Scope and quality of economic evaluations of Aboriginal and Torres Strait Islander health programs: a systematic review

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Abstract

Objectives: Identify the number, type, scope and quality of economic evaluations of Aboriginal and Torres Strait Islander health programs.

Methods: A systematic review of peer-reviewed and grey literature was conducted for articles published from 2010 to 2020 that reported a full economic evaluation of Aboriginal and Torres Strait Islander health programs. Data extraction included: type of economic evaluation, comparators, data sources and concerns, and outcome measures. Methodological quality was assessed using the Drummond checklist.

Results: Thirteen publications met inclusion criteria: two cost-consequence analyses, two cost-effectiveness analyses, five cost-utility analyses, and four cost-benefit/return on investment analyses. Most studies (n=10) adopted a health system perspective and used a range of key data sources for economic analyses. Ten studies identified data access limitations that restricted analyses and two studies identified data quality concerns. Twelve studies were of good methodological quality and one was of average quality.

Conclusions: Despite significant investment in strategies to close the gap in health outcomes for Aboriginal and Torres Strait Islander people, there is limited evidence about what constitutes a cost-effective investment in Aboriginal and Torres Strait Islander healthcare.

Implications for public health: More economic evaluation is required to justify the significant investment in health programs for Aboriginal and Torres Strait Islander people.

Key words: Aboriginal and Torres Strait Islander health, Indigenous, economic evaluation, systematic review

Aboriginal and Torres Strait Islander people make up 3.3% of the Australian population[1] but experience a disproportionate burden of ill health.[2] Disparities in health outcomes are a result of the ongoing impacts of colonisation, as well as entrenched structural, social, environmental, political and economic factors that contribute to poor health.[3]

The Australian Government's 'Close the Gap' strategy was implemented in 2008 to achieve equality for Aboriginal and Torres Strait Islander people in health and life expectancy within a generation by setting six measurable targets.[4] However, while there were small progressions on some of the targets, most Closing the Gap targets were not on track to be achieved. In July 2020, a new National Agreement on Closing the Gap was introduced. The National Agreement committed to four Priority Reforms that aim to change the way governments work with Aboriginal and Torres Strait Islander communities to accelerate improvements: 1) Formal partnership and shared decision making; 2) Building the community-controlled sector; 3) Transforming government organisations, and 4) Shared access to data and information at a regional level. They identified 17 targets across the following outcome areas: education, employment, health and wellbeing, justice, safety, housing, land and waters, and languages.[5]

More than 13 years on, the 2021 Closing the Gap Data Compilation Report indicates progress towards set targets in some areas.[6] The first report focused on only seven socioeconomic outcome areas for which data was available. Three outcome areas – healthy birthweight babies, the enrolment of children in the year before full-time schooling, and youth detention rates – were on track to be achieved. The remaining four (life expectancy, adult imprisonment, out-of-home care for children, and suicides) were not on track to be delivered.[5,6]

For example, between 2001 and 2018–19, there was an 11% decrease in smoking among Aboriginal and Torres Strait Islander people, while between 1998 and 2018 there was a 40% reduction in avoidable deaths.[7,8] However, while improvements in age-standardised mortality rates of approximately

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10% have been observed for Aboriginal and Torres Strait Islander peoples since 2006, similar improvements have occurred for other Australians, meaning the life expectancy gap of 10.6 years for men and 9.5 years for women has not narrowed. This means the target to reduce disparities in life expectancy between Aboriginal and Torres Strait Islander and non- Aboriginal and Torres Strait Islander Australians by 2031 is not on track and is unlikely to be met.[8]

Failure to improve health outcomes for Aboriginal and Torres Strait Islander peoples is despite significant investment in health services for this population.[8] In 2015–16, the average health expenditure for Aboriginal and Torres Strait Islander Australians was estimated to be $8,949 per person, which was $1.30 for every $1.00 spent per person for non-Aboriginal and Torres Strait Islander Australians.[9] In the period 2010–11 to 2016–17, Australian Government health expenditure per person for Aboriginal and Torres Strait Islander Australians grew by an average of 5.6% per annum in real terms (from $2,590 to $3,585).[9] This raises concerns that implemented programs might not always deliver benefits to Aboriginal and Torres Strait Islander people.[10]

Evaluation is a key tool for facilitating efficient and effective delivery of government services by maximising the impact of programs and ensuring evidence-based policy and decision making.[11] State and Federal governments in Australia have clearly stated their commitment to evaluate Aboriginal and Torres Strait Islander health programs to assess the relevance, efficiency and effectiveness of programs in delivering their intended outcomes. Central to this commitment is the development of the National Indigenous Evaluation Strategy by the Productivity Commission,[12] which provides a whole-of-government framework for selecting, planning, conducting and using evaluations of policies and programs affecting Aboriginal and Torres Strait Islander people.

