Chlamydial infections and Indigenous health

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Chlamydia **are obligate, intracellular, bacterial pathogens that cause three main diseases in humans worldwide: sexually transmitted disease (infertility and pelvic inflammatory disease), trachoma and respiratory infections. Rates of sexually transmitted infections (STIs) due to *C. trachomatis* are increasing (a 61% increase in notifications in Australia between 2003 and 2007) and the levels in Indigenous Australians continue to be unacceptably high: nearly five times higher than in non-Indigenous people. *C. trachomatis* also causes the ocular disease trachoma and, unfortunately, this condition continues to be common in Indigenous Australians, a situation that is unacceptable in a developed country. The other chlamydial species that infects humans is *C. pneumoniae*. While clinically less severe, the Australian Aboriginal population in the Top End have high rates of serologically diagnosed *C. pneumoniae* infection, which may contribute to the higher rates of respiratory disease observed in this group.**

Chlamydia are characterised by a unique two-stage developmental cycle, which involves the inter-conversion between a tough, extracellular elementary body, which is infectious but metabolically inactive and a non-infectious but metabolically active reticulate body, which replicates inside a host-bound inclusion body. Chlamydial taxonomy has been in a state of flux over the past 10 years, with the proposal by Everrett *et al*. in 1999 [1] to split the genus *Chlamydia* into two genera, Chlamydia and Chlamydophila. However, the two-genera or nine-species proposal has not been widely accepted by the chlamydial community [2] and so, for the purposes of this review, we will use the single genus, *Chlamydia,* nine-species terminology.

Humans are primarily infected with two species of *Chlamydia, C. trachomatis* and *C. pneumoniae. C. trachomatis* causes two major diseases in humans: (a) STIs that cause urethritis or cervicitis with possible damaging sequelae, leading to pelvic inflammatory disease (PID) and infertility (in females) and prostatitis and epididymitis (in males) and (b) ocular infections that can lead to trachoma in both males and females.

Despite public health intervention efforts, STIs caused by *C. trachomatis* have continued to increase at an alarming rate within the Australian population overall, with a 61% increase in notifications between 2003 and 2007 [3]. In fact, *C. trachomatis* continues to be the most frequently notifiable condition in Australia, with 51,867 diagnoses reported in 2007 (245 per 100,000). While these infection levels for the Australian population as a whole are of serious concern, the situation in the Aboriginal population is even worse. Indigenous people have considerably higher rates of disease for most STIs, including *Chlamydia.* In 2007, Indigenous people were nearly five times more likely to

be notified with *C. trachomatis* than non-Indigenous people (1,241 per 100,000, compared with 264 per 100,000, respectively) (Figure 1). Indigenous female *C. trachomatis* rates were 1,400 per 100,000 and Indigenous male rates were 700 per 100,000. For Indigenous people, notification rates are more common in the younger age groups, with the highest rates in 15 to 19-year-olds.

Although Indigenous *C. trachomatis* levels are higher in most Australian states, Queensland and the Northern Territory have been studied the most comprehensively. The rate of *C. trachomatis* in North Queensland is at least 2.5 times higher than the rates observed in the rest of the state [3]. The far north experienced a 39% increase in notification rates from 2005 to 2006 alone, while the increases seen in the remainder of the state were between 12 and 14% for this period. Nearly 5.5% of the estimated Indigenous population aged 15-19 years were positive for *C. trachomatis* in 2006. A recent genotyping study by Bandea *et al.* [4] found that the *C. trachomatis* genotypes found in Aboriginal communities (predominantly serovars E, F) were the same as those present in Australian, non-Indigenous communities and also in other Western countries. The higher prevalence of *Chlamydia* and other bacterial STIs within young Indigenous populations should not necessarily be interpreted as evidence of higher levels of unsafe sex behaviour, but instead is likely to be primarily the result of poor access to clinical services, allowing treatable bacterial STIs to proliferate in communities over time in the absence of appropriate testing and treatment.

