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Introduction

Severe kidney disease and kidney failure are more prevalent among Indigenous people than non-Indigenous people [1], but the high rates of end-stage renal disease (ESRD) (disease of the kidneys where the kidneys have stopped working) among Indigenous people have only been fully recognised in recent years. Rates are highest in northern Australian communities, where the incidence of renal failure among Indigenous people has been described as 'epidemic' in proportion [2]. As a result, end-stage renal disease (ESRD) has dominated research and health service priorities.

A number of generally less serious kidney and urinary tract disorders has failed, however, to elicit the same level of interest - despite their prevalence and the potential for recurrent or persistent infections to trigger kidney damage when coupled with conditions such as diabetes. These include acute post-streptococcal glomerulonephritis (APSGN), urinary tract infection (UTI), and urolithiasis among Indigenous children [3].

The poor social and economic circumstances that underlie the generally lower health status of many Indigenous people contribute to the high rates of kidney and urinary tract disorders in many Indigenous communities. Prevention, control and management of kidney and urinary tract disorders will depend not only on effective, acceptable treatment, but also on preventive action to address the poor socioeconomic conditions that underlie these conditions.

Kidney disorders

The main function of the kidneys is to regulate the mineral composition, water content and acidity of the body as well as being involved in the excretion of metabolic waste products and chemicals [\[1\]](#). 'Kidney disease', 'renal disease' and 'renal disorder' are collective terms that refer to a variety of different disease processes that affect the kidneys. These disease processes involve damage to the working units of the kidney and a consequent reduction in filtering capacity [\[4\]](#). Kidney disease is expensive to treat and has a marked impact on the quality of life of those who suffer as well as those who care for them [\[1\]](#).

A number of risk factors are associated with kidney disease including diabetes, high blood pressure, infections, low birth weight and obesity [\[1\]](#). These conditions are particularly common among Indigenous people and contribute to high rates of kidney disease. A number of pathways linking disadvantage and kidney disease also underlie these high rates. Factors include: sub-standard social and economic circumstances (poor living conditions, inadequate environmental sanitation and poverty), behaviours that may damage health (such as poor diet, low activity levels, and alcohol and tobacco use), and factors relating to the health-care system and government policies including limited access to medical care [\[5\]](#).

Chronic kidney disease (CKD) includes diabetic nephropathy, hypertensive renal disease, glomerular disease, chronic renal failure and ESRD [\[1\]](#). The terms 'kidney failure' and 'renal failure' have more serious ramifications, as they refer to the temporary or permanent loss of kidney function. This may occur rapidly, over a period of days or weeks, or slowly over years or decades [\[6\]](#). ESRD is the condition of total (about 95%) and permanent loss of kidney function [\[1\]](#) [\[4\]](#). Without treatment such as dialysis or kidney transplantation ESRD is terminal [\[1\]](#).

Indigenous persons identified as having ESRD and who subsequently undertake dialysis or kidney transplantation are registered with ANZDATA [\[1\]](#). As there is little information on earlier CKD the primary focus is on ESRD [\[1\]](#) [\[7\]](#). The registry uses information based on hospital records and compiles data on incidence, prevalence, renal complications, co-morbidities and patient deaths. Indigenous identification is thought more complete than general hospital data due to the heightened awareness of the extent of renal disease among Indigenous Australians and because of their prolonged and repeated contact with renal units in hospitals [\[1\]](#).

End-stage renal disease

Incidence

Very high rates of renal disease and renal failure are a major public health problem for Indigenous people. The full extent of ESRD among Indigenous people, particularly those living in remote parts of the country, has only been fully recognised in recent years. Most attention has focused on the NT and, to a lesser extent, WA,

but the notifications of ESRD are much higher for Indigenous people than they are for non-Indigenous people across most of the country particularly in remote areas - up to thirty times the national average [\[1\]](#) [\[7\]](#).

Data from the Australian and New Zealand Dialysis and Transplant Registry (ANZDATA) reveal that a total of 704 Indigenous people were newly identified with ESRD between 2001 and 2004 - the age-standardised notification rate of 779 per 1,000,000 population for Indigenous people was more than nine times the rate of 86 per 1,000,000 for non-Indigenous people (Table 1) [Derived from [\[8\]](#)]. The highest rates per 1,000,000 population were for Indigenous people living in the NT (2,180) and WA (1,048), but Qld (861) and SA (739) also had very high rates.

Table 1: End-stage renal disease: age-standardised notification rates, by Indigenous status, and rate ratios, selected jurisdictions, Australia, 2001-2004

Jurisdiction	Indigenous		Non-Indigenous		Rate ratio
	Number	Rate	Number	Rate	
Source: Derived from [9] and ABS low series population projections[e1]					
Notes:					
1. Rates per 1,000,000 population have been standardised using the Australian population at 31 December 2002 as the reference					
2. Rate ratio is the Indigenous rate divided by the non-Indigenous rate					
3. Figures for Australia include Tasmania and the ACT					
New South Wales	70	266	2,274	84	3.2
Victoria	19	321	1,852	93	3.4
Queensland	204	861	1,332	91	9.4
Western Australia	148	1,048	661	91	11.5
South Australia	42	739	540	84	8.8
Northern Territory	218	2,180	40	111	19.7
Australia	704	779	6,840	86	9.0

As with many other areas of Indigenous health, a striking feature of ESRD is the much younger age distribution of new cases (Table 2) [Derived from [\[8\]](#)]. Almost three-fifths (58%) of Indigenous people newly registered with the ANZDATA between 2001-2004 were aged less than 55 years compared with one-third (33%) of non-Indigenous people registered. Apart from the age group 0-14 years, age-specific notification rates were higher for Indigenous people across all ages compared with non-Indigenous people. Rate ratios were particularly high for people aged 35-44 years (8.9), 45-54 years (17.8) and 55-64 years (15.2). These figures confirm the much younger age profile of Indigenous ESRD patients documented previously [\[10\]](#)[\[11\]](#) but, the absence of an increase in treated ESRD incidence in Indigenous Australians aged less than 25 years, in contrast to sizeable increases in patients at all ages over 35 years, indicates the possibility of benefit from implementation of disease control measures and suggests a less pessimistic conclusion that trends have inexorably worsened [\[12\]](#).

