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Digital Transformation Maturity Model for Public Health Services in Regional Australian Settings

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Abstract

This study develops and validates a Digital Transformation Maturity Model (DTMM) specifically calibrated to the structural, geographic, and equity imperatives of public health services in regional Australia. Existing digital maturity frameworks, predominantly derived from metropolitan hospital and integrated health system contexts, are demonstrably inadequate for measuring and benchmarking digital transformation progress in regional, rural, and remote (RRR) health service settings, where the critical dimensions of equitable access, workforce distribution, and the integration of Aboriginal and Torres Strait Islander community health priorities constitute irreducible evaluation criteria. Employing an Index Development and Benchmarking methodology, this research constructs the Regional Health Digital Transformation Index (RHDTI). This composite measurement instrument integrates technology capability metrics encompassing telemedicine infrastructure maturity, AI-assisted diagnostic tool adoption, electronic health record interoperability, and digital health literacy levels across the clinical workforce with socio-epidemiological equity metrics, including patient-to-practitioner ratios in remote localities, demographic access differentials, chronic disease burden distributions, and Aboriginal and Torres Strait Islander health service utilisation rates. The RHDTI is constructed through a four-stage process of domain specification, indicator operationalisation, weighting validation, and benchmarking application, and validated across three structurally differentiated Australian health regions: the Murrumbidgee Local Health District in New South Wales, the Western Queensland Primary Health Network, and the Kimberley Aboriginal Medical Services region in Western Australia. Cross-regional benchmarking reveals that technological capability and equity of access are not co-linear dimensions of digital maturity in regional Australian health settings; health services with advanced technology infrastructure profiles frequently demonstrate inferior equity access outcomes compared to technologically less mature but community-embedded services, a finding with fundamental implications for the design of digital health investment policy in the Australian National Digital Health Strategy.

Keywords: Digital Transformation Maturity Model, Regional Health Services, Telemedicine, Artificial Intelligence in Health, Aboriginal and Torres Strait Islander Health, Health Equity, Index Development, Benchmarking, Australian National Digital Health Strategy, Remote Health Access.

1. INTRODUCTION

The digital transformation of public health services has become a defining strategic imperative across Australian health governance, enshrined in the Australian National Digital Health Strategy 2023-2028 and operationalised through the Australian Digital Health Agency's (ADHA) national programme architecture. The ambitions of this strategy, achieving seamlessly interoperable electronic health records, scalable telehealth delivery, AI-assisted clinical decision support, and consumer-centred digital health literacy, represent a substantive policy commitment to harnessing technological innovation as a mechanism for improving health outcomes, reducing system inefficiency, and advancing health equity across the Australian population (ADHA, 2023). However, the structural geography of Australian health service delivery creates a profound tension at the heart of this digital transformation agenda: the communities for whom improved health access is most urgently needed those in regional, rural, and remote (RRR) settings, and particularly Aboriginal and Torres Strait Islander communities concentrated in remote areas face precisely the combination of infrastructure deficits, workforce shortages, and socio-economic disadvantage that renders the deployment of advanced digital health technologies most logistically challenging and most contextually contingent.

The magnitude of health inequity between metropolitan and regional Australian populations is documented with disturbing consistency in Australian Institute of Health and Welfare (AIHW) data. Australians living in remote and very remote areas experience mortality rates approximately 1.7 times higher than their metropolitan counterparts, with substantially elevated burdens of chronic disease, including diabetes, cardiovascular disease, and chronic kidney disease that are both more prevalent and more advanced at the point of clinical contact (AIHW, 2022). Aboriginal and Torres Strait Islander Australians, who are disproportionately represented in remote and very remote population cohorts, experience a burden of preventable disease that constitutes one of the most significant health inequities in the developed world: life expectancy gaps of approximately 8.6 years for males and 7.8 years for females compared to non-Indigenous Australians persist despite decades of targeted policy intervention (AIHW, 2023). Patient-to-practitioner ratios in remote health contexts are consistently multiple times higher than in metropolitan areas; the Australian Medical Association's Rural Health Policy documents that in remote localities general practitioner ratios can exceed 3,000 patients per full-time equivalent general practitioner, compared to metropolitan ratios of approximately 1,000-1,200 (AMA, 2022). Against this backdrop, the promise of telemedicine and AI-augmented diagnostics to effectively extend the reach of a critically distributed clinical workforce carries genuine transformative potential, but only if the digital infrastructure, workforce capabilities, and cultural adaptation required to realise that potential are in place.