Economic evaluation is an important aspect of evaluation. Aboriginal and Torres Strait Islander concepts of health and wellbeing are holistic and important domains of health are interconnected.[13] Ensuring that finite health dollars are used in the most effective way to support the critical domains of physical, social, emotional, cultural, spiritual and ecological wellbeing is critical to addressing the life expectancy gap between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians. Economic evaluation is defined as the "comparative analysis of alternative courses of action in terms of both their costs and consequences".[14] In the context of healthcare, economic evaluation enables the generation of evidence about expenditure and broad benefits (outputs, impacts and/or outcomes) of health services or programs, allowing comparison of health services and the identification of those that represent the best allocation of financial resources and provide value for money.[15] Economic evaluation is critical to understanding whether funding is appropriate and value for money in the context of program objectives, and provides information to decision-makers on the efficient use of available resources for maximising health benefits.[15] Commonly used types of economic evaluation include cost-minimisation analysis, cost-effectiveness analysis, cost-efficiency analysis, cost-utility analysis, cost-consequences analysis and cost-benefit analysis.[16] In the context of increased commitment to evaluation and evidence-based policy, knowledge of the economic evidence available to make decisions about the delivery of Aboriginal and Torres Strait Islander health programs is critical. A previous systematic review examined the cost-effectiveness of health interventions (published up to May 2014) in Indigenous populations globally to identify the characteristics of successful and unsuccessful interventions, and areas for further research.[17] That review found nineteen studies reporting on economic evaluations of interventions targeting an Indigenous population, of which only seven evaluations were conducted with Aboriginal and Torres Strait Islander people in Australia. The authors concluded that the small amount of evidence available provided limited insight into cost-effective investment in health programs for Indigenous people globally. Since the publication of this review, there have been no examinations of the scope and methodological quality of economic evaluations of Aboriginal and Torres Strait Islander health programs in Australia. This evidence is important for policy-makers and those planning, commissioning and implementing economic evaluations.

Objectives

To conduct a systematic review of economic evaluations of Aboriginal and Torres Strait Islander health programs over the period 2010–2020, to identify:

- The number, type, and scope of economic evaluations undertaken, including the key data sources used and key data concerns reported.
- The methodological quality of identified economic evaluations.

Methods

Literature search

Searches of the peer-reviewed and grey literature were conducted. A comprehensive search was completed in the electronic databases: ATSIROM: Aboriginal and Torres Strait Islander; Informit (APAIS-Health, EBM reviews NHS economic evaluation database); MEDLINE; Embase; CINAHL; Ebsco; EconLit and Proquest (Healthcare Administration Database, PAIS, Public Health Database). The following combination of subject headings and keywords were used: [Indigenous OR Aborigin* OR Torres Strait Island*] AND Australia AND [Health program* OR Health Services OR Primary Health Care] AND [Investment OR Expenditure OR Funding] AND [Economic OR Value OR Impact OR Evaluation OR Return on investment]. Searches were limited to English language publications published from January 2010 to December 2020. This 10-year period encompasses the period of increased focus on the evaluation of Aboriginal and Torres Strait Islander health programs following the publication of the Department of Finance and Deregulation strategic review of Aboriginal and Torres Strait Islander expenditure.[10] To locate additional reports and papers not identified as part of the search of peer-reviewed literature, a thorough grey literature search was also undertaken. This included: a manual search of all papers and reports on the websites of the Australian Institute of Aboriginal and Torres Strait Islander Studies; the National Indigenous Australians Agency; the Australian Government Department of Health (both the 'new' and 'old' websites); Australian Indigenous HealthInfoNet; the National Aboriginal Community Controlled Health Organisation (NACCHO), and all state and territory-based affiliates of NACCHO organisations. A Google Scholar and Google search were also conducted as per the advice of the Campbell Collaboration[18] to identify additional studies. The terms 'Indigenous Aboriginal economic evaluation impact' were

used, with the first 100 results of each search screened for inclusion. The reference lists of all included studies and reports, as well as relevant published reviews, and reports that did not meet specific inclusion criteria were also manually searched to identify studies for inclusion.

Inclusion and exclusion criteria

Papers and reports were included if they reported new data (analysis or modelling) on an economic evaluation of an Aboriginal and Torres Strait Islander Australian health program. Only economic evaluations that included a comparative analysis of two or more interventions in terms of both costs (resource use) and consequences (outcomes, effects) were included. Economic analyses were therefore defined as including economic impact analysis, cost-benefit analysis, cost-effectiveness analysis, cost-consequence analysis, cost-utility analysis, cost-minimisation analysis and return-on-investment analysis. Costing studies that did not include evaluation of impact (e.g. cost of illness studies, cost analysis), case studies, commentaries, conference abstracts, protocol papers and review papers were excluded. Interventions that did not have healthcare outcomes as their focus (e.g. social welfare program with some health outcomes) were excluded.

Data screening

All retrieved abstracts were initially assessed by one author (JB) against the inclusion and exclusion criteria and rejected if the study did not meet eligibility criteria based on the assessment of the title and abstract. The remaining full-text articles were reviewed by two authors (JB and EL) and documents that met all criteria were retained for review. Any discrepancies were resolved through discussion.

Data extraction

For each included study, the following information was extracted by one author (JB) and checked by a second (CD): author, year, objective, methods and outcomes, key data sources, results, and key data concerns.

