

Uncertainty in general practice:

A bibliometric analysis

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Background and objective

Uncertainty is often considered a defining feature of general practice, yet empirical comparisons across medical specialties are limited. This study investigates whether uncertainty is uniquely prevalent in general practice or a commonality of clinical work across medical disciplines.

Methods

A bibliometric analysis of 3757 articles from PubMed (1966–2025) was conducted. A total of 287 relevant studies were categorised by specialty and study type to assess thematic focus and empirical content.

Results

Publications on uncertainty were comparable in number between general practice ($n = 87$) and non-general practice specialties ($n = 94$), with general practice publications showing a higher proportion of empirical studies (67% vs 61%). A recent acceleration in non-general practice literature suggests growing interdisciplinary interest.

Discussion

Findings challenge the narrative of general practice exceptionalism regarding managing uncertainty, suggesting that uncertainty is a systemic feature of medical practice. This has implications for medical education, professional identity and cross-specialty collaboration.

UNCERTAINTY IS WIDELY regarded as a defining characteristic of general practice,^{1,2} shaping clinical reasoning, influencing decision-making and contributing to the development of professional identity.³ It is often portrayed as more present,⁴ more acutely experienced⁵ and more consequential⁶ in general practice than in other medical specialties. This perception has become deeply embedded in medical education and professional discourse, to the extent that management of uncertainty is a core competency of general practice training.⁷ Almost one-third of general practitioners (GPs) report experiencing uncertainty with greater than 10% of initial diagnoses made in day-to-day practice.⁴ Discussions around uncertainty have suffered from a lack of definitional clarity, likely because of the complex nature of the phenomenon that defies a universal definition. Beresford⁸ offers a framework of uncertainty, describing; the technical (due to limited data or skill), the personal (describing patient-side factors and considerations), and the conceptual (considering the application of guidelines, criteria and protocols to real-world clinical scenarios). Han et al suggest that uncertainty be thought of as a 'state', a subjective cognitive experience and awareness of one's lack of knowledge.⁹

Uncertainty is considered an inherent component of general practice because of early, undifferentiated and varied disease presentations. Furthermore, there is complex

interaction between providing holistic longitudinal care within the context of the social determinants of health and patient and family agendas, which arguably constitute a profoundly unique and uncertainty-laden clinical setting.^{6,10} A large proportion of patient presentations cannot be connected to a diagnosis, or analysed by pre-determined diagnostic criteria, even after thorough history-taking and physical examination.¹¹ There is the perception that an intolerance of uncertainty does not support a career in general practice,¹² and that established GPs accept uncertainty as a 'part of the system'.¹⁰ A recent study challenges this assertion, showing that medical students' level of tolerance of uncertainty did not influence their intended postgraduate choice of specialty.¹³

Though uncertainty is widely accepted to be experienced in general practice, the empirical basis for the belief that the type or extent experienced is unique to general practice, when compared with other medical specialties, is limited. Much of the literature on uncertainty in general practice is grounded in studies conducted within the general practice professional community, intra-referential opinion pieces^{14,15} and reflective essays.¹⁶ While these contributions often offer valuable insights grounded in lived experience, they might also perpetuate a form of professional 'exceptionalism' that fails to draw on comparative evidence across specialties.

In this study, we apply bibliometric methods to examine the scope and characteristics of published research on uncertainty in general practice relative to other medical specialties. By using a proxy measure in analysing trends in publication volume, study types and thematic focus, we aim to assess whether the extant literature, by total publication frequency, reflects a professional preoccupation with uncertainty in general practice, or whether uncertainty provokes similar levels of interest across different specialties of medical practice and education. This study has implications not only for academic understanding but also for how uncertainty is taught, managed and internalised by current and future clinicians.

Methods

Bibliometrics¹⁷ involves the statistical analysis of published literature and its metadata to identify trends, relationships and patterns in scholarly communication. In this study we examine the scope and characteristics of published literature on uncertainty in general practice compared with other medical specialties.