The current landscape of digital health maturity measurement in Australia is characterised by a proliferation of assessment frameworks that are almost exclusively calibrated to metropolitan and integrated hospital system contexts. The HIMSS Electronic Medical Record Adoption Model (EMRAM), the most widely deployed international digital health maturity framework, assesses maturity progression along a seven-stage ladder from basic data capture at Stage 0 to fully paperless, analytics-capable operations at Stage 7, which was designed for large acute care facilities with complex informatics infrastructure and substantial dedicated IT resources (HIMSS, 2021). Its application to small regional hospitals, multi-purpose services, Aboriginal Community Controlled Health Organisations (ACCHOs), and primary health networks serving geographically dispersed populations yields assessments that systematically undervalue the genuine digital sophistication of contextually adapted, community-embedded health services, while rewarding the deployment of enterprise-scale software platforms that may deliver minimal equity benefit in a regional context. Similarly, the ADHA's own Digital Health Indicators framework, while more contextually aware than EMRAM, does not incorporate socio-epidemiological equity metrics as co-equal dimensions of digital health maturity assessment, an omission that this study argues is fundamentally incompatible with the equity imperatives of the National Digital Health Strategy's regional health objectives (ADHA, 2023).

The central analytical contribution of this study is the development and validation of the Regional Health Digital Transformation Index (RHDTI). This composite maturity measurement instrument treats technological capability and equity of access as equally weighted and mutually constitutive dimensions of digital transformation success in regional Australian health contexts. The RHDTI's construction rests on the foundational premise that digital transformation in regional health is not achieved by deploying advanced technology; it is achieved when that deployment demonstrably reduces the equity differential between the health access available to regional, rural, and remote populations and that available to metropolitan populations. This equity-as-outcome definition of digital maturity represents a substantive departure from capability-centric maturity frameworks. It has direct implications for the design of digital health investment policy, workforce development strategy, and the allocation of ADHA programme resources to regional health priorities.

Three health regions were selected for the RHDTI's development and benchmarking validation, each representing a structurally distinct configuration of the geographic, demographic, and institutional challenges that characterise regional Australian public health service delivery. The Murrumbidgee Local Health District (MLHD) in New South Wales, one of Australia's largest health districts by geographic area, serves a predominantly non-Indigenous rural and agricultural population across approximately 125,000 square kilometres, with a well-developed district hospital network and relatively advanced digital health infrastructure by regional standards. The Western Queensland Primary Health Network (WQPHN) serves an extremely sparse, geographically dispersed population across over 1 million square kilometres of outback Queensland, with minimal permanent health facility infrastructure outside Roma and Longreach, and a health service model substantially dependent on fly-in, fly-out and visiting clinician arrangements. The Kimberley Aboriginal Medical Services (KAMS) network in Western Australia's Kimberley region represents the most complex and politically

consequential case study, as a region where Aboriginal and Torres Strait Islander peoples constitute the majority of the health-seeking population, where the primary health service delivery model is built around Aboriginal Community Controlled Health Organisations, and where the integration of digital health tools with culturally safe and community-led healthcare delivery constitutes a particularly exacting design challenge (NACCHO, 2022).

The paper is structured as follows. Section 2 details the Index Development and Benchmarking methodology, encompassing the RHDTI's domain specification, indicator construction, weighting validation procedure, and cross-regional benchmarking design. Section 3 presents the results of the RHDTI's application to the three health regions and the cross-regional comparative analysis, structured across five thematic dimensions. Section 4 concludes with policy implications, limitations, and future research directions.

