

Prevalence of technology and connectivity issues in general practices in rural New South Wales and their impact on staff capability to perform their job

Margot Leeson-Smith B.HSc¹ | Louise Geddes PhD¹ | Heath Johnson
B.Communication (Hons)² | Sabrina Pit PhD^{3,4,5} | Robyn Ramsden PhD^{2,6,7} 

¹Rural Clinical School, School Of Medicine, Sydney Program, University of Notre Dame Sydney, Chippendale, New South Wales, Australia

²Rural Doctors Network, St Leonards, New South Wales, Australia

³University of Sydney, University Centre for Rural Health, Lismore, New South Wales, Australia

⁴School of Medicine, University of Western Sydney, Campbelltown, New South Wales, Australia

⁵Work Wiser International, Lennox Head, New South Wales, Australia

⁶Deakin University, Melbourne, Victoria, Australia

⁷Charles Sturt University, Bathurst, New South Wales, Australia

Correspondence

Robyn Ramsden, Rural Doctors Network, Level 7, 33 Chandos Street, St Leonards, NSW 2065, Australia.
Email: rramsdn@nswrdn.com.au

Abstract

Objective: To identify the technology and connectivity issues in rural and remote general practices, and the factors independently associated with these issues that negatively impact staff's capability to perform their job.

Methods: An annual cross-sectional survey of rural and remote general practice managers. Dependent variables included demographic data, practice size, geographic location, connection type and frequency of connectivity issues. Descriptive statistics are presented, and bivariate logistic regression was undertaken to determine factors independently associated with connectivity issues that negatively impact staff's capability to perform their job.

Participants: One hundred sixty-eight general practice managers from rural and remote New South Wales.

Results: The majority of respondents (87%, $n=146$) indicated that technology and connectivity issues had impacted staff's capability to perform their job. Internet problems were the most frequently reported issue (36%, $n=61$). In bivariate analysis, practices that had a total clinical staff headcount between 5 and 7 (OR 0.27; 95% CI 0.10–0.67; $p=0.005$) or between 8 and 11 (OR 0.39; 95% CI 0.16–0.95; $p=0.038$) were significantly less likely to report technology and connectivity issues that negatively impact staff's capability to perform their job, compared with practices with a total clinical headcount of less than five.

Conclusions: Technology and connectivity issues persist in rural and remote general practices. This is the first study to demonstrate that technology and connectivity issues impact on rural staff's capability to perform their job. Furthermore, smaller practices face more technology and connectivity issues that negatively impact staff's capability to do their job than larger practices. Further research is required to find solutions to address these challenges.

KEYWORDS

general practice, general practitioner, internet, practice manager, primary care, remote

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1 | BACKGROUND

It is well documented that health inequalities exist between residents living in metropolitan and those living in rural and remote locations in Australia.¹ Approximately, one quarter of the Australian population live in regional, rural and remote areas,¹ while in New South Wales (NSW), approximately one-third of the population live in these locations.² Life expectancy of individuals living in capital cities is greater compared with those who reside outside capital cities across Australia.¹ There are many determinants that contribute to the overall health burden of people living in rural and remote areas including lower rates of education, lower socioeconomic status, increased rates of family and domestic violence and increased chronic disease prevalence.¹ Access to health care becomes more problematic due to a range of factors including the cost of health care delivery to remote areas with low population density, an ageing population in these areas and health care workforce shortages.¹ Appropriate internet is also a determinant of health,³ as reliable internet access and effective hardware and software enable general practitioners (GPs) to provide effective evidence-based medicine and care.^{4,5} Inadequate internet access may also negatively impact on rural workforce retention as lack of access may result in the out-migration of health care workers to areas with better connectivity.⁶

Australian Bureau of Statistics (ABS) data indicate that households in metropolitan areas are more likely to have internet access than those in remote areas.⁷ The Australian Digital Inclusion Index (ADII) monitors the level of digital inclusion among the Australian population,⁸ and in 2019, the ADII found that digital inclusion was 8.1 points higher in capital cities (63.8) than in rural and remote areas (55.7).⁸ Although the general trend demonstrated that the digital divide between metropolitan and rural areas was reducing, fluctuations were evident from year to year. Digital exclusion is the continual unequal access to, and capacity to use communication technologies among a sub-population or section of society,^{9,10} and is particularly prevalent in rural communities. It arises from factors such as slow adoption of information and communication technologies, high infrastructure costs in sparsely populated areas, low demand, lower socioeconomic status of rural populations, and the diversity of skills associated with using technology.^{9,11} While the National Broadband Network (NBN) rollout has made progress in digital inclusion, technology and connectivity issues remain. Challenges persist such as access to suitable internet connections,¹² consistent mobile phone coverage in some rural and remote areas, and addressing 'black spots'.¹³ Despite efforts to improve the provision of reliable internet with the NBN, the quality of connectivity in rural settings remains an issue,¹⁴ with