Data source and search strategy

A search was conducted in the PubMed (Medline) database to identify articles related to 'uncertainty' in medical practice. The search included all articles indexed from 1966 to the present. The term 'uncertainty' was used as the primary keyword, and no language or publication type restrictions were applied at the initial stage (Box 1).

Box 1. Search strategy

('uncertainty' OR 'diagnostic uncertainty' OR 'clinical uncertainty' OR 'decision-making uncertainty' OR 'medical uncertainty')

AND

('clinical decision-making' OR 'medical decision-making' OR 'diagnosis' OR 'treatment decisions' OR 'patient care' OR 'clinical practice')

AND

('general practice' OR 'primary care' OR 'medical specialties' OR 'medical students' OR 'healthcare professionals' OR 'physicians' OR 'medical education')

Screening and inclusion criteria

A total of 3757 articles were retrieved. Titles and abstracts were initially screened for relevance to clinical uncertainty in medical practice. The term 'uncertainty' was broadly applied and included diagnostic, clinical, decision making and medical practice variations. Articles were included if they addressed uncertainty in a clinical, educational or professional context. Exclusion criteria included articles

unrelated to uncertainty as experienced in any of the clinical, educational or professional context, and those focused solely on statistical or methodological uncertainty. A total of 287 articles met the inclusion criteria (Figure 1). The process was replicated within the research team to assess for consistency and reproducibility of the approach. Differences were resolved via discussion and consensus before confirming final outcomes.