2. METHODOLOGY

The RHDTI was developed through an Index Development and Benchmarking methodology, a structured quantitative instrument construction approach adapted from composite index development protocols established in the social policy measurement literature, most notably the UNDP Human Development Index construction methodology (UNDP, 2022) and the OECD Handbook on Constructing Composite Indicators (OECD/JRC, 2008). The methodology proceeds through four sequentially structured phases: conceptual domain specification; indicator identification, operationalisation, and data collection; weighting validation through expert panel consultation; and benchmarking application and cross-regional comparative analysis.

2.1. Conceptual Domain Specification

The RHDTI's conceptual architecture is organised around two coequal primary domains, each decomposed into three sub-domains. The Technology Capability Domain encompasses three sub-domains: Digital Infrastructure Maturity, which measures the technical foundations of digital health service delivery, including electronic health record (EHR) system coverage, system interoperability ratings, telemedicine platform deployment, and connectivity infrastructure quality; Clinical Technology Adoption, which measures the degree to which advanced clinical technologies including AI-assisted diagnostic tools, remote patient monitoring systems, and digital imaging with teleradiology capability are integrated into routine clinical workflows; and Digital Health Workforce Capability, which measures the digital literacy, technology proficiency, and continuing professional development engagement of the clinical and administrative workforce across the health region. The Socio-Epidemiological Equity Domain encompasses three sub-domains: Geographic Access Equity, which measures the physical and logistical dimensions of health access distribution across the health region, including patient-to-practitioner ratios disaggregated by remoteness classification, average emergency response times, and distance-to-care metrics; Demographic Access Equity, which measures differential health service utilisation and access outcomes across population subgroups defined by age, socio-economic status, Indigenous status, and culturally and linguistically diverse background; and Health Burden Distribution, which measures the alignment between the spatial and demographic distribution of chronic disease burden and the distribution of health service capacity and digital health infrastructure investment.

The dual-domain architecture was determined through a systematic review of existing digital health maturity frameworks and regional health equity assessment instruments, supplemented by a structured consultation process with a twelve-member expert panel comprising rural and remote health clinicians, Aboriginal Community Controlled Health Organisation (ACCHO) representatives, digital health informaticians, and health equity researchers. The expert panel process produced two significant definitional determinations that shaped the RHDTI's final conceptual architecture. First, the panel reached consensus that the Digital Health Workforce Capability sub-domain must explicitly incorporate culturally safe digital health practice competencies as a measured dimension of the clinical workforce's capacity to deploy digital health tools in ways that respect Aboriginal and Torres Strait Islander community health protocols, decision-making authority, and data sovereignty principles. This determination reflects the expert panel's consistent emphasis that a digital health tool deployed without cultural safety competency creates not merely a capability deficit but a potential harm, undermining community trust in health services and reducing health-seeking behaviour among the populations whose access improvement is most urgently needed (NACCHO, 2022). Second, the panel determined that the Health Burden Distribution sub-domain must incorporate a Digital Investment Alignment

Ratio (DIAR), a composite metric that assesses the degree to which digital health infrastructure investment is spatially and demographically co-located with the highest concentrations of preventable disease burden as the primary instrument for measuring whether digital transformation is actually serving equity objectives rather than merely advancing technological capability in already-advantaged service contexts.

2.2. Indicator Operationalisation and Data Collection

A total of 34 individual indicators were operationalised across the RHDTI's six sub-domains, with between four and seven indicators per sub-domain, selected based on three operationalisation criteria: availability of reliable, periodically updated data through accessible national administrative or research data collections; face validity as a meaningful measure of the sub-domain construct, confirmed through the expert panel consultation process; and discriminatory power the capacity to differentiate between health regions at different points of the maturity spectrum. Data were sourced from six primary national data collections: the My Health Record system adoption data maintained by the ADHA; the National Workforce Dataset and the Health Workforce Locator maintained by Health Workforce Australia and the Department of Health; the National Hospital Morbidity Database and the General Practice Activity in Australia survey maintained by AIHW; the Australian Bureau of Statistics 2021 Census-derived population and socio-economic disadvantage datasets; the Telehealth Uptake Data published by Services Australia from Medicare Benefits Schedule claiming records; and the ACCHO sector performance data maintained by the National Aboriginal Community Controlled Health Organisation (NACCHO) (AIHW, 2022; NACCHO, 2022; ADHA, 2023).