Table 2: End-stage renal disease: age-specific notification rates, by Indigenous status, and rate ratios, Australia, 2001-2004

Age group	Indigenous		Non-Indigenous		Rate ratio
	Number	Rate	Number	Rate	

Source: Derived from [\[9\]](#) and ABS low series population projections

Notes:

1. Rates are per 1,000,000 population
2. Rate ratio is the Indigenous rate divided by the non-Indigenous rate
3. Figures for Australia include Tasmania and the ACT

0-14	3	4	96	6	0.7
15-24	11	31	185	18	1.8
25-34	41	141	383	34	4.1
35-44	114	488	644	55	8.9
45-54	242	1,603	960	90	17.8
55-64	198	2,546	1,314	168	15.2
65-74	79	2,155	1,836	343	6.3
75+	16	987	1,339	286	3.4
All ages	704		6,840		

The numbers of patients starting ESRD treatment have more than doubled in the last decade with the rate for Indigenous people increasing faster than the rate for non-Indigenous patients [\[1\]](#). In 2003-04, the most common diagnosis for Indigenous Australians was care involving dialysis with 29% of all hospitalisations reported for renal dialysis [\[1\]](#). The rate of renal dialysis is 6-8 times that of the non-Indigenous population. For 2003-04 there were around 83,000 hospitalisations of Indigenous Australians for CKD with Indigenous males comprising 43% and Indigenous females 57%, nearly nine times and 16 times as many hospitalisations than their non-Indigenous counterparts respectively [\[1\]](#). The most common reason for hospitalisation for Indigenous people in 2003-04 was the diagnosis of 'care involving dialysis', with the admission rate 12 times that of non-Indigenous people. Hospitalisation rates for care involving dialysis for Indigenous people were higher in older age groups, peaking for males aged 45-64 years and for females 65 years or over compared with other Australians who peaked at 65 years or over and at much lower levels for both males and females^[e2] [\[1\]](#). Overall in 2003-04 Indigenous male and female hospitalisation rates for care involving dialysis were 1.2 and 1.3 times higher than in 2000-01.

Indigenous Australians account for a disproportionate number of new cases for ESRD in all states and territories. In the NT 85% of all newly registered patients were Indigenous with 20% accounted in WA and 12% in Qld. Bearing in mind the reduced access to treatment and variation in socioeconomic disadvantage, standardised ESRD incidence in remote regions has been shown to be up to 30% times the national incidence for all Australians [\[1\]](#). Attempts to better define regional rates and trends of ESRD in Indigenous people should facilitate rational resource planning and appropriate funding policies for treatment programs in all States and Territories [\[13\]](#).

Mortality

For the period 1999-2003, death rates from CKD were up to 10 times higher for Indigenous people than for non-Indigenous people [\[1\]](#). Chronic renal failure was reported as accounting for 43% of male deaths and 40% of female deaths while diabetic nephropathy accounted for 23% (males) and 29% (females) respectively. Death rates were especially high after the age of 25 years for both Indigenous males and females compared with non-Indigenous people. The greatest differences occurred in the 25-34 and 45-54 age groups with Indigenous males recording 38 and 31 times the rates for non-Indigenous males and Indigenous females 57 and 48 times the rates for non-Indigenous females in the same age groups [\[1\]](#). These figures potentially underestimate the contribution of CKD to death rates as deaths involving CKD can occur in the context of other chronic conditions [\[14\]](#).

Associated conditions

Indigenous patients often present with various co-morbid conditions, including diabetes, hypertension, infections and poor nutrition [\[15\]](#). These conditions, coupled with high-risk behaviours (heavy smoking and drinking, and inadequate compliance), magnify the problem, complicate treatment and reduce survival rates [\[15\]](#)

As only one cause of death can be recorded as the underlying cause of death it is useful to describe the extent to which any or all co-existing conditions at time of death have been reported [\[1\]](#). For example, deaths from diabetes, where renal failure was reported as an associated cause of death among Indigenous people, occurred at almost twice the rate for Indigenous males and females than for their non-Indigenous counterparts [\[1\]](#).

Factors contributing to high levels of ESRD among Indigenous people

High rates of ESRD among Indigenous people reflect the operation of multiple risk factors [\[13\]](#). The full spectrum of risk factors has yet to be identified [\[16\]](#), but known risk factors include: increasing age, low birthweight and infant malnutrition, adult weight gain and the signs of Syndrome X (increasing blood pressure, insulin, blood glucose and lipid levels), skin infections, post-streptococcal glomerulonephritis, heavy drinking, repeated pregnancies and a family history of renal disease [\[1\]\[17\]](#).

A number of health conditions are also associated with renal disease including cerebrovascular disease, lung disease, peripheral vascular disease, coronary artery disease, smoking and diabetes [\[1\]](#). For patients beginning ESRD treatment, aside from diabetes which was reported for 70% of Indigenous patients compared with 27% for non-Indigenous patients, other conditions were reported in similar proportions for both groups [\[1\]](#). In 2003, diabetes was attributed as the main cause of ESRD for more than 55% of Indigenous dialysis patients compared with 18% of non-Indigenous dialysis patients [\[18\]](#).

Research highlights the broader socioeconomic determinants that underlie the physiological risk factors associated with current levels of Indigenous renal disease. The socioeconomic dimensions of the epidemic considered to be at the root of burgeoning rates of ESRD include:

- overcrowded and substandard housing;
- relatively poor nutrition;
- reduced activity levels;
- high levels of tobacco and alcohol consumption; and
- community and cultural disruptions [\[19\]\[20\]](#).

These factors have social origins related to absolute poverty, relative deprivation, unemployment, homelessness and fractured kinships since the time of colonisation.

Aetiology

Within a matter of a few decades, the convergence of multiple biopsychosocial risk factors has culminated in epidemic levels of chronic disease within Indigenous communities [\[13\]](#) [\[19\]](#). The association of syndrome X (increasing blood pressure, insulin, blood glucose and lipid levels) with renal and vascular disease, coupled with the increasing numbers of Indigenous ESRD patients who have type 2 diabetes, hypertension, and cardiac disease [\[13\]](#) [\[21\]](#), clearly suggest a shared aetiology for these chronic diseases. These findings challenge single-cause models of renal disease [\[16\]](#), suggesting instead that factors such as diabetes facilitate the development of renal disease rather than constitute the singular or principal cause of the underlying nephropathy [\[13\]](#) [\[22\]](#). This is reflected in medical records, where a degree of uncertainty increasingly surrounds the causes of ESRD.

An analysis of hospital and clinical records from Darwin [\[13\]](#) listed the major causes of ESRD between 1993 and 1996 as unknown (44%), diabetes (26%) and glomerulonephritis (19%). Compared with figures for the period 1989-1992, the proportion of ESRD in Indigenous people attributed to diabetes has almost doubled, the proportion attributed to glomerulonephritis has fallen by more than half, and cases of ESRD of 'unknown' aetiology have increased by 70%. This shift in the attributed causes of ESRD coincides with the marked increase in rates of diabetes in Indigenous communities, and the current trend to categorise many cases previously attributed to glomerulonephritis as 'unknown'. A similar pattern is observed among Indigenous people in other states. In NSW, the primary causes of ESRD among Indigenous patients (identified through the ANZDATA registry between 1987 and 1998) were: diabetes - 32%; glomerulonephritis - 30%; hypertension - 12% and uncertain - 11% [\[23\]](#).