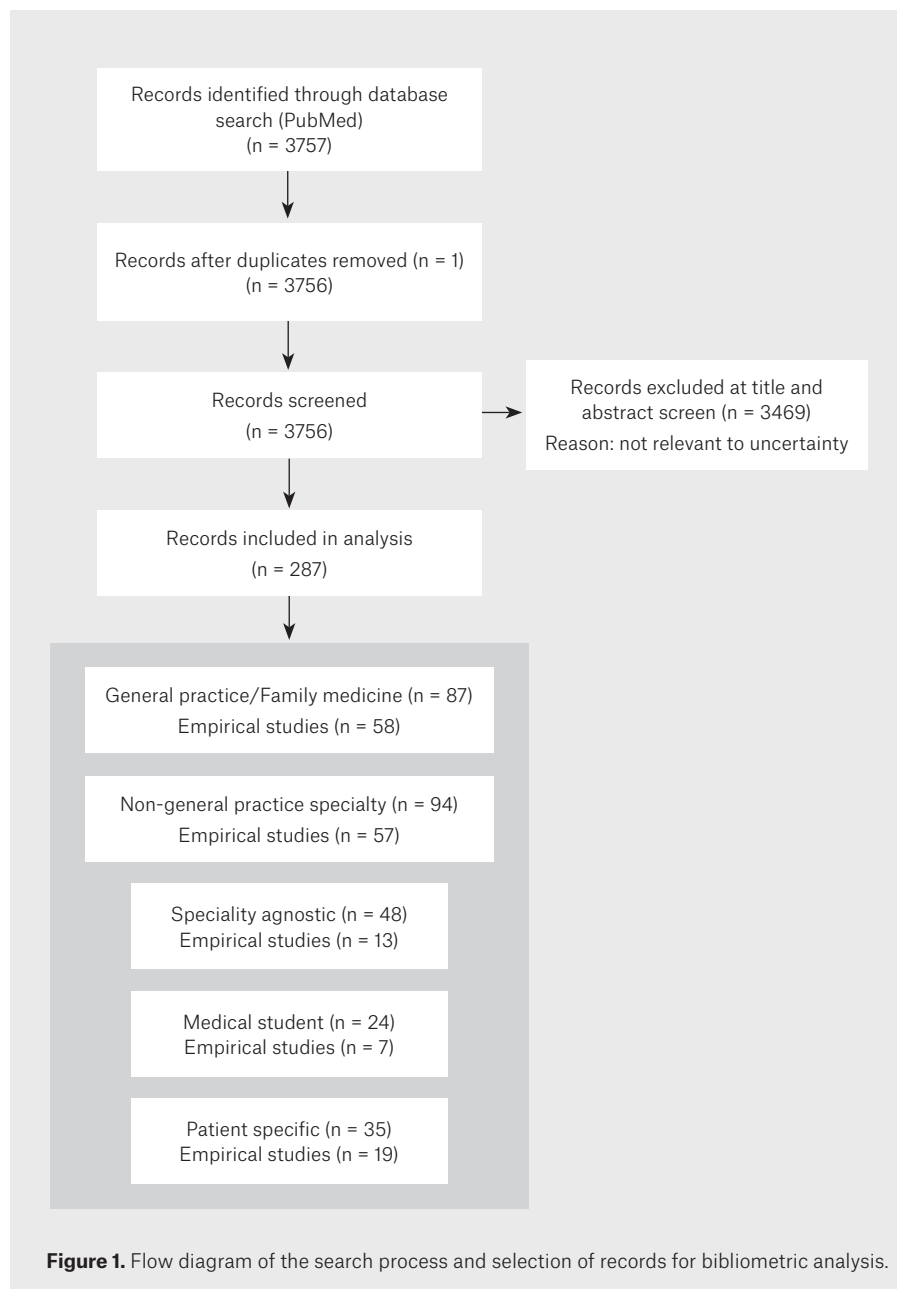


Figure 1. Flow diagram of the search process and selection of records for bibliometric analysis.

Table 1. Total number of records relating to uncertainty by thematic grouping with proportion of empirical studies

Group	No. records	Empirical studies	Empirical studies as proportion of total records (%)
General practice/Family medicine	87	58	67
Non-general practice medical specialty	94	57	61
Specialty agnostic	48	13	27
Medical student	24	7	29
Patient specific	35	19	54

Categorisation

Relevant articles were categorised into five thematic groups on the basis of their primary focus. These were (1) general practice/family medicine; (2) non-general practice medical specialties; (3) specialty agnostic (general medical literature not relating to any specific medical specialty); (4) medical students; and (5) patient specific. This categorisation captures the multifaceted nature of medical uncertainty by grouping literature according to the primary context or audience it addresses. It distinguishes between uncertainty as experienced in clinical practice (general practice, non-general practice specialties), educational settings (medical students), patient-centred perspectives and cross-cutting or theoretical discussions (specialty agnostic). There were instances in which articles overlapped categories. The predominant focus of the article was used to determine a final single category in all except one instance where the article suitably fit into two categories. This categorisation allowed for a nuanced analysis of how uncertainty manifests and is managed across different roles and domains in healthcare. Each article was further classified by study type: empirical research (quantitative or qualitative), review articles or opinion pieces. This allowed for an evaluative bibliometric approach, assessing the proportion of empirical evidence within each category.

Data analysis

A summary of the number of publications in each category and the distribution of study types is provided. Temporal trends were described to assess changes in publication

volume over time. The proportion of empirical to non-empirical studies was calculated to evaluate the strength of the evidence base within each category. This methodology enabled a comparative analysis of how uncertainty is represented in the literature across the different categories.

Results

The proportion of empirical studies (quantitative or qualitative) varied across categories (Table 1). The non-general practice medical specialties with the highest frequency of articles on uncertainty were emergency medicine (n = 24), paediatrics and neonatology (n = 14), genetics (n = 9) and radiology (n = 6). Categorised by World Health Organization (WHO) region, most studies were from the Americas (n = 133) and Europe (n = 130), followed by the Western Pacific (n = 20), Southeast Asia (n = 2), Eastern Mediterranean (n = 1) and Africa (n = 1).

Temporal trends

Publication trends over time revealed a sustained output of general practice-specific articles across the decades (Figure 2). There is a steady increase in output across all categories, with an accelerated increase in publications related to non-general practice specialties and specialty-agnostic perspectives from 2020 onwards.

Discussion

This bibliometric analysis provides a novel lens through which to start to examine the

long-standing belief that uncertainty is uniquely experienced in general practice. It provides some insight into the question of whether general practice is uniquely characterised by uncertainty or whether this perception is a product of professional narrative. While general practice has maintained a steady output of literature on uncertainty over time, the recent acceleration in publications from non-general practice specialties suggests that uncertainty is increasingly recognised as a universal feature of medical practice.