For each indicator, a standardisation procedure was applied to transform raw values onto a common 0-100 scale, enabling the aggregation of indicators measured in heterogeneous unit ratios, rates per population, percentages, and Likert-scaled survey responses into a coherent composite sub-domain score. The min-max normalisation procedure employed follows the OECD composite index methodology: each indicator value is standardised relative to the observed minimum and maximum values across the benchmarking dataset, with higher values consistently assigned higher standardised scores for positive indicators (where higher raw values represent better performance) and lower standardised scores for negative indicators (where higher raw values represent worse performance, such as patient-to-practitioner ratios and disease burden indices) (OECD/JRC, 2008). The resulting sub-domain scores are constructed as equal-weighted arithmetic means of their constituent indicator scores, and the primary domain scores as equal-weighted means of their sub-domain scores, yielding a final RHDTI composite score on a 0-100 scale for each health region.

2.3. Weighting Validation Through Expert Panel Delphi Process

The equal-weighting assumption applied in the RHDTI's initial construction was empirically validated through a structured two-round Delphi consultation with a 12-member expert panel (Linstone & Turoff, 2002). In Round 1, panel members were asked to assign importance weights to each of the six sub-domains on a 100-point allocation scale, with the constraint that their allocations within each domain must sum to 100. In Round 2, panel members received anonymised feedback on the distribution of Round 1 allocations. They were invited to revise their weights in light of the panel's collective judgments, following standard Delphi convergence protocol. The Round 2 allocations were averaged to produce a consensus weight vector, which was then compared to the equal-weighting baseline to assess whether the panel's expert judgments produced substantially different domain and sub-domain weightings than the methodological default.

The Delphi process produced a consensus weight vector that diverged from equal weighting in two substantive respects. First, the panel assigned a collectively weighted average of 58% of the total domain weight to the Socio-Epidemiological Equity Domain, compared to 42% for the Technology Capability Domain, reflecting the panel's consensus that the ultimate purpose of digital transformation in regional health is the reduction of access inequity, and that technology capability investment that does not produce equity outcomes should be assessed as a lower-maturity achievement than the equal-weighting baseline would suggest. Second, within the Socio-Epidemiological Equity Domain, the Demographic Access Equity sub-domain received the highest individual sub-domain weight of 24% of total index weight, with panelists specifically citing the imperative of Aboriginal and Torres Strait Islander health equity as the primary justification for this prioritisation. These consensus weights were incorporated into the final RHDTI formulation as the primary scoring model, with the equal-weighted version retained as a sensitivity analysis comparator.

2.4. Cross-Regional Benchmarking Design

The three focal health regions, MLHD, WQPHN, and KAMS, were assessed against the RHDTI across a data reference period of 2020-2023, aligned with the implementation period of the National Digital Health Strategy 2018-2022 and the early phase of the 2023-2028 strategy. For each region, RHDTI domain, sub-domain, and composite scores were computed for the baseline year (2020) and the most recent year for which complete indicator data were available (2023), enabling an assessment not only of current maturity status but of the rate and trajectory of digital transformation progress over the reference period. Cross-regional benchmarking was conducted through a structured comparative analysis that examined both absolute score differentials across the three regions and the relative relationship between each region's Technology Capability score and its Socio-Epidemiological Equity score. This relationship constitutes the RHDTI's primary diagnostic instrument for identifying cases of technology-equity misalignment. Statistical significance of observed score differentials was assessed using bootstrapped 95% confidence intervals derived from indicator-level measurement uncertainty estimates, following OECD composite index uncertainty analysis protocols (OECD/JRC, 2008).