Numerous risk factors for ESRD have been identified, but knowledge of the aetiology and natural history of renal disease in Aboriginal and Torres Strait Islander people remains incomplete, preventing comprehensive evaluation of changes in behaviour over time, and the effects of interventions. Empirical evidence demonstrates clearly that the aetiology of renal disease is complex, multi-determinant and intimately linked

to other chronic diseases [24], but a more definitive explanation has yet to occur. Two aetiological hypotheses have received attention in research circles. The first is the possibility of a genetic predisposition, the second is the proposed link between renal disease and intrauterine and infant malnutrition.

It has been suggested that the excess renal morbidity and mortality suffered by Indigenous people may be due, in part, to a genetic susceptibility [24]. It is proposed that such a predisposition may have resulted from an early adaptation to the arid conditions of outback Australia. In light of the traditional Indigenous lifestyle and the harsh environmental conditions of the outback, altered renal function may in the past have conferred a survival advantage by restricting loss of salt and water [24]. However, contemporary Indigenous dietary and behaviour patterns are such that any evolutionary adaptation of this kind would now pose a risk for the development of renal disease.

The hypothesised genetic predisposition offers an apparent explanation for the observed clustering of renal disease in Indigenous families [24]. However, Hoy cautions that Indigenous-specific genetic markers are unlikely to explain much of the excess of kidney disease [16]. Instead, she and colleagues have argued more strongly in support of the Barker hypothesis, which proposes that lower renal volumes and consequent renal disease may be attributed, in part, to intrauterine growth retardation and infant malnutrition [25]. Hoy notes that: 'The link between low birth weights and infant weights and adult renal disease is novel. It complements the proposal of Barker and others that low birth weight and infant malnutrition predispose to cardiovascular disease, hypertension, dyslipidaemia, insulin resistance, diabetes and, probably, chronic lung disease in adult life [26] and is further evidence of the shared background from which renal disease and these other common health problems arise' [19].

Consideration of the Barker hypothesis in terms of the current Indigenous health profile has led Hoy and colleagues to suggest that present high levels of Indigenous renal disease reflect, in part, notable improvements in infant mortality. They note that improved management of hospitalised infants led to a marked fall in Indigenous infant mortality rates in the 1960s and 1970s. Resultant increases in the survival rates of low birthweight infants, coupled with the Indigenous population's current propensity for excessive weight gain in later life [27], have given rise to a contemporary cohort of adults at heightened risk for a range of chronic diseases [13] [19] [28].

Management of ESRD

Medical intervention is necessary to avert deaths among individuals with ESRD. Current treatment options require either a kidney transplant or regular dialysis to mechanically filter the blood and help maintain the functions normally performed by the kidneys [1][29]. Kidney transplants are usually the best option in terms of both medical outcomes and cost effectiveness [30]. Indigenous people represent less than 2% of the national population, but they account for approximately 10% of all

people commencing Renal Replacement Therapy (RRT) each year [9]. Of the 1,431 patients aged less than 65 years, who were on the waiting list in Australia at 31 December 2004, 90 (6%) were Indigenous patients, residing in the NT (81%), WA (21%), Qld (9%), NSW, the ACT and SA (all 4%) and Vic (1%) [9].

Rates of RRT for ESRD have increased over the past 20 years for Indigenous people, but they are still only about one-third as likely as non-Indigenous people to receive a kidney transplant [31]. In 2003, of all Indigenous ESRD patients registered, 86% were reliant on dialysis and only 14% had received a kidney transplant compared with 54% of non-Indigenous Australians reliant on dialysis and 46% having received a kidney transplant [1]. This is thought partly due to higher rates of co-morbidities, but opportunities for transplantation within the Indigenous population are also limited by a number of other factors.

Once dialysis treatment has commenced, Indigenous people are less likely to be placed on the active transplant waiting list and less likely to move from the waiting list to transplantation [1][32][33]. For those who do receive a transplant, the success rate for Indigenous people remains about two-thirds that for non-Indigenous people. Logistical problems associated with service delivery, problems posed by infections or poor compliance, miscommunication between Indigenous patients and health professionals, a lack of compatible donors and access issues for those who do opt for transplantation often required to travel hundreds of kilometres to access services located within the major urban centres of Perth, Adelaide, Melbourne, Sydney, Newcastle and Brisbane, all contribute to the low rates of transplantation among Indigenous people [7][13][30].

Dialysis, specifically haemodialysis conducted in urban or regional clinics and hospitals, is the most common form of treatment for Indigenous people with ESRD [1], but evidence suggest that rates of withdrawal from treatment are frequently high for Indigenous people [13]. Challenges facing home haemodialysis in remote communities include being able to retain suitable dialysis partners/carers due to their requirements for attendance at cultural duties, suitable housing, changing social circumstances and communication problems (such as language barriers) [34].

More recent data for Indigenous people receiving haemodialysis treatment was not available, but about 70% of all Indigenous dialysis patients on the ANZDATA registry in 1999 were receiving haemodialysis treatment in either a hospital or a hospital satellite unit [35]. More than three-quarters of all Indigenous people commencing RRT in remote areas during 1999-2001 had to relocate to access treatment. At the beginning of 2001, only five of the 16 ATSIC regions with the highest Indigenous ESRD incidence rates had satellite dialysis units. Several new satellite dialysis facilities have been opened since the collection of these data, but, given the low population density in many areas, access to treatment for people with ESRD is still an issue that requires dramatic changes in living circumstances [14].

Currently in Queensland, three Health zones have developed Renal Service Plans in recognition of Indigenous people as a priority population and in acknowledgement that many rural/remote areas of the state do not have ready access to a hospital renal units or satellite units [\[36\]](#). These plans include specific strategies to address renal disease including health promotion, early detection, clinic management, renal replacement services, workforce management and information support actions all specifically tailored to the needs of Indigenous people [\[36\]](#). Examples of this include the opening in March 2004 of the Mt Isa satellite service which is providing haemodialysis closer to home for those patients previously utilising this service outside of Townsville. Another strategy includes the multi-user, self-care dialysis strategy established in the Toowoomba Renal Service.

Self-care dialysis in remote communities

In a bid to address poor treatment outcomes associated with relocation, efforts have been made to deliver self-care dialysis services close to, or in, the home. This means that Indigenous people remain in their own communities, with their own family and social supports, and the costs of re-housing and supporting relocated dialysis patients are avoided [\[37\]](#).