What this study adds

- The greatest connectivity issue reported among remote, rural and regional practice managers was internet access and connectivity (36%), followed by issues with software (16%) and hardware (9%).
- Smaller practices appear to have greater connectivity issues than larger practices.
- There is a link between technology and connectivity and the capability of practice managers (PMs) and other practice staff to perform their job.

What is already known about this subject

- Rural and remote areas of NSW experience technology and connectivity issues.
- Despite the rollout of the National Broadband Network rural practices continue to face connectivity issues.

two-thirds of regional users experiencing difficulty with internet speeds.¹⁵ Nationally, NBN uptake is increasing, with 75.7% of all Australian accessing the network in 2019.⁸ The rollout of NBN in most remote, rural and regional areas has largely been completed; however, some Australians are still outside the NBN 'footprint', making connectivity much more difficult.¹³

In health care, technology plays a vital role in bridging the access gap and subsequent health disparities between metropolitan and rural areas.¹⁶ High-speed broadband access was identified as a priority in the 2022 AMA Rural Health Issues Survey, demonstrating the requirement for quality internet in the provision of medical services, including eHealth and telemedicine.^{5,17} Given bushfires, floods and the coronavirus pandemic (COVID-19) in NSW, there has been an increased reliance on technology to provide primary health care services. During COVID-19, digital disparities between metropolitan and rural and remote areas were particularly prominent.¹⁸ The literature addresses the exacerbation of the digital divide in the context of the COVID-19 pandemic and the pivot to telehealth services.^{19–21} Those living in lower socioeconomic areas, culturally and linguistically diverse communities, people with disabilities, and those with low health literacy faced additional challenges.²¹ Although rural and remote areas are well versed in telehealth services, even prior to the pandemic, these services represent less than 1% of all specialist consultations, with minimal data existing for general practice consultations.²² While

the pandemic resulted in an increase in the use of digital health services,²³ reliable infrastructure and internet is required to ensure a sustainable and equitable service for rural and remote areas.²⁴ As a result, GPs often used phone consultations due to internet issues experienced during telehealth sessions.²³

These technological considerations intersect with recent analyses on rural health workforce retention and posit that health professionals' decisions to stay or leave a rural health position are multifaceted, and are shaped by personal, organisational and social factors.²⁵ One of these factors is thought to be access to technology. Technology can be a key enabler providing timely access to specialist or additional advice as well as a conduit to accessing education.²⁶ Capability refers to skills and experience an individual possesses²⁷ and considers factors such as the extent to which individuals can adapt to change, generate new knowledge and continue to improve their performance.^{27,28} Capability enables a person to work effectively in varying and unfamiliar contexts, which is important in rural settings.²⁸ Technology has been identified as a factor that can impact rural health workforce capability.²⁹ Furthermore, Ramsden et al.³⁰ reported that where health practitioners have limited professional support, access to applications and technology that make them feel more capable in health behaviour or decision-making in rural practice may be extremely beneficial.

Despite what is known about the role of technology in providing health care in rural and remote locations, little is known about the prevalence of the technology and connectivity issues experienced in rural and remote general practices, and its impact on practice staff's capability. This study aimed to determine the specific technology and connectivity issues experienced in rural and remote general practices, and to identify the factors associated with these issues that negatively impact practice managers' and their staff's capability to perform their job.

2 | METHODS

2.1 | Study design

This study utilised data from the 2020/21 iteration of the Rural Doctors Network (RDN) Practice Manager (PM) Survey. This cross-sectional survey is conducted annually with practice managers of general practices across rural and remote NSW and provides evidence for workforce development. The PM survey consists of a set of core questions asked in every iteration of the survey; however, the 2020/21 iteration of the survey invited further comment about the challenges of technology and connectivity during a time marked by COVID-19 and

other environmental disasters. Ethics approval was obtained from the University of Notre Dame Sydney Human Research Ethics Committee (2021-151S).