The findings challenge the assumption of general practice exceptionalism regarding uncertainty² by showing firstly that the total volume and empirical preponderance of uncertainty-related publications in general practice are comparable to those across non-general practice medical specialties. The ratios of GPs to non-GP specialists across different countries will vary. In Australia in 2023 there were 33,480 GPs compared with 44,312 non-GP specialists.¹⁸ In 2007, GPs in Australia published at a rate of three publications per 1000 GPs per year, compared with 159.5 publications per 1000 physicians and 67.8 publications per 1000 surgeons in the same period.¹⁹ Our findings suggest that, proportionally, the corpus of literature produced by the general practice discipline regarding uncertainty is greater in number, per publishing practitioner, than in other medical specialties.

We note, though, that the evidence we cite to illustrate the ratio of GPs to non-GP specialists, and their relative publishing outputs, is of Australian data and such ratios will vary widely across countries because of differences in healthcare systems and workforce definitions. Direct global comparisons are limited by the absence of consistent international data. However, trends from individual countries provide useful context: in the US, family physicians form a small, distinct segment of the workforce,²⁰ while in the UK, GPs comprise 43% of the specialist workforce and 21% of the total medical workforce.²¹ As such, the Australian data (with its large disparity in publishing rates) should be viewed as illustrative rather than definitive, offering insight into publication patterns while acknowledging the limitations of generalising across diverse international contexts.

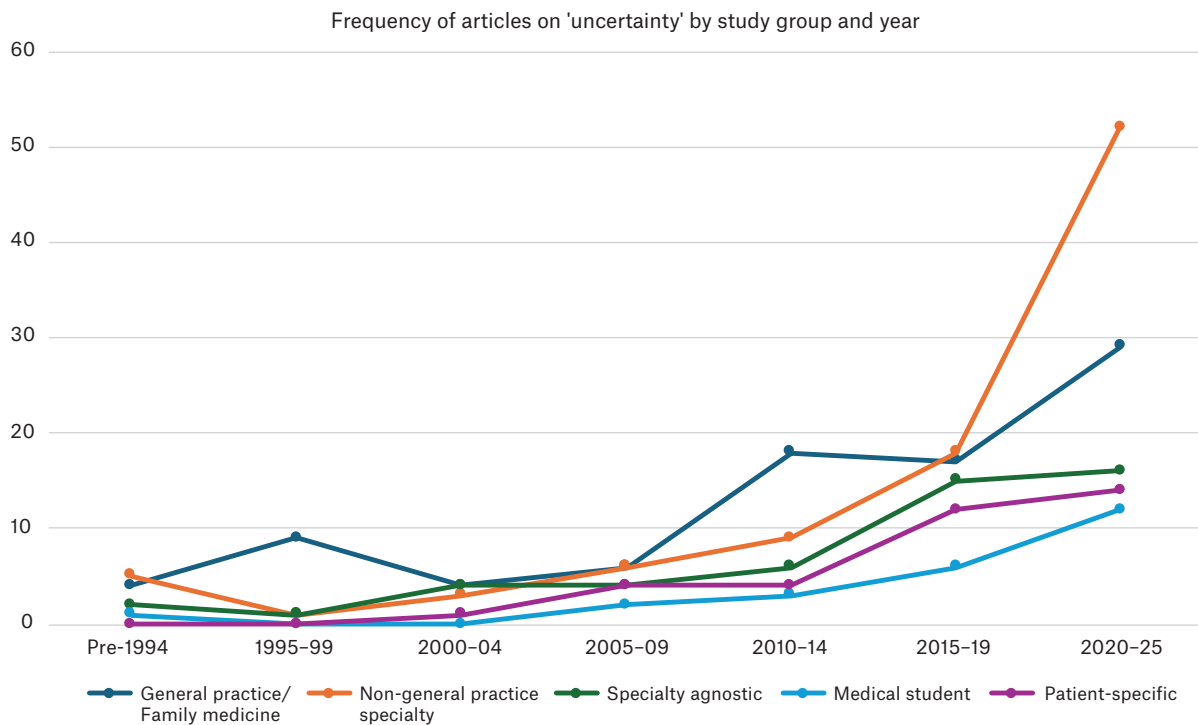


Figure 2. Frequency of articles on 'uncertainty' by study group and year.