The challenge of delivering self-care dialysis in remote communities has been successfully met by a number of nephrology units around Australia, among them the WA renal program based at the Royal Perth Hospital [\[30\]](#). Since 1989, the RPH rural and remote area renal program has delivered chronic ambulatory peritoneal dialysis (CAPD) and self-care haemodialysis in areas up to 3,500 km away from the parent nephrology unit. These nephrology units boast results that approach, and are sometimes better, than those observed in urban dialysis units treating non-Indigenous populations [\[38\]](#) cited in [\[30\]](#). Remote-area dialysis is still 25% more expensive than metropolitan self-care dialysis, but, when one takes account of re-location expenses, the overall cost is around half of that involving relocation of patients to the city [\[30\]](#).

Relocation to metropolitan dialysis facilities

Although self-care dialysis in remote communities can provide an effective alternative to metropolitan-based treatment, when this option is not available or not practicable, remote-area patients are relocated to dialysis units in major cities, with significant bio-psychosocial and economic consequences for both the individuals and the health care system [\[30\]](#). Research has documented the enormous social, cultural, geographical and physical difficulties experienced by many Indigenous renal patients who have to relocate from remote communities [\[39\]](#).

Increasing attention has been directed to the social implications of renal disease for Indigenous people. A joint study by the Central Australian Aboriginal Congress and the Menzies School of Health Research is notable for its investigation of the social and cultural complexities that accompany the relocation and treatment of ESRD among Aboriginal people in central Australia [\[39\]](#).

The research documented the enormous social, cultural, geographical and physical difficulties experienced by Indigenous renal patients who, for the most part, relocated to Alice Springs from remote central Australian communities of just several hundred people [\[39\]](#). The sociocultural alienation and isolation reported by the study participants was extreme, debilitating and ultimately life-threatening.

The study demonstrated clearly that successful management and treatment of Indigenous renal patients had been hampered by the conflict that exists between the values of the medical culture and those of the Indigenous community. It found that, despite widespread awareness of patient difficulties and the importance of optimal social and cultural conditions for treatment success, government health services had devoted little attention to addressing crucial social issues. Subsequent research has highlighted the need to facilitate a shared understanding of the combined biopsychosocial dimensions of the illness experience of Indigenous people [\[40\]](#). It draws attention to major problems in communication between Indigenous patients with ESRD and healthcare workers.

Qualitative studies have provided strong evidence of the urgent need for comprehensive health care that encompasses both socioculturally responsive medical care and preventive measures. Others have advocated specific measures to reduce the extent of alienation and dislocation experienced by Indigenous ESRD patients [\[30\]](#). They include: the employment of Indigenous liaison officers in hospital dialysis units; and the referral of renal patients to the closest treatment program regardless of State borders.

Withdrawal from treatment

ESRD treatment rates for the Indigenous population are high, but evidence suggests that rates of withdrawal from treatment are also frequently high. This has been demonstrated in the NT where withdrawal from treatment accounts for approximately one-quarter of deaths among Indigenous patients from the Darwin-based ESRD treatment program [\[13\]](#). In comparison, only one non-Indigenous patient has ever withdrawn from the same program.

High Indigenous withdrawal rates in the NT have been attributed to difficulties with chronic disability, the complex treatment regimen, and the loss of social support and connection with the land that accompanies relocation [\[13\]](#). However, it should be noted that the high rate of withdrawal observed in the NT is not necessarily representative of the wider Indigenous population [\[23\]](#).

Survival rates

In the NT, the mortality associated with voluntary withdrawal from treatment is compounded by the low survival rates of Indigenous people who persist with treatment. Despite their younger age, the survival rates for Indigenous ESRD patients are often markedly lower than those for non-Indigenous patients [\[13\]](#).

Figures from Darwin demonstrate that the median survival time for Indigenous people on dialysis is low (3.3 years v. 6.5 years in non-Indigenous people) and patient survival after transplant is poor (60% at 5 years versus 93% in non-Indigenous people). Graft survival after transplant is poorer still (37% at 5 years versus 88% in non-Indigenous people) [\[13\]](#) and contributes to the wide gap between Indigenous and non-Indigenous survival times when an aggregate for all forms of treatment is calculated (3.6 versus 12.3 years respectively). In NSW too, patient and graft survival rates tend to be lower among Indigenous people than among non-Indigenous people, but the differences are not significant [\[23\]](#).

The poor outcomes observed among many Indigenous ESRD patients are likely to continue as growing numbers present with diabetes and hypertension [\[13\]](#). These co-morbid conditions heighten the likelihood of complications and death associated with cardiovascular disease, and has negative consequences for treatment, treatment costs and survival. The negative impact of increasingly prevalent cardiovascular conditions is reflected in current ESRD survival rates, which have failed to show improvement in recent years [\[13\]](#).

Prevention of ESRD

Renal disease clearly has major medical and social implications for Indigenous people. Increasing rates of ESRD, the negative social consequences that accompany treatment, and the high cost of tertiary level medical care all illustrate the immediate need for a comprehensive approach that addresses both the medical and socioeconomic dimensions of this growing problem.

Primary prevention of the social and economic conditions that underlie much of the Indigenous renal health burden is a fundamental priority, but secondary and tertiary measures, such as screening and pharmacological interventions, also promise to reduce the risk of serious renal disease. Screening for renal disease can now be accomplished with simple, cheap and reliable techniques [\[30\]\[41\]](#). Such screening instruments may be readily incorporated within existing chronic disease screening protocols and coupled with interventions to modify the disease process.

A systematic treatment program implemented in the Tiwi Islands (off the coast of the NT) offers primary, secondary and tertiary prevention measures designed to intervene in the disease process before individuals progress to ESRD [\[42\]](#). The program focuses on vigorous blood pressure control and better metabolic management for people with diabetes and renal disease, or with diabetes and high blood pressure. It is centred on the use of the long-acting angiotensin converting enzyme inhibitor, (ACEi) perindopril, an anti-hypertensive with cardiovascular and renal protective effects.

An early evaluation of the health outcomes of the program indicates that it has: slowed the progression of renal disease; postponed renal failure; reduced premature death; averted much cardiovascular morbidity; and diminished associated health

care costs [\[2\]\[43\]](#). Evaluation suggests that progression to end-stage renal failure has been reduced by half and that there has been a reduction in deaths from natural causes. This has led to a reversal in the pattern of ESRD in the community, with previously increasing rates of ESRD and natural death reduced [\[43\]](#).

The success of the program has been attributed to a strong sense of community involvement and a partnership approach between the health workforce delivering the program and the community. Specific facets of the program thought to have contributed to its success include:

- maximum involvement of local workers;
- a community-based rather than clinic-based focus;
- a collaborative, non-authoritarian approach;
- involving participants in their own testing;
- personalising health goals; and
- providing information not directives [\[16\]](#).

