [IQR]: 3–9) articles. In the first sensitivity analysis using the subset with at least one author with hospital pharmacy department affiliation and no university affiliation, the median was four (IQR: 2–6) articles. In the second sensitivity analysis using the subset having the first author with hospital pharmacy department affiliation, the median was three (IQR: 1–4) articles. The annual output and values for the 10th, 25th, 50th, 75th, and 90th percentiles are in Table 2. Hospitals in the 25th, 50th, 75th, and 90th percentile published on average one, two, three, and ten original research articles every year, respectively. If articles were restricted to those that had at least one author with hospital pharmacy department affiliation and no university affiliation then the annual output for the 25th, 50th, 75th, and 90th percentile reduced to zero, one, two, and three original research articles every year, respectively. Figure 2 depicts the type of article published for each hospital in the primary and sensitivity analyses.

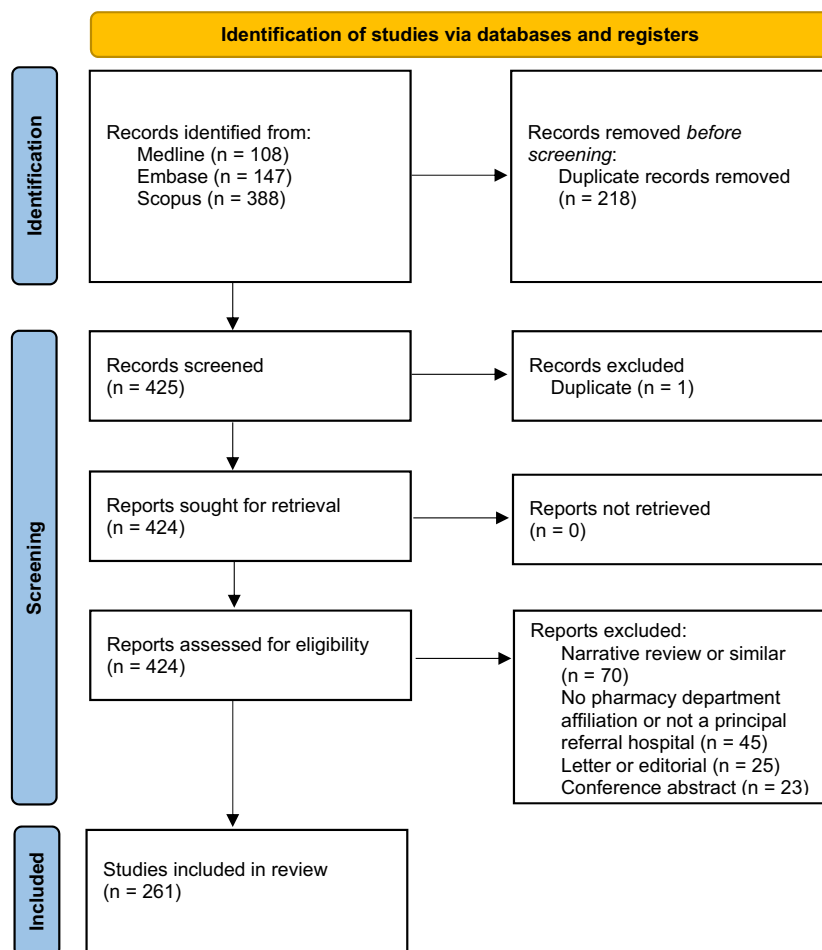


Figure 1 PRISMA flow diagram for study selection.

### First Author Articles

The first author had a pharmacy department affiliation in 35% ( $n = 90$ ) (subgroup for sensitivity analysis 2) of articles. Articles where the first author had a pharmacy department affiliation were more likely to be systematic reviews and less likely to be stability studies (Table 1). This mirrored the level of evidence differences. Thus, articles where the first author had a pharmacy department affiliation were more likely to be level of evidence 1 and less likely to be level of evidence 5 (Table 1). Table 1 has data stratified by first author for each article type and level of evidence.

### University Affiliation

Most articles, 97% ( $n = 252$ ), had at least one author with a university affiliation. Of these 252 articles, if a university affiliation was present, then in 53% ( $n = 135$ ) of articles, the author had both a hospital and university

affiliation, and in 47% ( $n = 117$ ) of articles, the university affiliation was from an author who was not affiliated with the pharmacy department. Overall, 48% ( $n = 126$ ) of articles had at least one author with a hospital pharmacy department affiliation and no university affiliation (subgroup for sensitivity analysis 1).