Given these higher rates of STIs in younger populations, the issue of pathological sequelae, particularly the long-term impact on fertility, should be a priority for consideration by health planners. Indigenous women tend to give birth at younger ages than non-Indigenous women, with the 20–24 year age group the peak group for births to Indigenous women, compared with 30–34 years of age for all women [5]. Consequently, the impact of *Chlamydia* associated inflammation may be not be readily apparent, given the young age of pregnancy in Indigenous women.

The second major disease caused by *C.trachomatis* is trachoma, which is the leading cause of infectious blindness worldwide. Repeated episodes of ocular infection by *C. trachomatis* lead to long-term inflammation, scarring of the tarsal conjunctiva and distortion of the upper eyelid, with in-turning of the eyelashes that abrade the surface of the globe. This constant abrasion can cause irreversible corneal opacity and blindness. *C. trachomatis* serovars Ba and C seem to be the most common strains involved [6, 7]. In Australia, the burden of disease falls almost exclusively on the Aboriginal population. A 2007 study by Roper *et al.* (2008) [8] examined the clinical prevalence of trachoma in five Aboriginal communities in the Northern Territory. They reported that 32% of Aboriginal people in their study had ocular scarring due to *C. trachomatis,* which is more than four times the acceptable threshold set by the World Health Organization (WHO). Active trachoma, which is the end result of this infection, was at endemic levels across the five communities studied (>10%). While active trachoma rates vary between regions, they are equally unacceptable in Aboriginal children in most Australian states: 0%–21% in South Australia, 4%–22% in Western Australia, 5%–26% in the Northern Territory [9]. Ashamedly, Australia is the only developed country that still has endemic trachoma.

The other species of *Chlamydia* that infects humans is *C. pneumoniae. C. pneumoniae* primarily infects the respiratory site, resulting in mild upper respiratory tract infections that can develop into bronchitis, pharyngitis and pneumonia in up

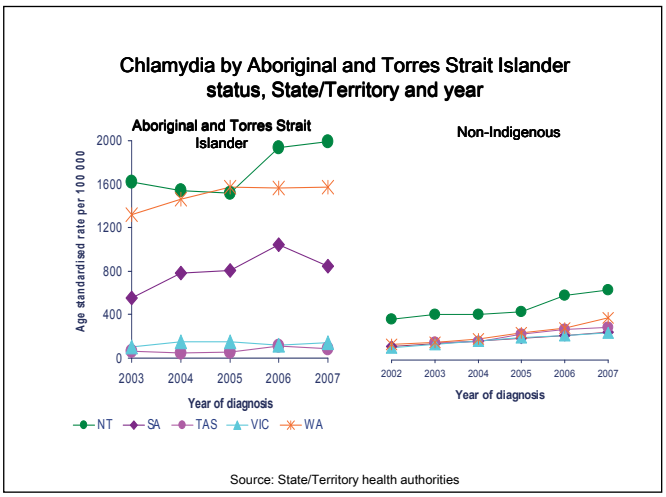


Figure 1.