2.2 | Setting and recruitment

Each year, the PM survey is sent via email to practice managers in general practices across rural and remote NSW, accessed from the RDN database. These practices vary in geographic remoteness, staff size and service provision. PMs are defined as an individual who manages all business aspects of a medical practice, including human resources, marketing, operations, finance, information technology and compliance.³¹ Participation was voluntary and not financially reimbursed. The survey was implemented between late December 2020 and late March 2021. Only respondents who completed the technology and connectivity questions were included in the study.

2.3 | Measures

Demographic data and practice information were collected including age, gender and number of years' experience of PMs, total clinical headcount (GPs and nurses) and full-time equivalent (FTE). Geographic classifications were based on the 2019 Modified Monash (MM) model, which measures geographic remoteness as per the ABS using a scale of 1 (major city) to 7 (very remote).³² Supplementary questions regarding technology and connection used within the practice included type of internet connection (NBN, ADSL, ADSL2 or ADSL2+, mobile broadband, non-NBN cable, other). The frequency of issues with technology and communication devices (phones, software, hardware, internet and training and support) were classified as never, a little (less than once a year or several times a year), sometimes (haphazard [on and off] or monthly) or a lot (weekly or daily).

2.4 | Statistical analysis

The primary outcome of this study was to identify factors associated with technology and connectivity issues that negatively impact staff's capability to perform their job in rural and remote general practices. Respondents who reported that technology and connectivity issues had never occurred or had occurred 'a little' were classified as having minimal technology and connectivity issues, while those who reported that issues had occurred 'sometimes' or 'a lot' were classified as having frequent technology and connectivity issues. Given the

substantial shift towards NBN use, type of connection was re-categorised into NBN, non-NBN (ADSL, ADSL2 or ADSL2+, mobile broadband, non-NBN cable and others) and multiple connection types. Multiple connection types may include a combination of NBN and non-NBN connection types or a combination of several non-NBN connection types. Practices may have a combination of connection types for various reasons such as disaster preparedness. Modified Monash model categories six and seven were collapsed into MM5 due to small numbers of respondents. Total clinical staff headcount was collapsed into quartiles (less than 5, 5 to 7, 8 to 11 and more than 11). Logistic regression models calculated odds ratios (OR) and 95% confidence intervals (95% CI) to identify factors associated with technology and connectivity issues. Due to the limited number of variables available, all variables were forced into the multivariate model, irrespective of significance at the bivariate level, to ensure that any significance detected at this level was also observed at the multivariate. Data were analysed using STATA version 18.0 (Stata Corporation, College Station, TX, USA).

3 | RESULTS

The overall response rate of the 2020/21 PM survey was 23%. A total of 168 PMs completed the PM survey, including the questions regarding technology and connectivity issues. As shown in Table 1, the majority of PMs were female (91%), with a median age 53 (interquartile range [IQR] 46–59 years) and three in five (62%, $n=105$) reported having more than 6 years' experience in their role. In each practice, the median number of GPs was 4 (median FTE 3.8), while the median number of nurses was 3 (median FTE of 3.0). Two in five respondents managed a practice in a large rural town (MM3, 44%) and three in four practices used NBN for internet (76%). Two in three respondents (64%) reported that they had experienced an internet connection issue in the previous 6 months, and the majority of respondents (87%) reported technology and connectivity issues negatively impacted their own and their staff's capability to perform their job.

As shown in Table 2, after excluding respondents who reported that they didn't know their connection type or if they had experienced an internet in the previous 6 months, the majority of respondents in all connection type categories reported they had experienced internet issues. Those who reported having multiple connection types reported the highest proportion of internet issues (77%), followed by non-NBN connections (68%) and NBN (62%). There was no statistically significant difference ($\chi^2(2)=1.35$, $p=0.509$) observed between categories.

TABLE 1 Characteristics of PMs and general practices.