Appraisal of methodological quality

The methodological quality of studies was independently assessed by two reviewers using the Drummond Checklist for economic evaluations.[14] The checklist has been used in several critiques of economic evaluations[19-22] and assesses 10 domains of methodological quality: description of interventions, intervention effectiveness, identification measurement and valuation of costs and consequences, discounting, incremental analysis, allowance for uncertainty of results and the discussion of the results. Each article was checked against the 10 major headings. Articles were scored as 'good' if they fulfilled at least 7 of the 10 major heading requirements, average if they fulfilled 4–6 requirements and poor if they fulfilled three or fewer. Discrepancies between reviewers in scoring were resolved by discussion and with input from a third reviewer.

Results

Search results

An overview of the search results and the study coding process is outlined in Figure 1 using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) four-phase flow diagram.[23] A total of 330 citations was initially retrieved from the comprehensive literature search and an additional 28 reports and other documents were retrieved from grey literature and hand searches. Following the removal of 78 duplicate citations, 280 citations were screened for eligibility and 59 underwent full-text screening. A total of 14 publications met inclusion criteria and are included in the review. The main reasons for exclusion were that an economic evaluation was not included and that only a partial economic evaluation (cost analysis) was conducted.

Number, type, and scope of evaluations

The characteristics of included studies are presented in Table 1. Ten published papers and four relevant reports were identified. Papers and reports were published between 2014 and 2020, meaning no studies were found for the period 2010–2013. Nine studies reported on economic evaluations conducted in the Northern Territory,[24-32] four were conducted in Queensland[33-35] and one modelled economic impact across Australia.[36] No studies reported using an Aboriginal and Torres Strait Islander research methodology or evaluation framework.

Type of economic evaluations

Two cost-consequence analyses,[26,35] two cost-effectiveness analyses,[29,30] six cost-utility analyses[27,28,32,34,36,37] and four cost-benefit/return on investment analyses[24,25,31,33] were identified. Nine studies identified the costing perspective adopted[26-28,32-34,36,37] and for the remaining five studies, perspective could be inferred. Eleven studies adopted a health system perspective,[26-31,33-37] two adopted a societal perspective[24,25] and one considered a partial social perspective (i.e. combining the health sector and commercial stores where the intervention occurred).[32] The two cost-consequence studies used prospectively collected data to compare two models of midwifery care for pregnant Aboriginal and Torres Strait Islander women[26] and examine different models of management by Aboriginal and Torres Strait Islander health workers of Aboriginal and Torres Strait Islander adults with poorly controlled type 2

Figure 1: PRISMA four-phase flow diagram.

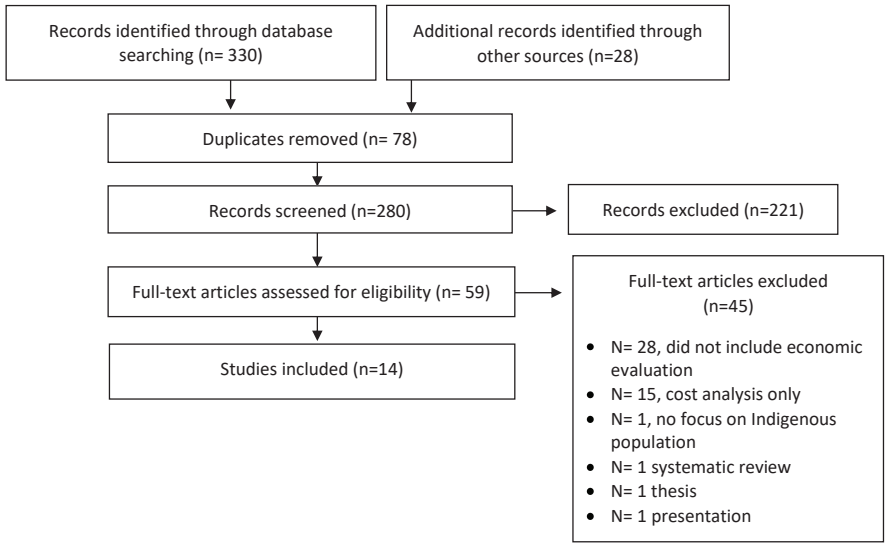

Table 1: Characteristics of included studies (n=12).