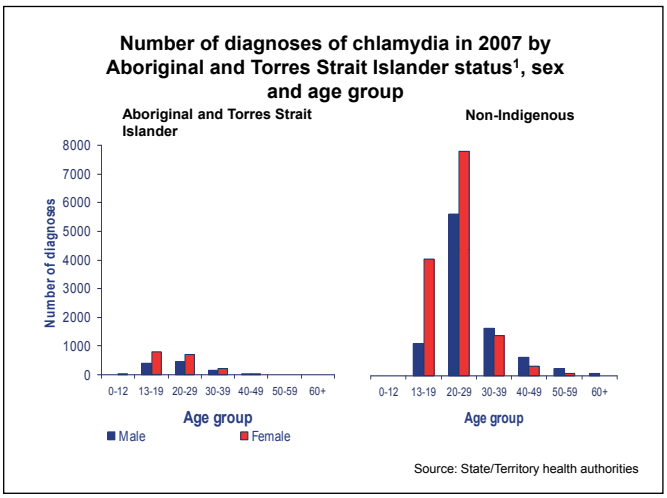
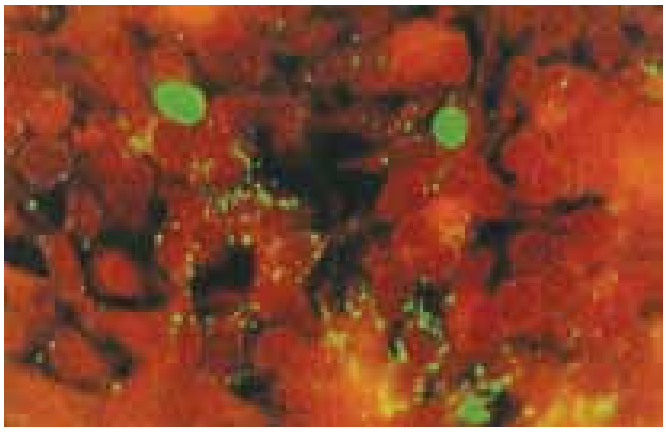


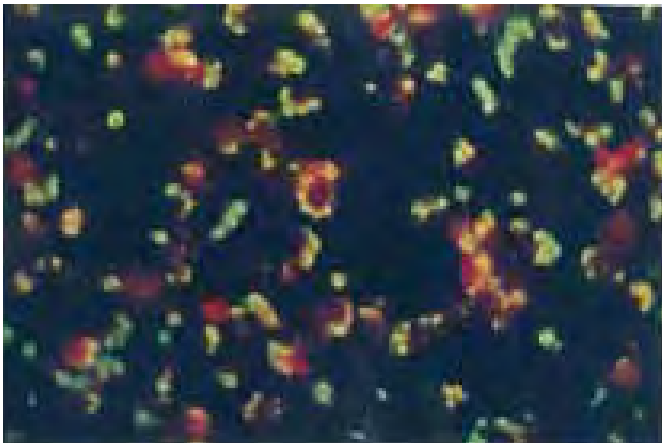
Figure 2.

Figure 3. ***In vitro*** **culture of** ***Chlamydia pneumoniae*** **isolated from an Aboriginal child from a Northern Territory population. The chlamydial particles and inclusions stain apple green against the background of red staining Hela cells.**



to 10% of cases. While serious disease due to *C. pneumoniae* is seldom reported in most parts of Australia, the incidence of *C. pneumoniae* infections in Top End Aboriginal populations is much higher. Respiratory infection and disease are significant factors influencing the high morbidity and mortality figure for Aboriginal people in northern Australia [10] and *C. pneumoniae* infections are an important contributing cause. Serological studies using the micro-immunofluorescence test, on 536 Aboriginal mothers and their children living across the Top End, reported a prevalence of 30.5% for *C. pneumoniae.* In one coastal island community, 25% of the children had antibodies against *C. pneumoniae*, while 71% of the mothers showed evidence of previous exposure [11]. Worldwide, *C. pneumoniae* has proved difficult to grow *in vitro*; however, the research group at the Menzies School of Health Research in Darwin were able to grow seven *C. pneumoniae* isolates from Aboriginal children living in Top End communities [11] (Figure 2).

It is clear that Australian Aboriginal populations have significantly higher levels of all types of chlamydial infections than non-Indigenous populations. The level of *C. trachomatis* STIs are high er in Indigenous than non-Indigenous populations and they appear to be increasing. Indigenous populations also have high levels of *C. trachomatis* trachoma, a situation that is unacceptable for a developed country. They also have high levels of respiratory infection due to *C. pneumoniae,* contributing to their burden of serious respiratory disease. All these situations are addressable with (a) increased access to appropriate health care, (b) improved diagnosis and treatment and (c) the future development of effective vaccines.



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