Despite the comparable volume of publications between general practice and non-general practice specialties, literature from general practice was more consistently produced over time. The recent growth in non-general practice literature is an aggregate of all non-general practice specialties. Individually, each specialty had a fractional contribution to this category. This acceleration in research output on uncertainty from non-general practice specialties might reflect a growing recognition of uncertainty as a broader issue in medical practice.²²

While bibliometric analysis provides useful insights into scholarly attention, publication frequency is an imperfect proxy for disciplinary interest or importance. Trends might reflect factors such as funding priorities, editorial focus or discipline publishing norms. For instance, general practice has a strong tradition of narrative and reflective writing that might not be captured in indexed empirical literature. Conversely, the recent rise in non-general practice publications might reflect emerging

recognition of uncertainty in those fields, rather than a sudden increase in relevance.

The relatively high proportion of empirical studies in both general practice and non-general practice categories indicates that uncertainty is not only a conceptual concern but also a subject of considerable investigation across disciplines. This finding is also reflected among the more general medical literature (specialty agnostic) and that which specifically focuses on medical education and medical students, where management of uncertainty is considered a core competency.²³

However, the long-standing influence of opinion pieces and reflective essays in the general practice literature on uncertainty might reflect a professional culture that values narrative and experiential knowledge. This aligns with the historical development of general practice as a relational and humanistic specialty,²⁴ where uncertainty is often framed as a defining challenge and a marker of professional maturity and identity.^{25,26}

This framing might also contribute to a form of 'general practice exceptionalism', wherein uncertainty is portrayed as more intense or consequential in general practice than elsewhere. This belief has deep historical roots, emerging alongside the professionalisation of general practice and reinforced by influential figures and foundational texts.²⁷ Over time, it has become a self-sustaining narrative, potentially limiting cross-disciplinary dialogue and comparative research.

Only one study included both GPs and non-GP specialists.²⁸ The absence of direct comparative studies between general practice and other specialties has allowed this narrative to persist largely unchallenged. Our findings suggest that interest in uncertainty from a research perspective is not exclusive to general practice but is instead a shared, systemic feature of clinical work. This reframing has important implications for how uncertainty is taught, managed and normalised across the medical education continuum.

Strengths and limitations

This study includes its novel application of bibliometric methods to explore the scope and nature of literature on clinical uncertainty across general practice and other medical specialties. The categorisation system and comparative analysis provide a structured lens through which to examine long-standing professional narratives. Identifying empirical versus non-empirical studies adds depth to the evaluation of the evidence base. Limitations include reliance, in this initial study, on a single database (PubMed), which might exclude relevant findings from other disciplines or regions, and the researcher-derived necessarily broad categorisation and screening of articles relating to 'uncertainty', which might introduce bias despite efforts to ensure reproducibility.

Implications

The findings of this bibliometric analysis have several important implications for medical education, professional identity formation and the broader discourse on clinical uncertainty.

First, by critically examining the notion that uncertainty is unique to general practice, this study invites a more inclusive and interdisciplinary approach to understanding and teaching uncertainty. Recognising uncertainty as a shared feature of medical practice and health professions can foster greater collaboration across specialties, breaking down silos that might have been reinforced by professional narratives.

Second, reframing uncertainty as a ubiquitous rather than exceptional experience might help reduce the psychological burden on general practice trainees. The perception that general practice is uniquely fraught with uncertainty can contribute to anxiety, self-doubt and deter people from pursuing a career in the field. By normalising uncertainty as a universal aspect of clinical work, while being careful not to trivialise the differing contexts of individual disciplines, educators can promote a growth mindset and resilience among learners.²⁹

Third, the findings underscore the need for more comparative and cross-specialty research on uncertainty. While general practice has led the way in exploring this topic, the recent increase in publications

from other non-general practice specialties suggests a growing recognition of its relevance across the medical spectrum. Future research should aim to directly compare how uncertainty is experienced, managed and responses to uncertainty taught in different clinical contexts. It would examine the types and sources of uncertainty across disciplines and specialties.