Author, year	Objective	Methods and outcomes	Key data sources	Results	Key data concerns
Cost consequence					
Gao, 2014[26]	Cost consequence analysis of two models of service delivery: Midwifery Group Practice (MGP) and baseline care	A retrospective and prospective cohort study in a regional hospital in NT. Baseline cohort included Aboriginal mothers and their infants from two remote communities who gave birth from 2004-06. The MGP cohort included all Aboriginal mothers and their infants from 7 communities who gave birth from 2009-11. A range of antenatal, birth, neonatal and postnatal outcomes were collected.	Prospectively collected data using medical records. Direct costs incurred from the first antenatal presentation to six weeks post-partum for mothers and up to 28 days post births for infants were included in analysis.	There was no significant difference between the two cohorts for major birth outcomes such as mode of birth, preterm birth rate and low birth weight. Cost savings (mean A$703) were found but were not statistically significant.	A small number of missing records in both cohorts. Some cost items (e.g., hostel costs) were excluded from the analysis as the authors were not able to obtain the data.
Segal 2016[35]	Cost consequence analysis of intensive management by Indigenous health workers (IHWs) of Indigenous adults with poorly controlled type 2 diabetes.	Twelve primary health care services in rural and remote north Queensland communities with predominantly Indigenous populations. Participants were Indigenous adults with poorly controlled type 2 diabetes and at least one comorbidity. Main outcome measures included per person cost of the intervention, differential changes in mean HbA1c levels, percentage with extremely poor HbA1c level control, quality of life, disease progression, and number of hospitalisations. Analysis relied on Markov modelling.	Program data was used to inform costing analysis. Hospitalisation data from Queensland Admitted Patients Data Collection was used to populate the model.	Intervention was associated with a non-significant greater reduction in mean HbA1c levels, a significant reduction in the proportion with extremely poor diabetes control, and a sub-significant differential reduction in hospitalisation rates for type 2 diabetes. This resulted in a net reduction in mean annual hospital costs of $646/person (P=0.07). Quality of life utility scores declined in both groups. Rates of disease progression were high in both groups.	Data quality was a concern. Example given was that HbA1c data extracted from participants clinical files included some baseline data gathered well before the trial commenced.
Cost-effectiveness					
Zhao, 2014[29]	Cost-effectiveness and return on investment associated with primary care utilisation for chronic disease management in remote Indigenous communities in Australia's Northern Territory.	A historical cohort study involving 14,184 Indigenous residents aged 15 years and over who lived in remote communities and used a remote clinic or public hospital from 2002 to 2011. A propensity score was used to improve comparability between high, medium, and low primary care utilisation groups. Outcomes included avoidable hospital admissions, deaths, and years of life lost.	Individual level demographic and clinical data were drawn from primary care and hospital care information systems using a unique patient identifier.	Increased primary care utilisation is a cost-effective way of improving health outcomes for Indigenous people living in remote NT communities. Primary care for renal disease and diabetes ranked as more cost-effective, followed by hypertension and ischaemic heart disease.	No access to ACCHS or mortality data (beyond 2007), unable to eliminate any potential confounding effects of distances from patient's residence to clinics or to hospital due to lack of data on geocoded localities.
Zhao, 2017[30]	Cost-effectiveness analysis of stroke care for Aboriginal patients compared with non-Aboriginal patients in the Northern Territory.	A cohort-based follow-up study of stroke incidents collected from public hospitals in the NT from 1992 to 2013. Survival time was used to measure effectiveness of stroke care, in comparison with the net costs per life year gained, from a healthcare perspective, by applying multivariable models to account for time-dependent confounding. Markov modelling. Outcome measures including ICERs were calculated and assessed graphically. Various statistical methods were used to assess the robustness of point estimates.	Individual patient data were extracted and linked from the hospital inpatient and primary care information systems.	The differential costs and effects for each population were distributed evenly across the incremental cost-effectiveness plane threshold line, indicating no difference in cost-effectiveness between populations. After further adjustment for confounding and censoring, cost-effectiveness appeared greater for Aboriginal than non-Aboriginal patients, but this was not statistically significant (p=0.25).	Lifetime stroke costs were based on health service use, which did not cover costs associated with the loss of quality of life among stroke survivors.
Cost utility					
Ong, 2014[36]	Cost utility of five interventions to prevent CVD among Indigenous people	Used ACE (Assessing Cost Effectiveness) methods. Costs measured in dollars and outcomes measured in disability adjusted life years (DALYs) averted. Health sector perspective and hypothetical null scenario	A range of secondary data including peer reviewed studies and routinely collected data. Cohort modelling.	Pharmacological interventions produced more Indigenous health benefit when delivered via Indigenous health services, but cost-effectiveness ratios were higher due to greater health service costs and were higher in remote than in non-remote regions.	Due to the unavailability of Indigenous individual level CVD risk factor data, interventions had to be applied to the entire Indigenous population aged >35 years rather than those at high CVD risk. Cost-effectiveness ratios are therefore higher than if they had been targeted at high-risk individuals.
Nguyen, 2015[34,55]	Cost-effectiveness of a community based mobile tele-medicine enabled screening and surveillance service (MTESS) for the Deadly Ears Program alone or supplemented with the MTESS service.	Data were obtained from personal communications with Deadly Ears staff, high-level summary data provided by Queensland Health or summarized from the Centre for Online Health database, data obtained from the published literature, and expert opinions.. Four health state Markov cohort models using 12-month cycles were developed to calculate the outcomes of screening and treatment and the cost.	Screening rates were obtained from the Queensland primary health care patient information and recall system. Prevalence data was obtained from the Aboriginal and Torres Strait Islander Health Survey 2012-13. Cost information was sourced from program data, the tax office, enterprise bargaining agreements and expert opinion. Certain values relied on empirical evidence.	MTESS service is a cost-effective strategy. Compared with the Deadly Ears Program, the probability of an acceptable cost-utility ratio at a willingness-to-pay threshold of $50,000/QALY was 98% for the MTESS service.	Limited literature to inform the probability of hearing loss associated with medial or surgical treatment, or the probability of hearing loss for Indigenous children in the absence of treatment (i.e., prevalence, natural history, and prognosis with different treatment options).
Thomas, 2014[28]	The cost-effectiveness of primary care for Indigenous Australians with diabetes living in remote Northern Territory communities.	A population-based retrospective cohort study 2002-2011 among Indigenous NT residents 15 years of age with diabetes who attended one of five hospitals or 54 remote clinics. Individuals were categorised to one of three groups based on their level of use of primary care services. Data were stratified by disease stage. Outcome measures include hospitalisations, potentially avoidable hospitalisations (PAH), mortality and years of life lost (YLL).	Data from 54 remote clinics and 5 public hospitals was extracted from primary care information system and hospital admission data system.	Medium and high primary care use are cost-effective in terms of hospitalisations avoided. Investing $1 in medium-level primary care for people with diabetes in remote Indigenous communities could save $12.90 in hospitalisation costs. Investing $1 in high-level primary care use could save $4.20.	No access to mortality data beyond 2007, no access to data from ACCHS and acknowledge that some patients may have been using primary care elsewhere. Unable to eliminate any potential confounding effects of distances from patient's residence to clinics or to hospital due to lack of data on geocoded localities.