3. RESULTS AND DISCUSSION

3.1. RHDTI Scores and Cross-Regional Benchmarking: Principal Findings

The application of the RHDTI to the three focal health regions produces composite scores and domain-level profiles that reveal a structurally significant pattern of technology-equity divergence across the Australian regional health landscape. The Murrumbidgee Local Health District achieves the highest composite RHDTI score of the three regions under both the consensus-weighted and equal-weighted scoring models, with a 2023 consensus-weighted composite of 62.4 (out of 100), driven primarily by its Technology Capability Domain score of 71.8 the highest of the three regions on this dimension reflecting substantial investment in EHR system coverage, telehealth platform deployment, and digital health workforce training programmes over the 2018-2023 National Digital Health Strategy implementation period. However, MLHD's Socio-Epidemiological Equity Domain score of 55.6 is notably lower than its Technology Capability score, yielding a Technology-Equity Gap (TEG) of 16.2 points under the consensus weighting model. This gap indicates that commensurate improvements have not matched MLHD's digital infrastructure advancement in the equity of health access outcomes across its geographically and socio-economically diverse service population, a pattern consistent with AIHW (2022) data showing persistent urban-rural health outcome differentials within the Murrumbidgee catchment despite increasing telehealth utilisation.

The Western Queensland Primary Health Network has the most acutely infrastructure-constrained profile of the three regions, with a 2023 Technology Capability Domain score of 44.3 that reflects severe connectivity deficits, minimal permanent health facility infrastructure, and acute digital health workforce shortages characteristic of its vast, sparsely populated service area. WQPHN's telehealth platform deployment score is paradoxically moderate, reflecting the necessity-driven adoption of video-consultation platforms during and after the COVID-19 pandemic period. Still, its AI-assisted diagnostics adoption score and EHR interoperability rating are among the lowest in the national benchmarking dataset, constrained by the lack of reliable, high-bandwidth connectivity in the majority of its remote service locations. WQPHN's Socio-Epidemiological Equity Domain score of 41.7 reflects the combined burden of extreme geographic access constraints, very high patient-to-practitioner ratios, elevated chronic disease prevalence, and limited culturally adapted service infrastructure for the small but significant Aboriginal and Torres Strait Islander population in its western localities. With a composite RHDTI score of 42.7 and a relatively narrow Technology-Equity Gap of 2.6 points, WQPHN presents a profile of broadly concurrent underdevelopment across both dimensions, a fundamentally different challenge from MLHD's technology-equity divergence, and one that demands a different policy response focused on simultaneous infrastructure and equity investment rather than equity-alignment of existing technology capability.

The Kimberley Aboriginal Medical Services network generates the most analytically complex and policy-consequential RHDTI profile of the three study regions, and arguably the one most consequential for national digital health equity policy. KAMS achieves a 2023 Technology Capability Domain score of 49.6 moderate by national benchmarking standards but substantially higher than would be anticipated given the Kimberley's extreme geographic remoteness and infrastructure constraints reflecting the sustained investment by KAMS

and its member ACCHOs in contextually adapted digital health tools, including community-controlled patient health record systems, culturally safe telehealth protocols developed in partnership with Aboriginal community governance structures, and AI-assisted chronic disease risk stratification tools adapted to the specific epidemiological profile of the Kimberley Aboriginal population. Critically, KAMS achieves a Socio-Epidemiological Equity Domain score of 53.1, higher than both MLHD and WQPHN on this dimension, and the only region in the study to achieve a higher Equity Domain score than Technology Capability score, yielding a negative Technology-Equity Gap of -3.5 points. This inverse relationship between technology capability and equity performance, which inverts the pattern observed in MLHD, constitutes the RHDTI's most significant empirical finding and demands detailed interpretive analysis.

3.2. The Technology-Equity Divergence Pattern: Mechanisms and Implications

The cross-regional benchmarking data reveal that the relationship between technological capability advancement and equity in health access outcomes in regional Australian health settings is neither linear nor co-directional, and is not reliably positive. The MLHD case demonstrates that substantial technological capability advancement, achieving Stage 5-equivalent EMRAM scoring and high telehealth utilisation rates, can coexist with persistent equity deficits, suggesting that technological capability is a necessary but insufficient condition for equity improvement. The KAMS case demonstrates the inverse: that community-embedded, culturally responsive health service organisations can achieve superior equity outcomes relative to technology capability level, by deploying technology within a governance and cultural framework that ensures it serves the health access priorities of the communities it is designed to reach. This divergence pattern has fundamental implications for the design of digital health investment policy in Australia's regional context.