Variable	Total sample (N = 168)
Gender	
Male	16 (10)
Female	152 (91)
Age (years)	
Median (Interquartile range [IQR])	53 years (46–59 years)
Missing	13
Number of years' experience	
Less than 1 year	10 (6)
1–5 years	52 (31)
6–10 years	37 (22)
Greater than 10 years	68 (40)
Missing	1 (1)
GPs in practice	
Median headcount (IQR)	4 (2–7)
Median FTE (IQR)	3.8 (2–6)
Missing	0
Nurses in practice	
Median headcount (IQR)	3 (2–4)
Missing	0
Median FTE (IQR)	1.6 (0.9–2.6)
Missing	0
Geographic location	
MM3	73 (44)
MM4	42 (25)
>MM5	53 (32)
Type of internet connection	
NBN	128 (76)
Non-NBN	22 (13)
Multiple	13 (8)
Don't know	5 (3)
Internet connection issues in the last 6 months	
Yes	107 (64)
No	58 (35)
Don't know	3 (2)
Technology and connectivity issues negatively impacting staff's capability to perform their job	
Not at all	22 (13)
A little	50 (30)
Sometimes	56 (33)
A lot	40 (24)

As shown in Table 3, internet issues were the most frequently reported issue that affected respondents (36%, $n=61$), followed by software (16%, $n=26$) and hardware issues (9%, $n=15$). Respondents were least likely to report

experiencing an issue with phones, with two in five respondents (42%, $n = 71$) reporting not to have experienced an issue.

As shown in Table 4, total clinical staff headcount decreased in more remote geographical locations (MM5+). Approximately one in two (45%) practices located in MM5 and above had a total staff headcount of 1–4. In contrast, 32% of practices in MM3 have a clinical total staff headcount of 11 or more ($\chi^2(6) = 17.6, p = 0.007$).

As shown in Table 5, at the multivariate level, practices that had a total clinical staff headcount between 5 and 7 (AOR 0.27; 95% CI 0.10–0.67; $p = 0.005$) or between 8 and 11 (AOR 0.39; 95% CI 0.16–0.95; $p = 0.038$) were significantly less likely to report a technology and connectivity issue that negatively impacted their own and their staff's capability to perform their job, compared with practices with a total clinical staff headcount of less than five.

4 | DISCUSSION

This research builds on previous research which has investigated the use of technology in health care, and the technological issues experienced by health care providers.^{4,12} It confirms that general practices in rural and remote NSW experience issues with internet and digital infrastructure.³³ Additionally, this is the first study to demonstrate

that technology and connectivity issues impact on rural staff's capability to perform their job from a practice managers' perspective. Surprisingly, our data did reveal a difference in technology and connectivity issues between remote, rural and regional geographical areas using the Modified Monash Model (MM). This finding aligns with broader literature that highlights a pronounced divide in technology and connectivity experiences between metropolitan/urban areas and rural regions.^{34,35} Our finding is significant because it highlights that it is not only the most remote communities that experience technology issues. Notwithstanding, it should also be noted that there is a substantial body of research,^{36,37} that illuminates the nuanced differences in technology use and connectivity challenges among regional, rural and remote locations. The study found that lack of access and/or connectivity to the internet was the most frequently experienced issue; however, issues regarding other technology and connectivity (phone, software, hardware and training and support) were widespread. Importantly, three in five PMs (57%) reported technology and connectivity issues had regularly impacted staff's capability to perform their jobs. It is known that a key factor in attracting and retaining health care professionals in rural and remote areas is access to technology and connectivity.³⁸ This is particularly important among younger professional workers who consider the availability of technology when they are deciding where to work and live.³⁹ The study also highlights the specific technologies required to accommodate current needs, and future needs in scenarios of natural disasters or health emergencies, such as the COVID-19 pandemic.

A key finding of this study was that smaller practices (total GP and nurse headcount between 1 and 4) were more likely to have technology and connectivity issues that negatively impact staff's capability to perform their job than larger practices (total GP and nurse headcount > 4). As shown in Table 4, larger practices tended to be situated in large rural towns (MM3) that have populations of sufficient size to sustain the practice, and therefore may have the technology infrastructure and investment to support the practice. Conversely, smaller practices were significantly more likely to be located in remote areas (MM5+).

TABLE 2 Connection type versus internet issues in the previous 6 months experienced in rural and remote general practices $N = 161$ ($n, (\%)$).

Connection type	Internet issues in the previous 6 months		Total
	No internet issues	Yes, internet issues	
NBN	48 (38)	78 (62)	126 (100)
Non-NBN	7 (32)	15 (68)	22 (100)
Multiple connections	3 (23)	10 (77)	13 (100)

Note: $\chi^2(2) = 1.35, p = 0.509$.

TABLE 3 Specific technology and connectivity issues experienced in rural and remote general practices $N = 168$ ($n, (\%)$).