The program has demonstrated that renal disease can be easily diagnosed and its progression dramatically altered by available interventions [\[17\]](#). It has shown also that Indigenous people are interested in health issues and receptive to health messages. Their willingness to participate enthusiastically and effectively in the long-term management of chronic disease has led to demonstrable improvements in their renal health [\[43\]](#). Finally, the Tiwi model has shown that huge savings, in terms of both premature death and cost, are achievable if investments are made in community-based strategies for kidney disease [\[44\]](#). It is estimated that the Tiwi program saved between \$700,000 and \$3.1 million in dialysis costs alone in its first three years of operation [\[17\]](#).

The need for comprehensive health care

Over the past decade there has been significant research into the causes, consequences and management of ESRD in the Indigenous population. A growing body of evidence demonstrates that some achievements have occurred, but it highlights, too, the gaps in the current health care approach. Consideration of the evidence as a whole provides clear guidance for the way forward.

Indigenous renal patients require, and deserve, effective, acceptable treatment. The current emphasis on complex, expensive, often problematic, hospital-based treatment should be balanced with comprehensive, community-based, preventive action to minimise the underlying causes of the problem [\[2\]\[13\]\[19\]\[39\]](#). Prevention of the socioeconomic antecedents of renal disease is inherent in such an approach, which calls for:

- sustained improvements in living and environmental conditions, education, infrastructure and health services;
- implementation of integrated, effective and well resourced primary health care programs;
- primary health care measures to improve diet, control blood pressure and infections, maintain healthy adult weight, and to increase birth weight;

- systematic screening for early and established renal disease; and
- pharmacological intervention programs to slow disease development [\[2\]\[13\]\[30\]\[19\]\[45\]](#).

Regular evaluation is a necessary component of any health program, and local ownership and management of health strategies is vitally important, particularly for the Indigenous population [\[15\]](#).

The added advantage of comprehensive action is that it will reduce not just renal disease but also other chronic and communicable conditions that underlie the excess mortality observed in much of the Indigenous population [\[13\]](#). It is within the capabilities of integrated socioeconomic and public health initiatives to quickly reduce renal risk, and modify the existing disease profile, with potential savings in, morbidity, mortality and health care costs [\[2\]\[19\]](#).

Recent policies and strategies to improve renal health

In 2006, Kidney Health Australia released the National Chronic Kidney Disease Strategy. The mission of the strategy is to reduce the incidence of CKD and improve the kidney health of all Australians via the facilitation of equitable, evidence-based and holistic programs and services that address prevention, early detection and best-practice management for patients, carers and families affected by CKD [\[14\]](#). The strategy proposes 54 recommendations in priority areas including; risk reduction and prevention, early detection and management of CKD, management of advanced CKD, dialysis, organ donation and transplantation and in recognition of the distinct issues faced by Aboriginal and Torres Strait Islander peoples with CKD, an additional priority area was allocated to cover this topic. The National CDK Strategy states what needs to change to achieve optimal kidney health services and care in Australia, but is not an implementation plan as to how to achieve this change.

The Renal Division at the George Institute is currently involved in several studies aimed at improving renal health. A new project - The RENAL study (RCT of Normal vs. Augmented Level of Renal Replacement Therapy) aims to look at the effect of different doses of dialysis in around 1,500 patients with severe, acute kidney failure across Australia and New Zealand over a two-year period [\[46\]](#). Another new project looking at the economic impact of the burden of CKD in Australia, aims to establish the human and financial burden of CKD in Australia and to explore the cost-effectiveness of screening and intervention to prevent progression of disease. Ongoing projects in the Division include; the SHARP study (Study of Heart and Renal Protection), which began recruiting participants in 2003, and aims to determine the effects of cholesterol lowering with a combination of simvastatin and ezetimibe on the risk of major vascular complications in patients with CKD and IMPAKT (Improving Indigenous Patient Access to Kidney Transplantation), a project aimed at identifying Indigenous Australians' barriers to accessing renal transplantation, and proposing strategies to reduce disparities in Indigenous Australians' access to renal transplantation [\[46\]](#).

Glomerulonephritis

The term 'glomerulonephritis', like the broader terms 'renal disease' and 'renal disorder', is collective and refers to a number of pathologies that result in inflammation of the glomerulus and subsequent damage to the filtration process of the kidney [\[3\]\[47\]](#). (The active filtration and excretion processes take place in the nephron, approximately one million of which make up each kidney. Filtration within each nephron occurs at the glomerulus, a network of blood capillaries that remove waste products from the bloodstream. When these processes are operating at an optimal level waste products are filtered into the urinary tract and expelled from the body as urine.) Of the various conditions that are encompassed by the term glomerulonephritis, acute post-streptococcal glomerulonephritis (APSGN) continues to pose a significant public health problem in developing countries and among Indigenous populations of the developed world [\[48\]](#). (APSGN has been uncommon among the affluent populations of developed countries since the early 1900s - due mainly to the dramatic improvements in living conditions that occurred around that time. Later, the availability of antibiotic therapy and improved access to health care also played a role.)

Acute post-streptococcal glomerulonephritis among Indigenous people

It is suggested by some research that episodes of acute post-streptococcal glomerulonephritis (APSGN) are associated with the high prevalence of ESRD among Indigenous Australians. APSGN is a potentially serious, non-suppurative condition that occurs two to three weeks after skin or throat infection with nephritogenic strains of group A streptococcal bacteria [\[49\]\[50\]](#) (Occasionally, infections with groups C or G streptococcus may also cause APSGN.) Clinical characteristics include oedema, hypertension and glomerular haematuria with reduced serum complement levels [\[49\]](#). The usual period between streptococcal infection and development of APSGN is 1-4 weeks with an average of 10 days however after streptococcal skin infections this may be longer (3-6 weeks) or shorter (1-2 weeks) after streptococcal throat infections.

APSGN is uncommon in the wider Australian population, but occurs frequently among Indigenous children living in remote areas in the north of Australia, where group A streptococcal pyoderma is endemic [\[51\]](#).

Outbreaks of APSGN in remote Indigenous communities in northern Australia have been reported since the 1960s [\[52\]](#), and continue to occur with sporadic cases every 5 - 7 years across the Top End [\[49\]](#). The full extent of the problem is not known but it is probable that the condition is endemic throughout this region [\[51\]\[53\]](#).

The role of APSGN in the subsequent development of chronic renal disease, particularly its contribution to epidemic rates of ESRD observed in northern Australia, is of obvious interest. The link appears plausible, but understanding of the epidemiology of APSGN within Indigenous populations remains incomplete and a definitive relationship has yet to be established. Recent evidence suggests that

childhood APSGN may lead to progressive renal disease among Indigenous adults [54], but long-term longitudinal studies will be necessary to determine whether renal damage progresses to ESRD [55].

Factors contributing to high levels of APSGN in northern Australia

Humid climatic conditions in tropical northern Australia, the ubiquity of scabies and skin sores, and the inadequate social and economic circumstances that underlie the generally poor health status of many Indigenous Australians, all contribute to the high rates of APSGN [51]. Poor, overcrowded housing, limited access to medical care, poor personal hygiene and inadequate environmental sanitation are the major contributing factors to spread of the disease [48][50].