### Research Collaboration

As there may be collaboration between hospitals, an article may have more than one pharmacy department. In 5% ( $n = 12$ ) of the articles there was more than one hospital pharmacy department affiliation. There were 278 pharmacy department affiliations in the 261 articles.

### Research Output by State

In the primary analysis, the rank of research output by state from most to least was Queensland, Victoria and New South Wales, South Australia, Tasmania, Western

**Table 1** Count of articles published by Australian principal referral hospitals between 2018–2020 by article type and level of evidence

	Overall, n (%)	First author not pharmacy department, n (%)	First author pharmacy department, n (%)	p- value
<b>Study type<sup>a</sup></b>				
Systematic review	26 (10)	11 (6)	15 (17)	0.015
Clinical trial	10 (4)	7 (4)	3 (3)	1.000
Observational	145 (56)	92 (54)	53 (59)	0.512
Survey	11 (4)	6 (4)	5 (6)	0.520
Qualitative	13 (5)	10 (6)	3 (3)	0.552
Case report	25 (10)	17 (10)	8 (9)	1.000
Stability studies	17 (7)	17 (10)	0 (0)	0.001
Other	14 (5)	11 (6)	3 (3)	0.392
<b>Level of evidence<sup>b</sup></b>				
1	14 (5)	5 (3)	9 (10)	0.021
2	22 (8)	13 (8)	9 (10)	0.493
3	130 (50)	83 (49)	47 (52)	0.604
4	27 (10)	16 (9)	11 (12)	0.523
5	68 (26)	54 (32)	14 (16)	0.005

<sup>a</sup>Percentages may not add to 100% due to rounding.

<sup>b</sup>According to the Oxford Centre for Evidence-Based Medicine classification system.<sup>7</sup>

Australia, Northern Territory, and Australian Capital Territory. However, the order of the top three changed in the sensitivity analyses, with Victoria having the highest output (Table 3).

## DISCUSSION

This study showed that pharmacy departments in Australian principal referral hospitals generally publish at least two original research articles every year. This is reduced to one original research article every year where the first author is affiliated with the hospital pharmacy department. However, hospitals in the 90th percentile are publishing substantially more (average ten per year) than hospitals in the 50th percentile (average two per year). This disparity indicates that there is potential for the 50th percentile hospitals to increase their research output. For instance, principal referral hospitals appear to be engaged with research, as these hospitals had on average eight abstracts presented at the annual SHPA Medicines Management Conference in 2019, but few of them are being published.<sup>9</sup> This publication rate is similar to those reported from pharmacy

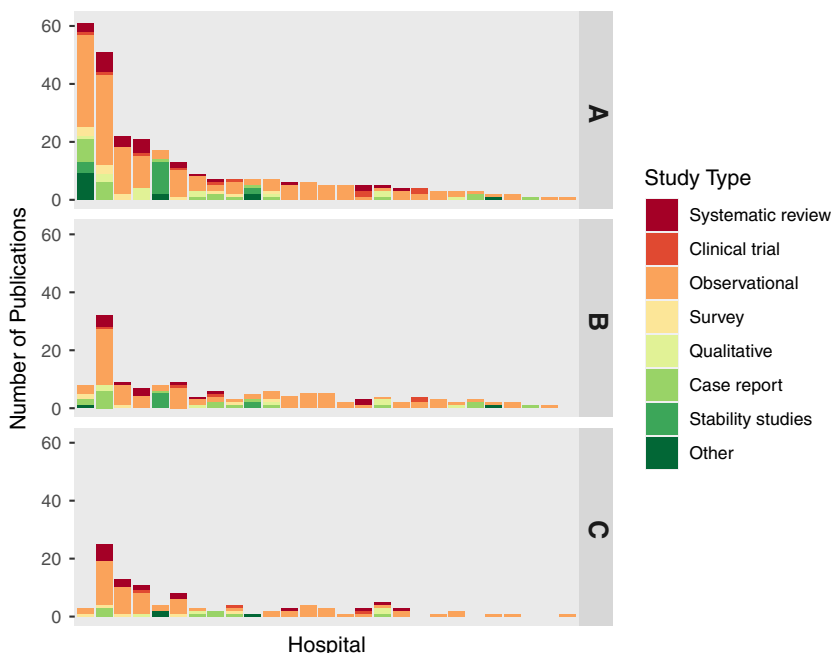
**Table 2** Count of articles published by Australian principal referral hospitals by percentile