Reframing uncertainty as a shared feature of clinical work across specialties invites a more inclusive and collaborative approach to medical education and practice. It shifts the focus from managing uncertainty as a uniquely general practice challenge to recognising it as a universal competency, relevant to all clinicians navigating complex, evolving healthcare environments. This perspective not only broadens the scope for interdisciplinary dialogue but also supports the development of resilient professional identities across the medical spectrum.

Finally, these insights have implications for curriculum design. Medical education programs, both undergraduate and postgraduate, could integrate the recognition and management of uncertainty, not only in general practice but across all specialties. This includes developing shared frameworks, assessment tools and reflective practices that equip all clinicians to navigate uncertainty with confidence and competence.

Conclusion

This bibliometric analysis challenges the prevailing narrative that uncertainty is more present, more acutely experienced and more consequential in general practice. The persistence of the belief in general practice exceptionalism appears to be rooted more in historical and professional identity narratives than in empirical evidence. While uncertainty might be experienced in a particularly unique way within the general practice context, by reframing uncertainty as a ubiquitous aspect of medical practice, this study encourages a more inclusive and balanced discourse, one that supports all clinicians in developing the skills and resilience needed to navigate uncertainty.

Future research should aim to directly compare experiences of uncertainty across specialties, using shared frameworks and

validated tools. Collaborative efforts to understand uncertainty and its effects on clinical reasoning across the spectrum of medical specialties will inform educational strategies that best prepare healthcare professionals to thrive in the face of complexity and ambiguity within their chosen discipline (including general practice).

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References

References are available online only.