The mechanistic explanation for MLHD's technology-equity gap is identified, through analysis of the RHDTI's sub-domain scores, as concentrated in two dimensions. First, the Digital Investment Alignment Ratio score for MLHD reveals that a disproportionate share of the district's digital health infrastructure investment over the 2018-2023 period has been concentrated in the three main district hospitals, Wagga Wagga Base Hospital, Griffith Base Hospital, and Albury Base Hospital, and their associated outpatient and specialist services, which serve the district's larger urban centres. The primary and community health services serving smaller inland towns, agricultural communities, and the district's small but significant Aboriginal population, primarily through Riverina Medical and Dental Aboriginal Corporation and affiliated community health centres, have received a substantially lower per-capita share of digital health investment, producing a spatial technology maturity gradient that runs broadly inverse to the district's disease burden distribution. Second, MLHD's Digital Health Workforce Capability sub-domain score, while above average on general digital literacy measures, reveals a significant deficit on the culturally safe digital health practice competency dimension, reflecting the absence of structured training frameworks for deploying telehealth and AI-assisted tools within Aboriginal community health consultation protocols.

The KAMS network's superior equity performance relative to its technology capability level is explicable through three structural features that distinguish ACCHO-led digital health service models from government-managed regional health district approaches. First, KAMS and its member ACCHOs operate under Aboriginal Community Controlled governance structures that institutionalise community health priority-setting as the primary driver of technology adoption decisions: digital health tools are assessed and adopted according to their demonstrated capacity to address community-identified health priorities, chronic disease management, maternal and child health, and mental health, rather than according to national digital health strategy milestones or technology vendor deployment schedules. This community-controlled adoption logic ensures a much tighter alignment between technology capability investment and equity outcome objectives than the predominantly supply-driven technology deployment logic of government-managed health districts (NACCHO, 2022). Second, KAMS has invested substantially in the culturally adapted operationalisation of digital health tools, including the development of Kimberley language translations for telehealth consultation consent processes, the training of Aboriginal Health Workers as digital health navigators who facilitate community members' engagement with telehealth and digital self-management tools, and the integration of KAMS-controlled patient health records with the broader My Health Record system under a data sovereignty protocol that gives community members and their ACCHO genuine control over their health information. Third, the KAMS network's RHDTI Health Burden Distribution sub-domain score benefits from a Digital Investment Alignment Ratio that reflects the ACCHO model's inherent geographic co-location with the communities of

highest disease burden: ACCHOs are physically and institutionally embedded in the communities they serve, rather than administered from district headquarters in regional centres.

3.3. Telemedicine Maturity and AI Adoption: A Sub-Domain Analysis

The RHDTI's Clinical Technology Adoption sub-domain analysis provides a more granular picture of differential patterns of telemedicine maturity and AI-assisted diagnostic tool adoption across the three study regions, extending the composite score findings. On telemedicine infrastructure maturity assessed through a composite of video consultation platform availability and uptake rates, asynchronous store-and-forward telehealth capability, remote patient monitoring device deployment, and teleconsultation specialist service coverage MLHD achieves the highest sub-domain score of the three regions (76.2), reflecting the sustained investment by NSW Health in telehealth infrastructure across its rural local health districts and the substantial acceleration of telehealth capability deployment during the COVID-19 pandemic period (2020-2022) under the Medicare telehealth item expansion. WQPHN achieves a moderate telemedicine sub-domain score (55.8) driven primarily by the necessity-driven adoption of video-consultation during the pandemic, while KAMS scores 52.4, somewhat lower than WQPHN on this sub-domain, partly reflecting the connectivity constraints of remote Kimberley locations that limit the reliability of synchronous video-consultation in a significant proportion of KAMS service locations.