	Number of publications by percentile rank				
	10th	25th	50th	75th	90th
<b>All publications</b>					
2018	0	1	1	3	12
2019	0	1	2	3	7
2020	0	1	2	3	12
Total over 3 years	1	3	5	9	31
<b>Publications having at least one author with hospital pharmacy department affiliation and no university affiliation</b>					
2018	0	0	0	1	2
2019	0	0	1	1	2
2020	0	0	1	3	4
Total over 3 years	0	0	2	5	8
<b>Publications having the first author with hospital pharmacy department affiliation with or without university affiliation</b>					
2018	0	0	1	2	3
2019	0	0	1	3	4
2020	0	0	1	2	3
Total over 3 years	0	0	3	7	10

residency projects in the United States, ranging from 2–20%,<sup>10–14</sup> and appear to be significantly lower than the 37% publication rate reported for all healthcare professionals.<sup>15</sup>

Dedicated research time, research training, and support from fellow pharmacists, employers, and line managers have all been identified as ways to improve pharmacists' involvement in research.<sup>16</sup> SHPA have also implemented multiple strategies to increase the publication rates of hospital pharmacists. This includes the introduction of the SHPA Australian Pharmacy Residency program in 2019, which includes a mandatory research project component and the recognition of Research as a SHPA Specialty Practice stream.<sup>17</sup> Such programs may increase hospital publication rates, but the effect can take several years to occur. Hence, results from this paper may be used as a baseline to compare publication rates of hospital pharmacy departments every 5 years to evaluate the impact of such strategies.

This study also identified that nearly every paper (97%) published by a hospital pharmacy department occurred in collaboration with a university. These results seem consistent with a systematic review of nine studies that identified hospitals with a university affiliation as a critical factor that improved hospital pharmacy participation in research.<sup>16</sup> In particular, Perreault et al.<sup>18</sup> found that pharmacy departments with a university affiliation were nearly four times as likely to be involved in research when adjusting for pharmacists' training,



**Figure 2** Research output per hospital by article type. (A) All articles. (B) Sensitivity analysis 1: subset with at least one author with hospital pharmacy department affiliation and no university affiliation. (C) Sensitivity analysis 2: subset with the first author with hospital pharmacy department affiliation with or without university affiliation. Hospitals are in the same order in A, B, and C to depict changes in output in each hospital based on sensitivity analyses.

**Table 3** Count of articles published by Australian principal referral hospitals between 2018–2020 by state

Primary ( <i>n</i> = 278)		Sensitivity 1 ( <i>n</i> = 140) <sup>a</sup>		Sensitivity 2 ( <i>n</i> = 104) <sup>b</sup>	
State	<i>N</i> (%) <sup>c</sup>	State	<i>N</i> (%) <sup>c</sup>	State	<i>N</i> (%) <sup>c</sup>
QLD	96 (35)	VIC	50 (36)	VIC	32 (31)
VIC	73 (26)	NSW	30 (21)	QLD	23 (22)
NSW	43 (16)	QLD	25 (18)	NSW	21 (20)
SA	34 (12)	SA	17 (12)	SA	21 (20)
TAS	17 (6)	TAS	8 (6)	TAS	4 (4)
WA	12 (4)	WA	7 (5)	WA	2 (2)
NT	2 (1)	NT	2 (1)	NT	1 (<1)
ACT	1 (<1)	ACT	1 (<1)	ACT	0 (0)

ACT = Australian Capital Territory; NSW = New South Wales; NT = Northern Territory; QLD = Queensland; SA = South Australia; TAS = Tasmania; VIC = Victoria, WA = Western Australia.

<sup>a</sup>Subset with at least one author with hospital pharmacy department affiliation and no university affiliation.

<sup>b</sup>Subset with the first author with hospital pharmacy department affiliation with or without university affiliation.

<sup>c</sup>Percentages may not add to 100% due to rounding.

personal interest, medical team, and administration support. Furthermore, pharmacy residency projects that had co-investigators affiliated with a university and a high h-index were also shown to increase the rates of

publications.<sup>19</sup> Similar benefits on departmental research culture have also been observed in medical, nursing, and allied health professional departments.<sup>20,21</sup> On the other hand, only half of the articles identified had at least one author with a hospital pharmacy department affiliation only. This means the authors with joint university and hospital affiliations may not be regularly involving pharmacists from their pharmacy department in their research. As authors with a joint university and hospital affiliations aim to increase research culture and capacity in the pharmacy department, it is recommended that they mentor and train other hospital pharmacists when conducting and publishing hospital-based research. In addition, it is recommended that performance evaluations of researchers with joint university and hospital affiliations should include how they have supported individuals and departments to engage in research in addition to traditional research metrics (e.g. publications and grants).<sup>22</sup>