Table 1 cont.: Characteristics of included studies (n=12).

Author, year	Objective	Methods and outcomes	Key data sources	Results	Key data concerns
Cost utility					
Roberts, 2017[27]	Cost-effectiveness of a proposed echocardiographic screening program compared with current practice.	Simulation of two screening strategies in Indigenous children aged 5 to 12-years. Assumed that rheumatic heart disease could be detected 1, 2, or 3 years earlier by screening. Outcomes included reductions in heart failure, surgery, mortality, and disability-adjusted life-years (DALYs) costs.	Routinely collected hospital admissions and costing data; estimated screening and outpatient costs; certain model parameters modelled based on empirical evidence and assumptions	Screening all Indigenous 5- to 12-year-olds in half of their communities in alternate years was found to be cost-effective, assuming that rheumatic heart disease can be detected at least 2 years earlier by screening. Modelling of improved adherence to secondary prophylaxis alone resulted in dramatic reductions in heart failure, surgery, and death; these outcomes improved even further when combined with screening.	The model did not estimate the risk of certain rheumatic heart disease complications, including stroke or endocarditis that incur significant expense, morbidity, and mortality.
Magnus, 2018[32]	Cost-effectiveness analysis of a 20% price discount on healthy food and beverages with and without consumer nutrition education, as trialled in remote Northern Australia	Markov modelling using DALYs arising from changes in dietary risk factor prevalence in the population, were estimated as the primary health outcome. The incremental cost-effectiveness ratio adopted a partial societal perspective, (including health and retail sector costs), as cost per DALY averted and was presented in 2011 Australian dollars.	Actual store sales, costs of strategies were sourced from paid invoices and time estimates of staff providing store-based discount promotion and consumer education	The strategies trialled were categorised as dominated by current practice, i.e, most expensive and less effective. The 20% discount on limited targeted products appeared to need to be considered in conjunction with other marketing strategies to support healthy food choices.	None identified. Several methodological limitations were noted including the trial design and budget precluded the measurement of actual change in adult BMI.
Kularatna, 2020[37]	Cost-effectiveness of an annual professional intervention for the prevention of dental caries in children of a remote Indigenous community in Far North Queensland	Markov modelling using QALYs. Analysis based on an annual preventive intervention protocol including treating all dental decay in those with disease, applying fissure sealants, a disinfectant swab, fluoride varnish and providing oral hygiene instructions and dietary advice to all participating school children.	Costs of treatment from the Queensland Department of Health were used and effectiveness was measured as quality-adjusted life years (QALYs) with the CHU-9D.	The preventive intervention was found to be highly cost-effective with an ICER of $3747 per QALY gained. Probability of new caries and seeking treatment were identified as the main drivers of the model.	Outcomes were modelled and based on results of a single study. Quality of life measures used a wetern instrument that was not valided in target population.
Cost-benefit/return on investment					
Deloitte Access Economics, 2016[25]	Cost-benefit analysis of the services provided by Danila Dilba Health Service (DDHS) relative to comparable organisations	Benefits of services were estimated with reference to the health status of DDHS clients in the three areas of interest – type 2 diabetes, CKD, and maternal and child health – minus the health status of NT Indigenous people who did not attend DDHS. Focused on the value of costs avoided, for example medication that is no longer required; and/or reductions in the burden of disease, which is measured by placing a monetary value on a year of healthy life.	Analysis relied on Aboriginal Health Key Performance Indicator, burden of disease data and empirical evidence.	The estimated benefit-cost ratio was 4.18, and the return on investment was 318%. These findings show that DDHS services substantially improve quality of life, and avoid health system costs, resulting in overall net benefits to NT (and thus Australian) society.	No Aboriginal Health KPI data was available for many of the conditions that have a high burden for Aboriginal people. This limited the health conditions that could be assessed for the analysis.
Deloitte Access Economics, 2019[24]	Updated cost benefit analysis of the services provided by Danila Dilba Health Service (DDHS) relative to comparable organisations.	Measured the incremental benefits generated by improved health outcomes in infants born at a low birthweight, CVD risk and Type 2 Diabetes management. The benefits included are savings from avoided health system costs and avoided mortality and burden of disease costs measured through the World Health Organization's (WHO) disability adjusted life year (DALY) framework. These benefits are then assessed relative to the incremental costs of providing care.	Analysis relied on Aboriginal Health Key Performance Indicator, burden of disease data and empirical evidence.	The benefit-cost ratio was 4.0, indicating an expected return of $4 for every $1 spent with a return on investment (ROI) of 297%.	None identified.
Campbell, 2019[33]	Cost benefit analysis of transition of primary healthcare services to an Aboriginal Community Controlled Health Service in Yarrabah, QLD	Part of a larger study that examined process, outcome, and economic indicators. Economic approach examined costs and a range of outcomes including cost implications of prevention, detection and successful management of acute and chronic conditions and reduction of the risk factors for disease sequelae.	Routinely collected primary and secondary data sources including GP practices and hospital admissions and costing data.	Transition to Aboriginal community control was cost-beneficial - for every $1 the social and economic return ranged from $1.68 to $1.82.	Much of the data needed for a robust economic analysis of transition to community control was unavailable including avoided time in hospital, improved quality of life, avoidable death, and community gain.
Spaeth et al. 2019[31]	Preliminary cost-benefit analysis of the clinical effectiveness of point-of-care (POC) testing for total and 5-part differential white blood cell (WBC DIFF) counts for the triage of patients with possible acute infection.	A previous study determined the average cost per medical retrieval to be AU$25,296 in the Top End to AU$17,136 in the Central Australia region of the NT. The number of patient cases determined to have a 'changed' outcome because of POC testing was multiplied by this average retrieval cost to provide a basic estimate of cost savings.	Cost data was obtained from a previous study.	POC test results changed the triage decision for 24 (41%) patients, of which 20 (34%) led to the prevention of an unnecessary medical retrieval and four (7%) indicated the patient had an acute infection which required a medical retrieval. POC test results assisted decision making for a further 13 (22%) patients. Cost savings related to avoiding unnecessary medical retrievals were estimated to be U$481,440. Extrapolated NT-wide cost savings were projected to be AU$5.33 million per annum.	None specified.