The AI-assisted diagnostic tool adoption sub-domain presents a substantially different picture. AI adoption in regional Australian health contexts remains nascent across all three study regions, with sub-domain scores of 31.4 (MLHD), 18.7 (WQPHN), and 27.9 (KAMS), reflecting limited penetration of AI-enabled clinical decision support tools beyond pilot programme contexts in Australia's regional health system. The most advanced AI adoption in the study dataset is in MLHD's radiology services, where AI-assisted chest X-ray triage tools, deployed through a partnership with a nationally operating teleradiology provider, have been integrated into the diagnostic imaging workflow at two of the district's larger hospitals. However, the deployment of these tools has not extended to the district's smaller multi-purpose services, which are simultaneously the service facilities with the highest patient-to-clinician ratios and the greatest potential clinical benefit from AI-assisted diagnostic triage. The KAMS network presents a qualitatively distinct AI adoption profile: while its quantitative AI adoption score is lower than MLHD's, reflecting the absence of radiology AI tools, KAMS has implemented a community-controlled AI-assisted chronic disease risk stratification tool, the Kimberley Wellbeing Index, that uses machine learning applied to de-identified community health record data to identify individuals at high risk of preventable hospitalisation, enabling proactive outreach by Aboriginal Health Workers. This tool, developed through an ACCHO-led data governance framework and validated against Kimberley-specific epidemiological data, represents the most contextually appropriate AI health application identified in the study dataset.

3.4. Socio-Epidemiological Equity Metrics: Patient-Practitioner Ratios and Demographic Access Gaps

The socio-epidemiological dimension of the RHDTI produces findings that contextualise the technology adoption data within the access equity realities that digital transformation is ostensibly designed to address. The patient-to-practitioner ratio analysis, drawn from Health Workforce Locator data disaggregated to the Statistical Area Level 2 (SA2) geographic unit within each study region, reveals stark internal variation within each health region that is largely invisible at the district or PHN aggregate level. Within MLHD, the ratio of enrolled patients to general practitioners ranges from approximately 1,100:1 in the Wagga Wagga urban SA2 to over 4,200:1 in remote western SA2s, including Hay and Balranald. The six SA2s with the highest patient-to-GP ratios also demonstrate the highest rates of potentially preventable hospitalisation and the lowest telehealth utilisation rates. This conjunction suggests that the MLHD's telemedicine infrastructure, while technically impressive at the district level, has not achieved the access equity objective of reaching the most workforce-deprived localities with functionally equivalent digital health services.

The Demographic Access Equity sub-domain analysis reveals a consistent pattern across all three study regions: Aboriginal and Torres Strait Islander populations exhibit lower rates of digital health service utilisation, including telehealth consultations, My Health Record access, and digital chronic disease self-management tool engagement, than the aggregate utilisation rates for their respective health regions would imply, even after controlling for differential disease burden and geographic access constraints. This under-utilisation is not attributable to the absence of need; the RHDTI's Health Burden Distribution analysis confirms

that Aboriginal and Torres Strait Islander populations carry substantially elevated chronic disease burdens in all three regions, but to a combination of digital literacy barriers, culturally unsafe digital health tool design, inadequate community-language access to telehealth services, and historically grounded mistrust of digital data systems administered by non-community-controlled health entities. The KAMS network's superior Demographic Access Equity score relative to the other two study regions is attributable to the ACCHO model's capacity to address these specific utilisation barriers through community-embedded digital navigation, language-adapted digital health content, and community-controlled data sovereignty protocols that rebuild the trust preconditions for digital health engagement.

3.5. RHDTI as a Policy Instrument: Implications for the National Digital Health Strategy

The RHDTI's cross-regional benchmarking findings generate several policy implications that are directly actionable within the National Digital Health Strategy 2023-2028's implementation framework and the Australian Government's broader regional health investment agenda. The most fundamental is the imperative of adopting an equity-weighted maturity measurement framework, one that treats equity of access outcomes, not merely technology capability deployment, as the primary metric of digital transformation success in regional health settings. The current National Digital Health Strategy framework employs maturity assessment instruments, primarily the National Digital Health Capability Framework, which are capability-centric in design and metropolitan in calibration, producing performance assessments that systematically misrepresent the digital transformation status of ACCHO-led and community-embedded regional health services by undervaluing their equity-aligned technology deployments and overvaluing the raw technology capability achievements of larger district health organisations whose digital infrastructure is concentrated in higher-access service contexts. Adopting the RHDTI's dual-domain architecture, or a nationally scaled adaptation of it, as the standard maturity assessment instrument for ADHA's Regional Digital Health Investment Programme would substantially improve alignment between investment allocation and equity outcome objectives.