Over half of all published articles by hospital pharmacy departments were observational studies. This rate is similar to the 41% of published US pharmacy residency projects, which are observational studies.<sup>12</sup> Such study designs may have started as medication audits or quality improvement projects and may be the first exposure many hospital pharmacists have to research. It is recommended that such studies involve authors from multiple

hospitals as one large multisite study may support patient outcomes more than multiple smaller research projects with limited generalisability. Such practices would also provide pharmacists with the opportunity to engage with research further. However, currently there appears to be very few joint research projects occurring between hospitals, as only 5% of articles included authors with more than one hospital pharmacy department affiliation. Another entry point to research may be systematic reviews. This study identified that articles with a first author from a pharmacy department were more likely to be a systematic review than first authors outside of pharmacy. This may highlight the growing need for hospital pharmacists to review and consolidate evidence in their routine clinical practice. A cross-sectional survey found that over 80% of pharmacists believe evidence-based medicine improves patient care.<sup>23</sup> However, these pharmacists may also be conducting systematic reviews as part of a higher degree. Regardless of the reason, as nearly all hospitals in Australia have access to health libraries, pharmacists may find publishing a systematic review a relevant starting point for research.

The intent was to benchmark hospital pharmacy research output for a 1-year period. However, publication output is a lagging indicator that represents previous work done. This is because of the time taken from idea conception to publication. In addition, publication output can fluctuate substantially year to year. Delays may also occur due to peer review or journal editorial processes, which may not be directly related to investigators' research output. Thus, to obtain a more accurate benchmark for 1 year, research output was averaged over the 3-year period. Many hospital departments may also be involved in research activities that may not be published due to a variety of reasons (e.g. lack of time, negative results, poor study quality).<sup>24</sup> These research activities are important for departments' internal quality assurance, research culture, and building staff confidence in research. However, published research ensures the work has a certain level of quality, completeness, and external generalisability that is more suitable for benchmarking. Published research also allows hospitals to learn from each other to prevent other hospitals from repeating similar activities, even if the results were negative.<sup>24</sup> We encourage hospital departments to publish their research to ensure more patients benefit from their research activities.

A major strength of our study was the rigorous article selection process utilising the institutional field from different databases. However, this study has some limitations. First, the search was limited to principal referral hospitals in Australia as it would not have been feasible to search for every Australian hospital in the databases. Principal referral hospitals are more likely to have

university affiliations than other hospital pharmacy departments. Furthermore, private hospitals were not included in this study as all principal referral hospitals in Australia are public hospitals. However, it is assumed that principal referral hospitals are more likely to engage with research than non-principal referral hospitals. In this case, the publication rate of hospital pharmacy departments in Australia may be lower than that which is reported in this study. Second, some articles only listed authors' hospital affiliation and not their department affiliation. These articles were excluded from the final analysis as we could not determine if the authors worked for a pharmacy department. Similarly, in some regions pharmacy staff are employed by clinical governance teams, digital transformation teams, or a local health network to work across multiple sites. These publications would not list the pharmacy department of a particular hospital and would not have been detected. Hence, the number of articles published by hospital pharmacy departments of principal referral hospitals may be higher than what is reported in this study. Third, a large number ( $n = 70$ ) of articles published by hospital pharmacists were excluded from this review as they were narrative reviews. Although narrative reviews are not considered to be original research, they have value as a part of scholarship and should still be encouraged by hospital pharmacy departments. Fourth, it could not be determined if pharmacists publishing were primarily doing so as part of their role at the hospital or if they had also enrolled in a higher degree by research. Last, while it was anticipated that research projects were affected in 2020 due to coronavirus disease 2019, we considered that the impact on publication output would be apparent beyond 2021.

## CONCLUSION

On average, hospital pharmacy departments in Australia publish two original research articles every year, with nearly all principal referral hospitals publishing over the period 2018–2020. Nearly all articles published by hospital pharmacy departments occur in collaborations with universities. However, studies are generally conducted at a single site with only 5% of articles having authors from more than one hospital pharmacy department.

## ACKNOWLEDGEMENTS

Open access publishing facilitated by The University of Sydney, as part of the Wiley - The University of Sydney agreement via the Council of Australian University Librarians.

## CONFLICTS OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest.

## AUTHORSHIP STATEMENT

All listed authors comply with the *Journal's* authorship policy.

## ETHICS STATEMENT

None required.

## DATA AVAILABILITY STATEMENT

Data will be made available upon reasonable request.

## Supporting information

Additional supporting information may be found in the online version of this article:

**Appendix S1.** Database: Ovid MEDLINE(R) ALL <1946 to October 18, 2021>.

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Received: 19 January 2022

Revised version received: 13 March 2022

Accepted: 31 March 2022