Aetiology

Group A streptococci (GAS) is the principal causative agent in the development of APSGN, and the endemic nature of GAS infections in northern Australia give rise to the high rates of APSGN observed in the region [53]. Scabies infestations and skin sores in children (and many adults) are the primary source of group A streptococcal infection and transmission in Indigenous communities [56][57][58]. The readiness with which new strains of GAS are transmitted in families and communities is reflected in the rapid spread of APSGN [48][50].

Patient demographics

APSGN can occur at any age but presents predominantly among children, generally affecting the sexes equally. Some studies suggest children under 5 years of age are at the greatest risk [59][60], others indicate that children between 5 and 8 years are the most vulnerable [51], and still others have noted a high proportion of children over the age of 10 years [61].

Incidence

That APSGN is a significant public health problem in northern Australian Indigenous communities is beyond doubt, but its full extent is unknown. Findings from various outbreak investigations and surveillance studies provide some indication of the extent of APSGN within Indigenous communities.

It should be noted, however, that methodological difficulties surround the identification of cases and the estimation of incidence rates. Identification issues include: lack of a standardised case definition; limitations and logistical difficulties associated with diagnosing the condition in isolated communities [51][59]; and the high number of subclinical cases of disease associated with each clinical case [50][51][62]. Surveillance methods also tend to miss cases, suggesting that the true incidence of APSGN is likely to be higher than estimates suggest [59].

APSGN outbreaks in Indigenous communities

Since the early 1980s, a growing number of reported epidemics in northern Australia have received rigorous investigation and sound documentation [51] [62][60][61][63]. Outbreaks occur frequently in the NT, with nine outbreaks reported between 1993

and 1995 alone [57]. A community outbreak is defined as the occurrence of at least two clinical cases of APSGN in one week, or at least three clinical cases of APSGN in one month [50][57].

In 1980, an outbreak among several hundred Indigenous people from several communities in the Top End of the NT prompted investigations by a number of researchers [62][64]. The epidemic generally involved young children and was preceded in many by a streptococcal skin infection, thought to have developed following an episode of scabies.

Seven years later, another epidemic was documented in one of the same Top End communities [63]. In 1994, in accordance with the cyclical nature of APSGN, a third, much smaller outbreak was reported [61]. The older age of affected individuals (four of the 10 confirmed and suspected cases were over 10 years of age) was considered a notable feature of this outbreak. On the basis of findings from both the 1987 and 1994 outbreaks [63] it was recommended that an older age distribution be taken into account in future screening and intervention programs.

Numerous outbreaks have been reported in the NT, but epidemics have been less frequently documented in other areas of northern Australia. Not a single epidemic was reported in far north Queensland for almost 20 years. Then, in 1993, 58 cases were diagnosed among Indigenous children from three remote communities [51]. The public health response to the epidemic involved the implementation of screening and intervention procedures. Of the 665 children aged between 2 and 14 years that resided in the three communities, 583 were screened. Of the 58 diagnosed cases (10% of all children screened), only one-third was symptomatic. The remainder were asymptomatic and were detected only through screening.

APSGN surveillance

Prompted by the 1993 outbreak, active-clinical and laboratory-based surveillance of APSGN was commenced in far north Queensland the following year [59]. A review of all new cases (100) identified in 1994 revealed that glomerulonephritis was a disease suffered almost exclusively by the Indigenous population: 58 cases were Aboriginal and 38 cases were Torres Strait Islander. The crude incidence rate for all Indigenous cases was 424 per 100,000 population. For children under 5 years of age, the incidence rate was 1,344 per 100,000. It is believed that the 1994 figures reflect new cases associated with the epidemic that began in 1993. If so, the size of the Queensland epidemic was of the same magnitude as the 1980 epidemic that occurred in the Top End of the NT [62][60]. However, it has been suggested that the true incidence of APSGN in Queensland is likely to be even greater, given the often poor level of medical resources in remote Indigenous communities and the potential for missed cases using the chosen surveillance methods [59].

Morbidity and mortality

The clinical course of APSGN has been described as mild and the usual outcome is one of complete recovery within days or weeks [62][54][57]. The long-term outlook has generally been regarded as excellent [54]. However, despite this apparently benign clinical profile, APSGN is associated with significant morbidity, hospitalisation and occasional mortality. APSGN may occasionally cause acute renal failure, but hypertension is the most frequent major complication [60].

Surveillance data from far north Queensland indicates that the morbidity associated with APSGN is considerable [59]. In 1994 of 100 identified cases (of which 96 were Indigenous), 72 were admitted to hospital where they remained an average of 8.5 days (range: 3-30 days) [59][60]. Major complications included severe hypertension (40 per cent of all cases), acute renal failure (18 per cent of all cases), fluid overload/pulmonary oedema (12 per cent of all cases) and bacteraemic infection (6 per cent of all cases). One child died, another developed pneumococcal pericarditis and a purulent effusion and required surgery, and a young pregnant woman underwent dialysis to manage acute renal failure - all were Indigenous [60].

The single death in Queensland corresponds with mortality rates observed during other outbreaks. Case-fatality rates of up to one per cent have been documented and a similar proportion of cases progress to chronic glomerulonephritis [50]. It has been suggested, however, that endemic APSGN may be associated with poorer health outcomes [61]. Likewise, the generally benign outcome observed in children may be more serious in adults, with a greater risk of progression to chronic glomerulonephritis [58]. As noted earlier, the contribution of APSGN to ESRD in later life is unknown, but it may be a risk factor for chronic renal failure [59][60][61].

Results of studies on the contribution of PSGN to chronic renal disease vary, but research undertaken in the isolated Indigenous community that experienced outbreaks of APSGN in 1980 [62] and 1987 [63] suggests that a remote history of APSGN in childhood is a powerful risk factor for subsequent renal dysfunction [54]. The findings of the study, which used the albumin to creatinine ratio (a sensitive early marker of renal damage) as its main outcome measure, suggest that about one-quarter of cases of overt albuminuria may be attributable to APSGN in childhood. Albuminuria has previously been shown to mark early chronic renal disease in the study population, and its progression predicts renal failure, as well as cardiovascular disease and mortality [54]. The authors concluded that a prospective study would provide the best evidence to identify the factors involved in the observed relationship between PSGN and albuminuria, and the postulated relationship with chronic renal disease.

Prevention and management of APSGN

There is no simple treatment, but APSGN is a potentially preventable disease [59]. No vaccine is yet available, so preventing streptococcal infection remains the most important control strategy [55]. Management of infection currently involves hospital

admission for major complications, coupled with the use of penicillin to inhibit further spread of the disease [50][51].