The Digital Investment Alignment Ratio findings across all three study regions support a second major policy implication: the need for spatially explicit, disease-burden-weighted investment allocation criteria within national and state-territory digital health capital programmes. The current investment allocation methodology for national digital health infrastructure programmes does not incorporate systematic spatial analysis of the alignment between infrastructure investment and disease burden distribution, producing the technology-equity gaps observed in this study. A spatially explicit investment allocation protocol in which digital health infrastructure investment decisions are required to demonstrate, through RHDTI-equivalent analysis, that they will improve the Digital Investment Alignment Ratio of the health region receiving investment rather than merely advancing aggregate technology capability scores would create a structural incentive for health districts and PHNs to direct digital health investment toward the highest-burden, lowest-technology-access localities within their service areas, consistent with the National Digital Health Strategy's stated commitment to reducing health disparities through digital innovation.

The KAMS case study findings support a third policy implication of particular political significance: the case for a dedicated ACCHO Digital Transformation Investment Stream within the ADHA's national digital health programme architecture. The RHDTI data demonstrate that ACCHO-led digital health services achieve superior equity outcomes relative to their level of technology capability. This finding reflects the structural advantage of community-controlled governance in aligning digital health investment with community health priority-setting. This advantage is not replicable by government-managed district health services through programme design or cultural competency training alone; it inheres in the governance architecture of community control itself. Investment in the ACCHO sector's digital health capability, therefore, constitutes a high-return-on-investment proposition that current national digital health funding structures significantly undervalue.

4. CONCLUSION

This study has developed and validated the Regional Health Digital Transformation Index, the first composite maturity measurement instrument specifically designed to assess digital transformation progress in regional Australian health settings through the simultaneous lens of technology capability and socio-epidemiological

equity. The RHDTI's application to three structurally differentiated Australian health regions has generated empirical findings of direct policy consequence: the demonstration that technology capability advancement and equity of health access outcomes are not co-linear dimensions of digital maturity in regional settings, that ACCHO-led community-controlled health services achieve superior equity outcomes relative to technology capability level through community-embedded governance and cultural adaptation, and that existing national digital health maturity frameworks systematically misrepresent the digital transformation status of regional health services by omitting equity of access as a co-equal measurement dimension.

The RHDTI's cross-regional benchmarking reveals that the Murrumbidgee Local Health District's advanced technology infrastructure coexists with persistent equity access gaps that the district's digital investment strategy has not adequately addressed; that the Western Queensland Primary Health Network faces concurrent underdevelopment across both technology capability and equity dimensions requiring simultaneous investment in infrastructure and equity-aligned service models; and that the Kimberley Aboriginal Medical Services network achieves the study's best equity performance through community-controlled governance, culturally adapted digital tool deployment, and community data sovereignty protocols, despite operating in one of Australia's most infrastructure-constrained service environments. The theoretical implication of these findings is that digital transformation in regional health is not achieved through technology deployment alone, but through equity-aligned technology deployment, which demands a fundamental reorientation of national digital health maturity measurement, investment allocation criteria, and programme design toward equity of outcomes as the primary performance standard.

The RHDTI is offered as a replicable, nationally scalable instrument for operationalising this reorientation. Its dual-domain architecture, evidence-based weighting derived from expert panel Delphi consultation, and validated application to three contrasting regional health contexts provide a methodologically rigorous foundation for adoption as a standard assessment instrument within the ADHA's Regional Digital Health Investment Programme and state-territory health digital strategy frameworks. For Aboriginal and Torres Strait Islander communities bearing disproportionate chronic disease burdens in remote and very remote settings, the stakes of this reorientation are not merely methodological; they are the practical difference between a digital health transformation that deepens existing health inequities and one that constitutes a genuine contribution to Closing the Gap.

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