	Not at all	A little	Sometimes	A lot	Unsure	Total
Technology						
Phones	71 (42)	41 (24)	22 (13)	14 (8)	20 (12)	168 (100)
Software	6 (4)	74 (44)	54 (32)	26 (16)	8 (5)	168 (100)
Hardware	9 (5)	74 (44)	62 (37)	15 (9)	8 (5)	168 (100)
Internet	4 (2)	36 (21)	66 (39)	61 (36)	1 (1)	168 (100)
Training and support	35 (21)	57 (34)	54 (32)	15 (9)	7 (4)	168 (100)

Smaller practices are more likely to experience technology and connectivity issues than larger practices. There may be several reasons for this. One possibility is that connectivity issues can be resolved more quickly in a larger practice, where the presence of additional staff may contribute the expertise to do so. Further research is required to explore the reasons for the differences between infrastructure, technological knowledge and skills and training between smaller and larger practices. By understanding the factors that contribute to smaller practices having greater technology and connectivity issues impacting staff capability, targeted interventions for these practices could be implemented to improve health care provision.

TABLE 4 Practice size (total GP and nurse headcount) and geographical location $N=168$ (n , (%)).

Total clinical staff headcount					
Geographic location (MM)	1–4	5–7	8–10	11+	Total
MM3	19 (26)	13 (18)	18 (25)	23 (32)	73 (100)
MM4	8 (19)	9 (21)	15 (36)	10 (24)	42 (100)
MM5 +	24 (45)	15 (28)	9 (17)	5 (9)	53 (100)

Note: $\chi^2(6)=17.6$, $p=0.007$.

Prior research found that enhancing capability is important in rural health care due to its implications for addressing health care inequities and promoting rural retention.^{29,30} Capability refers to skills and experience and takes into account factors such as values, commitment, creativity, intuition, integrity and other personal qualities, as well as context/environment.⁴⁰ Martiniuk et al.²⁹ suggest that supporting a health professional to be capable can help them be adaptable, feel motivated and thus have resilience to stay through ‘tough times’ which is necessary in a long career in rural health. Ramsden et al.³⁰ also highlighted the importance of factors such as access to technology and timely access to information to help build health workforce capability. Given that 24 per cent of practice managers indicated that technology and connectivity challenges impacted staff capability ‘a lot’ and 63 per cent indicated these challenges impacted ‘a little’ or ‘sometimes’ (Table 1), this study contributes to the emerging body of knowledge about health workforce capability. It highlights practice manager perceptions that technology and connectivity issues impact on the job capability of staff working in their rural and remote general practices. It also builds on this research by highlighting the influence of technology and connectivity on the capability of rural practice staff in smaller and more remote practices, which was shown in our data to be more likely in remote areas (Table 4).

TABLE 5 Frequency of technology and connectivity issues impacting staff’s capability to do their job and its association with total staff headcount, type of connection and rurality.

	Total sample ($n=168$)	Minimal technology and connectivity issues ($n=72$)	Frequent technology and connectivity issues ($n=96$)	OR (95% CI)	p -Value	AOR (95% CI)	p -Value
Total clinical staff headcount							
1–4 staff (reference)	51 (30)	15 (21)	36 (38)	1.0		1.0	
5–7 staff	37 (22)	21 (29)	16 (17)	0.32 (0.13–0.77)	0.011	0.27 (0.10–0.67)	0.005
8–11 staff	42 (25)	21 (29)	21 (22)	0.42 (0.18–0.98)	0.044	0.39 (0.16–0.95)	0.038
>11 staff	38 (23)	15 (21)	23 (24)	0.64 (0.26–1.55)	0.322	0.66 (0.26–1.66)	0.373
Type of connection							
NBN (reference)	128 (76)	58 (81)	70 (73)	1.0		1.0	
Non-NBN	22 (13)	8 (11)	14 (15)	1.45 (0.57–3.70)	0.436	1.53 (0.58–4.08)	0.392
Multiple	13 (8)	4 (6)	9 (9)	1.86 (0.55–6.37)	0.320	2.86 (0.78–10.46)	0.112
Don't Know	5 (3)	2 (3)	3 (3)	1.24 (0.20–7.69)	0.815	1.32 (0.19–9.05)	0.774
MM 2019 classification							
MM 3 (reference)	73 (43)	32 (44)	41 (43)	1.0		1.0	
MM 4	42 (25)	18 (25)	24 (25)	1.04 (0.48–2.24)	0.919	1.11 (0.50–2.46)	0.794
>MM 5	53 (32)	22 (31)	31 (32)	1.10 (0.54–2.25)	0.795	1.07 (0.49–2.33)	0.863

Values below 0.05 are significant and bolded.