The aetiological link between scabies, streptococcal skin infections and outbreaks of APSGN is widely recognised [57]. At a primary level, prevention requires control of scabies and skin sores, improved housing and social conditions, and hygiene education to reduce the prevalence and spread of streptococcal infections [50][59][60]. Secondary and tertiary prevention depends on improved surveillance, screening to identify cases, and penicillin prophylaxis to eradicate streptococcal carriage and stem the spread of epidemic disease [51][57][65].

Attempts to control APSGN outbreaks in Indigenous communities have frequently involved mass administration of parenteral penicillin to all children in the community [51]. However, an observational assessment of interventions, associated with several outbreaks in the NT in the mid 1990s, proposed that targeted treatment of children with skin sores and household contacts may also be an effective intervention. The advantages of targeted intervention include the need for fewer injections (the injection is painful and reactions may occur) and a less labour-intensive response (that is correspondingly less likely to compromise routine services or miss high-risk children) [49][57]. Such interventions were implemented in 2000, in 7 communities in the Top End experiencing outbreaks, but from October 2004 an increase in notifications of APSGN in the NT was detected. In 2005, a more sensitive outbreak case definition was trialled. This saw 'subclinical' cases now referred to as 'probable cases' and 'clinical cases' referred to as 'possible cases' [49].

Stage 1 of the intervention involved household and other close contacts were screened for scabies, sores, facial and peripheral oedema, haematuria and hypertension according to NT Centre for Disease Control Guidelines [49]. Contacts aged 3-15 years were treated with intramuscular benzathine penicillin regardless of skin status. After further screening and treatment involving the community at the school, crèche and healthy centre, those with scabies present were supplied with permethrin cream for treatment of all household members [49]. Stage 2 signified ongoing transmission of nephritogenic GAS and apparent ineffectiveness of the intervention at Stage 1 and therefore the definition of 'contact' was interpreted more broadly including playmates and those other than household members. All contacts regardless of age or skin status were then treated with intramuscular penicillin. The results of the intervention can be seen in Table 3.

Table 3: Number of children with sores treated out of number of children with sores identified at Stage 1 and Stage 2, by week of intervention.

Week of intervention	Stage 1	Stage 2
Source: [49]		
First week	132/161 (82%)	96/105 (91%)
Second week	176/182 (97%)	135/139 (97%)
Third week	178/182 (98%)	136/139 (98%)

Evidence suggests that prevention of streptococcal infection, through improved economic and living conditions and attention to the control and treatment of scabies and skin infections, will not only reduce rates of APSGN but may also contribute to reductions in ESRD [\[54\]](#) [\[58\]](#). Conversely, many of the socioeconomic primary prevention measures designed to address the factors that underlie the current Indigenous epidemic of ESRD will contribute to the control APSGN.

Disorders of the urinary tract

Unlike the severe diseases of the renal system, disorders of the urinary tract (specifically disorders of the bladder, ureters and urethra) generally present as clinically mild cases. However, they have the potential to cause considerable morbidity, and may, on occasion, lead to severe renal disease, including ESRD [\[3\]](#). The potentially serious consequences associated with urinary tract disorders, coupled with their prevalence (particularly among women) highlights the public health significance of these conditions.

The health effects of diseases of the urinary tract upon Indigenous people have received comparatively little attention in recent years, with limited documentation of the prevalence of disorders of the bladder, ureters and urethra. Available data suggest, however, that the pattern of urinary tract infection (UTI) exhibited among Indigenous people tends to differ from that observed among non-Indigenous people [\[64\]](#).

Urinary tract infections

Epidemiological and anecdotal evidence from the 1980s indicates that UTIs are particularly common among Indigenous people [\[64\]](#)[\[66\]](#). Unfortunately, easily treated UTIs often remain undetected, particularly in Indigenous children, and increase the individual's risk of developing more serious renal disease [\[66\]](#).

UTI may be present despite few physical symptoms, but lower urinary tract infection is typically associated with frequent, painful urination, and tenderness in the lower pelvic area [\[3\]](#). Upper urinary tract infection is associated with a range of clinical features, most commonly: fever, back or loin pain; and chills and rigors [\[3\]](#)[\[47\]](#). Single episodes of UTI rarely have serious consequences, but recurrent or persistent infections may promote kidney damage when coupled with conditions such as diabetes [\[3\]](#).

Risk factors and aetiology of urinary tract infections

UTIs are generally bacterial in origin, but *Mycobacterium tuberculosis*, fungi, parasites and adenoviruses may also cause infection. Inadequate living conditions and poor environmental standards contribute to the high levels of UTI observed in some Indigenous communities [\[66\]](#). Females are more likely than males to contract UTIs, and other risk factors include age and sexual activity [\[64\]](#).

Incidence

The most common types of procedures recorded for Indigenous people in 2003-04 were procedures on the urinary system [\[1\]](#). A majority (32%) of these procedures were for haemodialysis (a procedure which artificially performs the work of the kidneys in patients with ESRD).

A hospital-based study in Darwin found that Indigenous men and women had higher rates overall of UTI than their non-Indigenous counterparts, but age-specific rates are greater among non-Indigenous people after the age of 60 years [\[64\]](#). With the exception of children in their first year of life, UTIs occurred far more frequently among Indigenous females, with consistently high rates of infection until around 60 years of age. Indigenous males, on the other hand, were at greatest risk during infancy.

Half a decade later, a study investigating the association between pre-term birth and genitourinary tract infections in Indigenous women during pregnancy found that almost 30% of the Indigenous women sampled had a urinary tract infection during pregnancy, and 11% had an infection at the time of delivery [\[67\]](#).

Treatment and prevention of UTIs

Lower urinary tract infection is easily treated, generally by a single dose or short course of antibiotics. Upper urinary tract infection usually requires hospitalisation and administration of intravenous antibiotics. Antibiotics may also be administered to prevent recurrent infection [\[3\]\[47\]](#). Despite the simplicity of prophylaxis and cure, evidence suggests that screening, treatment and follow-up of infections among Indigenous people is often inadequate, and must be improved [\[66\]\[67\]](#). Like other conditions of the kidney and urinary tract, rates of UTI among Indigenous people will undoubtedly be reduced when socioeconomic conditions and overall health status improve.

Other disorders of the kidney and urinary tract

A number of conditions may affect both the renal system and the urinary tract, among them urolithiasis. The term urolithiasis refers to the formation of one or more pebble-like masses (commonly referred to as calculi or stones) in the renal or urinary tract [\[3\]\[64\]\[47\]](#). Urolithiasis is not a common public health problem within affluent populations in developed countries, but its prevalence and unusual presentation among some Indigenous children justifies its coverage here [\[68\]](#).