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References

- Cooper M, Sornalingam S, Jegatheesan M, Fernandes C. The undergraduate 'corridor of uncertainty': Teaching core concepts for managing clinical uncertainty as the 'special technique' of general practice. *Educ Prim Care* 2022;33(2):120–24. doi: 10.1080/14739879.2021.1996276.
- Armstrong RM, Van Der Weyden MB. Uncertainty in general practice: A sure thing. *Med J Aust* 2006;185(2):58–59. doi: 10.5694/j.1326-5377.2006.tb00469.x.
- Barnhoorn PC, Nierkens V, Numans ME, Steinert Y, van Mook WNKA. "What kind of doctor do you want to become?": Clinical supervisors' perceptions of their roles in the professional identity formation of general practice residents. *Med Teach* 2023;45(5):485–91. doi: 10.1080/0142159X.2022.2137395.
- Zhou AY, Zghebi SS, Hodgkinson A, et al. Investigating the links between diagnostic uncertainty, emotional exhaustion, and turnover intention in general practitioners working in the United Kingdom. *Front Psychiatry* 2022;13:936067. doi: 10.3389/fpsy.2022.936067.
- Gerrity MS, Earp JAL, DeVellis RF, Light DW. Uncertainty and professional work: Perceptions of physicians in clinical practice. *Am J Sociol* 1992;97(4):1022–51. doi: 10.1086/229860.
- Cooke GP, Doust JA, Steele MC. A survey of resilience, burnout, and tolerance of uncertainty in Australian general practice registrars. *BMC Med Educ* 2013;13(1):2. doi: 10.1186/1472-6920-13-2.
- The Royal Australian College of General Practitioners (RACGP). RACGP 2022 Curriculum core competency framework. RACGP, 2022. Available at www.racgp.org.au/getmedia/7f9a0902-8506-4250-bf9e-3277fa6d6b03/ID-2335-Curriculum-and-Syllabus-Core-Competency-Framework-V3.pdf.aspx [Accessed 1 August 2025].
- Beresford EB. Uncertainty and the shaping of medical decisions. *Hastings Cent Rep* 1991;21(4):6–11. doi: 10.2307/3562993.
- Han PK, Klein WM, Arora NK. Varieties of uncertainty in health care: A conceptual taxonomy. *Med Decis Making* 2011;31(6):828–38. doi: 10.1177/0272989X10393976.
- O'Riordan M, Dahinden A, Aktürk Z, et al. Dealing with uncertainty in general practice: An essential skill for the general practitioner. *Qual Prim Care* 2011;19(3):175–81.
- Peveler R, Kilkeny L, Kinmonth AL. Medically unexplained physical symptoms in primary care: A comparison of self-report screening questionnaires and clinical opinion. *J Psychosom Res* 1997;42(3):245–52. doi: 10.1016/S0022-3999(96)00292-9.
- Borracci RA, Ciambrone G, Arribalza EB. Tolerance for uncertainty, personality traits and specialty choice among medical students. *J Surg Educ* 2021;78(6):1885–95. doi: 10.1016/j.jsurg.2021.03.018.
- Wegwarth O, Pfoch M, Spies C, et al. Tolerance for uncertainty and medical students' specialty choices: A myth revisited. *Med Educ* 2025;59(8):833–41. doi: 10.1111/medu.15610.
- Spooner MA. Dealing with uncertainty in family medicine. *J Fam Pract* 1975;2(6):471–72.
- Biehn J. Managing uncertainty in family practice. *Can Med Assoc J* 1982;126(8):915–17.
- McWhinney IR. William Pickles Lecture 1996. The importance of being different. *Br J Gen Pract* 1996;46(408):433–36.
- Ninkov A, Frank JR, Maggio LA. Bibliometrics: Methods for studying academic publishing. *Perspect Med Educ* 2022;11(3):173–76. doi: 10.1007/S40037-021-00695-4.
- Australian Government Department of Health, Disability and Ageing. Summary statistics, medical profession. Australian Government Department of Health, Disability and Ageing, 2025. Available at <https://hwd.health.gov.au/resources/data/summary-mdcl.html> [Accessed 20 September 2025].
- Askew DA, Schluter PJ, Gunn JM. Research productivity in Australian general practice: What has changed since the 1990s? *Med J Aust* 2008;189(2):103–04. doi: 10.5694/j.1326-5377.2008.tb01931.x.
- Phillips WR, Dai M, Frey JJ 3rd, Peterson LE. General practitioners in US medical practice compared with family physicians. *Ann Fam Med* 2020;18(2):127–30. doi: 10.1370/afm.2503.
- General Medical Council. The state of medical education and practice in the UK: Workforce report 2024. General Medical Council, 2024. Available at www.gmc-uk.org/cdn/documents/somep-workplace-report-2024-full-report_pdf-107930713.pdf [Accessed 25 September 2025].
- Scott IA, Doust JA, Keijzers GB, Wallis KA. Coping with uncertainty in clinical practice: A narrative review. *Med J Aust* 2023;218(9):418–25. doi: 10.5694/mja2.51925.
- Patel P, Hancock J, Rogers M, Pollard SR. Improving uncertainty tolerance in medical students: A scoping review. *Med Educ* 2022;56(12):1163–73. doi: 10.1111/medu.14873.
- Myers J. The nature of a specialty. *Med Educ* 2025;59(3):264–66. doi: 10.1111/medu.15593.
- McWhinney IR. Being a general practitioner: What it means. *Eur J Gen Pract* 2009;6(4):135–39. doi: 10.3109/13814780009094320.
- Watkins CJ. The measurement of the quality of general practitioner care. *J R Coll Gen Pract Occas Pap* 1981;15(1):1–18.
- McWhinney I. A textbook of family medicine. Oxford University Press, 1997.
- Shackleton-Piccolo R, McKinlay JB, Marceau LD, Goroll AH, Link CL. Differences between internists and family practitioners in the diagnosis and management of the same patient with coronary heart disease. *Med Care Res Rev* 2011;68(6):650–66. doi: 10.1177/1077558711409047.
- Tran M, Prentice S. Transitions, adaptation and uncertainty in general practice training. *Aust J Gen Pract* 2025;54(11):774–77. doi: 10.31128/AJGP-12-24-7496.