diabetes.[35] The two cost-effectiveness studies used data from cohort studies to examine the cost-effectiveness of stroke care for Aboriginal and Torres Strait Islander compared with non- Aboriginal and Torres Strait Islander patients in the Northern Territory[30] and the cost-effectiveness of primary care utilisation for chronic disease management in remote Aboriginal and Torres Strait Islander communities. Cost-utility analyses examined the benefit of five different interventions to prevent cardiovascular disease among Aboriginal and Torres Strait Islander people,[36] a screening and surveillance program for ear disease and hearing loss compared with the same program paired with a community based mobile tele-medicine enabled screening and surveillance service,[34] different levels of primary care utilisation for Aboriginal and Torres Strait Islander Australians with diabetes living in remote Northern Territory communities,[28] a proposed echocardiographic screening program compared with current practice,[27] price discounts combined with an in-store consumer education program,[32] and an annual professional intervention for the prevention of dental caries in children.[37] Two of the cost-benefit/return on investment studies examined services provided by an Aboriginal Community Controlled Health Service.[24,25] Additional studies examined the cost-benefit arising from the transition to Aboriginal and Torres Strait Islander community control of a primary healthcare service[33] and the preliminary cost-benefit of point-of-care testing of blood for the triage of patients with possible acute infection.[31]

Key data sources

A range of key data sources was obtained for economic analyses. Nine studies used data extracted from medical records, including from hospital admission databases and primary care information systems.[26-30,33-35,37] Two studies obtained program data[34,35] and one study estimated direct costs of antenatal visits, postnatal visits and transport costs.[26] One study used actual store sales to estimate changes in the consumption of fruit and vegetables.[32] Studies also utilised a range of secondary data sources, including data from: empirical studies,[24,25,27,36] the Aboriginal and Torres Strait Islander Health Survey,[34] Aboriginal Health Key Performance Indicator data[24,25] and burden of disease data.[24,25]

Key data concerns

Ten studies provided information about data concerns. All ten of these studies identified data access limitations that restricted the analyses that could be undertaken. Limitations included a lack of Aboriginal and Torres Strait Islander key performance indicator data for many conditions with a high burden for Aboriginal and Torres Strait Islander people such as mental disorders, cancers, injuries, and chronic respiratory disease,[25] a lack of individual cardiovascular risk factor data for Aboriginal and Torres Strait Islander people,[36] a lack of access to required ACCHS data,[28,29] limited literature to inform outcomes,[34] inability to obtain some cost data,[26] limitations in the availability of data related to avoided time in hospital, quality of life, avoidable death and community gain,[30,33] and lack of access to geographical location data, which could have resulted in confounding.[28,29] These limitations resulted in the need to estimate parameters from mainstream (non-Aboriginal and Torres Strait Islander) data, draw data from related published research, base parameters on the recommendations of experts, and/or exclude certain costs from analyses. Two studies identified data quality concerns, including missing data for prospectively collected data[26] and missing data extracted from medical records.[35]