In the context of the literature that technology and connectivity issues further exacerbate access to professional development and feelings of isolation, this may negatively influence health professionals' retention.^{38,41,42} Technology may provide opportunities to leverage training and support for those who are working in rural and remote areas,^{43,44} and allow health practitioners to create health-focused groups to communicate with peers to address feelings of isolation, particularly in smaller locations.⁴⁵ Furthermore, it was also found that access to technology makes health professionals feel more capable in decision-making where they have limited professional support.³⁰

4.1 | Limitations

There are several limitations of this study. Firstly, the study was reflective of perceptions of PMs who were not directly involved in the care delivery process. Therefore, results cannot be representative of the perceptions of health professionals (GPs and nurses). Secondly, the overall response rate for this study was 23% and it is possible that our findings are not representative of the perceptions of PMs across all rural and remote general practices. However, studies have shown no significant relationship between response rate and nonresponse bias.⁴⁶ Thirdly, as the survey was delivered by RDN, practices that have an existing relationship with RDN may be more likely to participate, resulting in selection bias. Fourthly, given the survey was sent to PMs of general practices in rural and remote NSW, metropolitan general practices were not invited to participate, and therefore a comparison with metropolitan practices is not possible. As such, the study cannot determine whether these specific issues are also present in metropolitan areas. Additionally, small numbers of PMs were from remote areas (MM6 and MM7) and as such these responses were collapsed into the MM5 category. The study was therefore unable to determine if there was a geographic implication on technology and connectivity between MM5, 6 and 7. Finally, data were collected during 2020 and 2021, during COVID-19 lockdowns and sanctions. During this time, rural and remote areas were provided with increases in data usage by telecommunication companies, and as such, data presented may not be an accurate representation of the current state of technology and connectivity issues across rural and remote NSW.

5 | CONCLUSION

Technology and connectivity issues were prevalent among PMs working in rural and remote general practices in

NSW. There was a significant difference in technology and connectivity issues between smaller practices, generally located in more remote geographical locations, and larger practices, generally located in large rural land regional locations. However, our study highlights that it is not only the most remote communities that experience technology issues. The majority of respondents reported that technology and connectivity issues negatively impacted their own and their staff's capability to perform their job. Previous research in this field has focused mainly on issues concerning the availability and quality of internet connections, rather than the impact of these issues on the capability of staff to perform their job, and as such, further research is required on the impact of issues with other technologies (phones, software and hardware) in rural and remote practices. Additionally, further research is required as to whether other factors contribute to negative technology and connectivity experiences.

AUTHOR CONTRIBUTIONS

Margot Leeson-Smith: Conceptualization; writing – original draft; writing – review and editing; formal analysis; methodology. **Louise Geddes:** Writing – review and editing; formal analysis; supervision. **Heath Johnson:** Conceptualization; methodology; writing – review and editing; formal analysis; supervision. **Sabrina Pit:** Conceptualization; methodology; writing – review and editing; supervision. **Robyn Ramsden:** Conceptualization; methodology; writing – review and editing; formal analysis; supervision.

ACKNOWLEDGEMENTS

The authors would like to thank the practice managers who participated in the 2020 iteration of the Practice Manager Survey, and in each year that it has been implemented. The Practice Manager Survey is conducted as part of the Health Workforce Needs Assessment, funded by the Rural Health Workforce Activity, Department of Health and Aged Care. Open access publishing facilitated by Deakin University, as part of the Wiley - Deakin University agreement via the Council of Australian University Librarians.

CONFLICT OF INTEREST STATEMENT

None.

ETHICS STATEMENT

Ethics approval was obtained from the University of Notre Dame Australia Human Research Ethics Committee (2021-151S).

ORCID

Robyn Ramsden  <https://orcid.org/0000-0002-0418-9280>

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How to cite this article: Leeson-Smith M, Geddes L, Johnson H, Pit S, Ramsden R. Prevalence of technology and connectivity issues in general practices in rural New South Wales and their impact on staff capability to perform their job. *Aust J Rural Health*. 2024;32:715–723. <https://doi.org/10.1111/ajr.13129>