Urolithiasis among Indigenous people

In contrast to UTI, considerably more attention has been devoted to the problem of urolithiasis among Indigenous people. Apart from one early report, the literature consistently reports that urolithiasis is unusually common among some Indigenous children [\[68\]](#), but seldom presents among Indigenous adults. This contrasts with the pattern of urolithiasis reported among non-Indigenous people and other populations

of the developed world where the incidence is much higher among adults than children [\[68\]](#).

Risk factors and aetiology of urolithiasis among Indigenous children

The high rates of urolithiasis observed among some Indigenous children have been attributed to dietary factors, dehydration, endemic diarrhoea, recurrent infectious disease [\[68\]](#), hot, dry environmental conditions [\[68\]](#) and poor water quality . These risk factors are intimately related to the familiar socioeconomic risk factors that underlie the high burden of disease suffered by Indigenous people generally.

The varied risk factors point to the multifactorial aetiology of urolithiasis among Indigenous children. Until recently, a favoured hypothesis regarding the development of childhood renal stones focused on the role of cereal-based diets in the formation of urate and oxalate stones [\[68\]](#). However, recent research has challenged this hypothesis, emphasising instead the importance of diarrhoea and dehydration in the development of urolithiasis . The deleterious effect of endemic diarrhoea on hydration, and the contributory role in the formation of stones, is compounded by hot, dry environmental conditions and often unpalatable drinking water [\[68\]](#).

Patient demographics and clinical features

Indigenous children with urolithiasis tend to come from desert regions of Australia, are more likely to be male, and are frequently less than 3 years of age [\[68\]](#). They commonly present with, or have a history of, failure to thrive, UTI, and/or recurrent infectious disease (particularly diarrhoea) [\[68\]](#).

The stones found in Indigenous children are rarely associated with anatomical or metabolic disorders and are commonly located in the upper urinary tract [\[68\]](#) . They are composed primarily of uric acid, urate and oxalate [\[68\]](#) similar to the 'endemic' stones typically found in paediatric populations from developing regions of the world where the disorder is prevalent [\[68\]](#).

The formation of calculi in non-Indigenous children is uncommon [\[68\]](#). When urolithiasis does occur, it presents at a later age (usually mid to late childhood) and is generally attributable to a malformation of the urinary tract or a metabolic disorder [\[68\]](#).

Incidence

National or regional statistics for urolithiasis do not exist, but a number of studies confirm high rates among Indigenous children from the arid inland areas of Australia - notifications appear to be rising in response to increased awareness and improved diagnostic techniques [\[68\]](#).

A comprehensive review of patient records collected between 1972 and 1986 from the major paediatric referral hospital in WA reported that the number of Indigenous children presenting with urolithiasis was more than double that of non-Indigenous

children [68]. A review of patients with urinary tract calculi admitted to the Urology Unit of the Adelaide Children's Hospital between 197

8 and 1987 estimated that 0.34% of Indigenous children under 10 years of age (based on 1981 census figures) suffered from the disease .

Other research conducted in the 1980s documented endemic urolithiasis among Indigenous children living in central Australia and in the dry inland regions of WA [68]. A more recent study has described rates of urolithiasis in children from a western desert Aboriginal community in central Australia as 'alarmingly high' . In this study, calculi occurred most frequently in the 0-2 years age group, with almost one in 10 children in this age group presenting with the disorder each year. This figure differs markedly from the rates reported in developed nations that range from one in 1,000 to one in 9,000 paediatric hospital admissions.

Morbidity

Reviews of hospital records reveal that Indigenous children with urolithiasis suffer considerable morbidity, which typically involves abdominal pain and difficult or painful urination . It is commonly chronic in nature and associated with poor growth [68], fever , abdominal pain and difficult or painful urination . It is not unusual for renal function to be compromised, and urinary tract obstruction may give rise to severe acute illness, but this is not common [68]. Despite the incomplete state of follow-up data, evidence suggests that the combination of obstruction and infection may culminate in renal damage [68].

Management

The management of paediatric urolithiasis has traditionally involved a variety of major surgical procedures to remove stones [68] . The significant morbidity suffered by many Indigenous children with urolithiasis is therefore often compounded by the need for extended hospitalisation and separation from family, and is accompanied by high economic costs [68] . Fortunately, the use of long-term antibiotic therapy and urinary alkalinisation as a means of treatment appears to have become more common in recent years, and the safe and effective use of alkaline therapy among many Indigenous children has been reported .

Prevention and control of urolithiasis

An understanding of the anatomical, physiological and dietary factors that underlie the development of urolithiasis in Indigenous children is likely to yield information that will contribute to the management of the condition, but the aetiological importance of hazardous living and environmental conditions should not be overlooked . Attention must be directed to the long-term public health implications and the need for preventive measures . Housing, water and waste disposal systems are inadequate in many Indigenous communities and increase the risk of urolithiasis. Improvements in environmental conditions, specifically the provision of adequate drinking water and the eradication of poor living conditions, are therefore essential to reduce the incidence of renal stones .

Summary

Disorders of the kidney and renal tract pose a significant, and frequently serious, public health threat for many Indigenous Australians. ESRD underlies much of the renal morbidity and mortality seen in Indigenous communities and currently dominates health care and research priorities. However, recurring epidemics of APSGN in northern Australia, the suspected high prevalence of UTIs, the unusual epidemiology of urolithiasis, and the potential contribution of each of these conditions to more serious renal disease, highlight the importance of these other kidney and renal tract conditions for Indigenous people. Continuing high rates of ESRD, the negative social consequences that accompany treatment, and the high cost of tertiary level medical care all illustrate the immediate need for a comprehensive health care approach that addresses both the medical and socioeconomic dimensions of this major problem.

A range of biopsychosocial issues underlie the generally poor health status of many Indigenous people. Poverty, poor living conditions, limited access to medical care, and inadequate environmental sanitation contribute to high rates of renal-urologic disorders in many Indigenous communities. The prevention, management and control of kidney and renal tract disorders will depend not only on effective, acceptable medical and surgical treatment, but, importantly, on preventive action to address the poor socioeconomic conditions that underlie these conditions. Without adequate forward planning that considers service needs, service availability, and workforce projections, however, there will not be adequate resources to provide minimum standards of care for the growing number of Indigenous people dependant on dialysis [14]. A comprehensive approach that addresses both the medical and socioeconomic dimensions of these health conditions is an immediate priority.

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Endnotes

1. Details of new cases of ESRD are provided to the Australian and New Zealand Dialysis and Transplant Registry (ANZDATA). The figures presented in Table 1 have been derived from data provided by ANZDATA. The HealthInfoNet is most grateful for the provision of these data, and for technical advice provided by ANZDATA.
2. Rates of dialysis are the outcome of some individuals accessing services many times for example an individual reliant on treatment may undergo dialysis 2 or 3 times a week.