Outcome measures

Four studies reported on cost savings of implemented health programs[26,28,31,35] one study reported both cost savings and disability-adjusted life years saved,[36] and one study reported cost savings per years of life lost.[29] Two studies reported benefit-cost ratios.[27] Five studies reported incremental cost-effectiveness ratios per survival year following stroke,[30] per quality-adjusted life year following hearing screening,[34] per quality-adjusted life year gained from improving oral health,[37] per disability-adjusted life year averted for echocardiographic screening for rheumatic heart disease,[27] and per disability-adjusted life years due to dietary modifications.[32] One study reported a social return on investment ratio.[33]

Cost-effectiveness and cost-savings

Twelve of the 14 interventions examined were deemed to be cost-effective or cost-saving. Investing $1 in primary care (provided by either a remote clinic or public hospital) in remote Aboriginal and Torres Strait Islander communities was found to save $3.95–$11.75 in hospital costs,[29] in addition to benefits for individual patients, including lower rates of hospitalisation, lower mortality and fewer years of life lost. All four cost-utility analyses were effective[27,28,34,36] and all three cost-benefit/return on investment analyses demonstrated effectiveness. Transition to community control was estimated to return between $1.68 and $1.82 per $1 spent,[33] and the estimated benefit-cost ratio of the Danila Dilba Health Service was estimated to be between 4.0[24] and 4.18.[25] Stroke care for Aboriginal people in the Northern Territory was at least as cost-effective as that for the non-Aboriginal population.[30] Intensive management by Aboriginal health workers providing primary healthcare services in rural and remote north Queensland communities with predominantly Aboriginal and Torres Strait Islander populations resulted in a net reduction in mean annual hospital costs of $646/person ($p$=0.07).[35] However, the authors deemed the implemented model of care to be a poor investment overall because of the high cost of the intervention and the modest effect on health outcomes. There were no significant cost-savings as a result of the implementation of a Midwifery Group Practice model of care offering continuity of care to pregnant Aboriginal and Torres Strait Islander mothers.[26] One study found that the interventions trialled were dominated by current practice, i.e more expensive and less effective.[32]

Quality assessment

The results of the quality assessment are presented in Table 2. Thirteen studies were rated good, and one average. All studies had a well-defined question presented in an answerable form, established effectiveness of the program or service examined, accurately measured relevant costs and consequences, and credibly valued relevant costs and consequences. The least satisfied items were adjustments of costs and consequences for differential timing – five studies did not meet these criteria;[26,29,31,33,35] and allowance for uncertainty in the estimates of costs and consequences – four studies did not meet these criteria.[26,31,33,35]

Discussion

There is a clear policy commitment to evaluating Aboriginal and Torres Strait

Islander health programs to assess their relevance, efficiency and effectiveness in improving the health of Aboriginal and Torres Strait Islander people. Evaluating cost-effective ways to deliver health services to Aboriginal and Torres Strait Islander Australians is critical to maximising efforts to Close the Gap through priority investment in programs that deliver the greatest return. Economic evaluation supports high-quality outcome evaluation and accountability by ensuring that health programs deliver value for money. This review systematically assessed the published literature to identify economic evaluations of Aboriginal and Torres Strait Islander health programs to provide important information about the conduct of future economic evaluations of Aboriginal and Torres Strait Islander health programs in Australia.

Despite Australian Government Aboriginal and Torres Strait Islander-specific health program expenditure increasing by 284% in real terms from 1995–96 to 2015–16,[38] and the investment of more than $4.8 billion through the Indigenous Advancement Strategy over four years from 2014–15,[39] only 13 published economic evaluations of Aboriginal and Torres Strait Islander health programs were identified for the period 2010–2020. The studies identified examined a variety of interventions across topic areas ranging from primary care to midwifery practice. No studies were found for the period 2010–2013. The small number of studies and their varied methodologies shows that the evidence base to inform investment into Aboriginal and Torres Strait Islander health programs in Australia remains limited and that investment in Aboriginal and Torres Strait Islander health services has not been tied to the generation of economic evidence of impact.

Reasons for the failure to undertake economic evaluations of Aboriginal and Torres Strait Islander health programs are multi-factorial. While there has been investment in policy development, design and program implementation, there have been few evaluations of implemented Aboriginal and Torres Strait Islander health programs broadly. A mapping exercise of Aboriginal and Torres Strait Islander-specific programs in Australia reported that of 1,082 programs delivered, more than 90% were not evaluated to determine whether programs achieved their specified goals and objectives.[40] Evaluations that are conducted are often narrowly focused,[40] of poor methodological quality,[41,42] and not built into evaluation planning and implementation (impacting the type and quality of data collected),[12] and are often not published in the public domain.[43] Economic evaluation is dependent on the availability of data about program effectiveness and costs of implementation. Failure to evaluate leads to failure to conduct an economic evaluation. The consequences of this lack of evidence are widespread. The lack of evidence means that policy-makers will struggle to make sound decisions about whether a program should continue to be funded, expanded or de-funded, and whether value for money could be achieved if money was redirected to other programs. It remains to be seen whether the investment of more than $40 million from 2017–2021 to strengthen the Indigenous Advancement Strategy and support implementation of rigorous evaluation will strengthen the evidence available.[44,45]

To strengthen the number and quality of economic evaluations in the Aboriginal and Torres Strait Islander health and wellbeing context, a key consideration is the availability of quality data. Key data concerns of published evaluations centred on data access limitations that significantly restricted the analyses that could be undertaken, and thus the type of economic evidence of the impact that could be generated. Rigorous economic evaluation can best be conducted when planned prospectively and integrated into evaluation planning. This approach will ensure that cost and patient experience data can be collected as part of the research. Such approaches require the development of population-specific instruments of patient experience and patient-reported outcomes, such as those that have been (or are being) developed in cancer[46,47] and diabetes.[48] Revision of the Aboriginal Health Key Performance Indicators might increase the amount of health outcomes data available and allow more sophisticated quantification of wellbeing and/or financial benefits (both positive and/or negative) for diseases with high burden amongst Aboriginal and Torres Strait Islander people. Notably, many studies included in the review acknowledged Aboriginal and Torres Strait Islander concepts of holistic health and wellbeing and the intangible benefits of health programs that could not be captured as part of formal economic evaluations. Increased stakeholder engagement in future economic evaluations to value users' experiences of outcomes such as improved lifestyle, better wellbeing, stronger relationships, more resilient communities and more culturally appropriate service provision, and the social value provided may enable more holistic analyses to be conducted.[30,49]

Table 2: Quality assessment of studies included in the review (n=12).

Author, year	Well-defined question?	Comprehensive description of alternatives?	Effectiveness established?	Relevant costs & consequences identified?	Relevant costs & consequences measured?	Relevant costs & consequences valued?	Adjustment for differential timing?	Incremental analysis?	Uncertainty analysis?	Appropriate interpretation?	Score
Cost consequence											
Gao, 2014	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Good
Segal, 2016	Y	Y	Y	Y	Y	Y	N	N	N	Y	Good
Cost-effectiveness											
Zhao, 2014	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Good
Zhao, 2017	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Good
Cost utility											
Ong, 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Good
Nguyen, 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Good
Thomas, 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Good
Roberts, 2017	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Good
Magnus, 2018	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Good
Kularatna, 2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Good
Cost-benefit/ return on investment											
Deloitte Access Economics, 2016	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Good
Deloitte Access Economics, 2019	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Good
Campbell, 2019	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Good
Spaeth, 2019	Y	N	Y	N	Y	Y	N	N	N	N	Average

A further consideration is how economic evaluations are positioned in relation to principles of Aboriginal and Torres Strait Islander Data Sovereignty and Data Governance.[50] When the included studies were considered against the Aboriginal and Torres Strait Islander Quality Appraisal Tool,[51] few studies met any of the criteria. This lack of congruency is unsurprising given the political and cultural context in which economic evaluations are commissioned,[52] the measures most used, and the purpose of the evaluation.[50] Even when evaluations are commissioned by an Aboriginal and Torres Strait Islander service, the measures and purpose often do not reflect Aboriginal and Torres Strait Islander cultural, social or political realities, but instead reflect the requirements of governments and the service's need to report against criteria they do not have the opportunity to influence.[53,54] Methods that move beyond pecuniary outcomes to understand and quantify social benefits of value to individuals and communities and include the participation of community such as social return on investment would be an initial step toward ensuring the cultural framework, control and content better reflect Aboriginal and Torres Strait Islander perspectives.

Strengths and limitations

Findings should be considered with regard to the strengths and limitations of the review. Strengths of this review include the broad and systematic search strategy that covered both the published and grey literature, the rigorous and reproducible review methods and the use of a standardised tool to assess the methodological quality of the identified economic evaluations. The small number of identified studies and the numerous topic areas they covered meant it was not possible to synthesise findings and draw conclusions across studies about the economic benefit of different interventions. The latter reflects the limitations of the current evidence base. Although we undertook a comprehensive search, it is possible that studies may have been missed. Nevertheless, we believe the results are robust and provide an accurate reflection of the state of play in regards to economic evaluations of Indigenous Aboriginal and Torres Strait Islander Australian health programs.

Conclusion

Despite strong commitments to closing the gap in health outcomes between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander people in Australia and to quality evaluation, there is limited evidence on what constitutes a cost-effective investment in Aboriginal and Torres Strait Islander healthcare. It is crucial that future economic evaluations of Aboriginal and Torres Strait Islander health programs are conducted to contribute to the generation of evidence about the economic benefit of implemented programs in ways that incorporate and reflect Aboriginal and Torres Strait Islander aspirations, epistemologies and values.

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