# Epidemiology of sexually transmitted infections on the Anangu Pitjantjatjara Yankunytjatjara Lands: results of a comprehensive control program

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## ABSTRACT

**Objective:** To assess the impact of a long-term comprehensive control program for sexually transmitted infections (STIs) in remote Aboriginal communities in Central Australia, and to investigate a recent rise in gonorrhoea prevalence.

**Design:** STI prevalence was determined from annual, cross-sectional, population-wide, age-based screening, 1996–2006. During 2006, gonococcal isolates were obtained by on-site culture and tested for antimicrobial susceptibility.

**Setting:** Six remote clinics on the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands, South Australia, which are served by Nganampa Health Council, an Aboriginal community-controlled health service.

**Participants:** All resident Aboriginal people aged 14–40 years at the commencement date of each annual population-wide screen.

**Main outcome measures:** Multivariable logistic regression models were used to compare prevalence of chlamydial infection, gonorrhoea and syphilis measured during each annual population-wide screen; antimicrobial susceptibility of gonococcal isolates obtained in 2006.

**Results:** Between 1996 and 2003, there was a significant reduction in prevalence of gonorrhoea and chlamydial infection, by 67% and 58%, respectively. Subsequently, chlamydia prevalence rate plateaued, but there was a rapid rise in prevalence of gonorrhoea. Syphilis prevalence decreased linearly over the study period (odds ratio, 0.81; $P < 0.001$). During the first 6 months of 2006, 89 gonococcal isolates were obtained, 39 through on-site culture during the 6-week screening period, and all were sensitive to penicillin (in the less-sensitive category).

**Conclusions:** The decrease in STI prevalence asssociated with the program was maintained until 2006 for chlamydial infection and syphilis, but not for gonorrhoea, which rose in prevalence after 2003. There was no change in antimicrobial resistance to explain this rise, and gonorrhoea transmission dynamics and travel of core transmitters to regions without STI control programs might be responsible.


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*See also page 446*

In 1995, Nganampa Health Council (NHC) implemented a comprehensive control program for sexually transmitted infections (STIs) in remote communities on the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands in Central Australia. The program incorporated aggressive screening for gonorrhoea and chlamydial infection, and a report of its first 4 years of operation documented a reduction in prevalence of each of these infections, which was statistically significant in the case of gonorrhoea.[1]

Since then, NHC has sustained intensive STI control measures and continued to monitor the prevalence of gonorrhoea, chlamydial infection, and syphilis. We report the patterns of prevalence of these infections from April 1996 to June 2006. In addition, we describe our investigation of a rapid rise in gonorrhoea prevalence that occurred from 2004.

## METHODS

The study was a component of NHC's comprehensive STI control program, which aims to reduce the prevalence of STIs across all communities of the APY Lands. NHC is the Aboriginal community-controlled health service that delivers health care in the APY Lands — 106 000 square kilometres in the north-western corner of South Australia. The population is almost exclusively Aboriginal.

Ethical approval for the study was granted by the NHC Aboriginal board of management.

### The program

The structure of the comprehensive program is illustrated by the model "Eight ways to beat HIV" (Box 1). The major strategies were developed with guidance from Aboriginal steering committees, who were informed about current international STI control strategies and how they might be adapted locally.

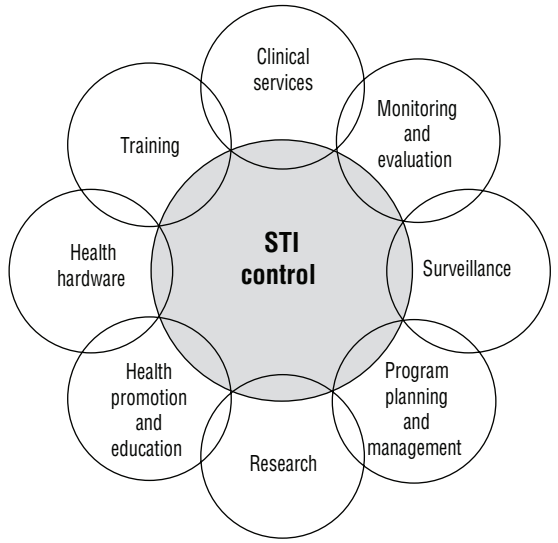
A major focus was on improving diagnosis and treatment of STIs by increasing opportunistic testing throughout the year and conducting annual population-wide screening. Annual syphilis screening had been undertaken since the mid 1980s, resulting in a reduction in syphilis prevalence from 20% in 1985 to 1.7% in 1996.[2] The comprehensive program emphasised training staff to recognise symptomatic presentations where treatment, testing and contact tracing were indicated on the day. In addition, education was provided about STIs and risk reduction, and a range of educational materials were developed in the local language.

### Prevalence study

Cross-sectional data from the annual population-wide screening were used to determine the impact of the program. The eligible population included in the screening (and from which prevalence was determined) comprised all Aboriginal people aged 14–40 years resident on the APY Lands at the commencement of the annual population-wide screen. The screen occurs over a 6-week period each year. A population census was undertaken by NHC in the month before screening, and the resident population was classified as "permanent" or "regular visitor"; both categories were considered eligible for screening.

Diagnosis of gonorrhoea and chlamydial infection was by polymerase chain reaction (PCR) testing of first-void urine for males during all annual screens. For females, self-obtained low vaginal swabs were preferred as samples from 2001, because of the higher sensitivity for gonorrhoea diagnosis.[3,4] The

**1 Eight ways to beat HIV: model of an STI control program, Nganampa Health Council**




**Improved access to diagnosis and treatment**

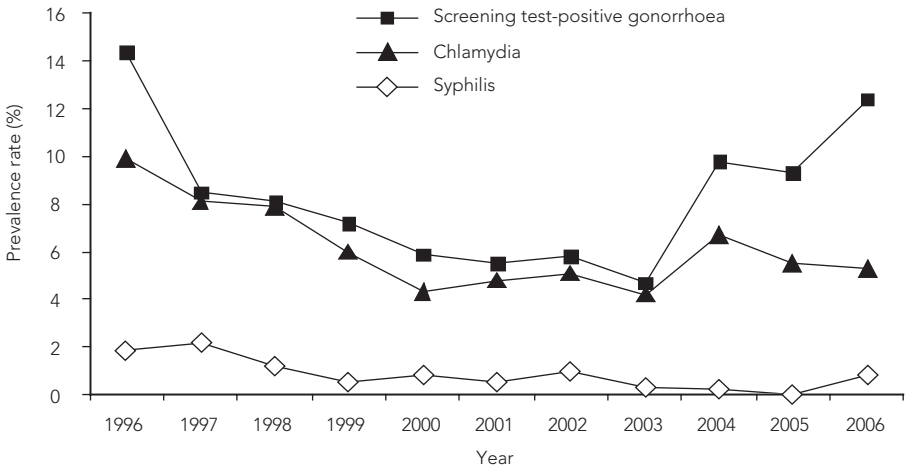
- Increasing testing activity
  - ➢ opportunistic
  - ➢ targeted
  - ➢ annual population-wide
- Minimising interval to treatment
- Presumptive treatment for symptoms
- Improved partner notification

**Clinic systems and infrastructure**

- Access to male and female staff
- Separate male and female clinic rooms
- Clinic systems for confidentiality

STI = sexually transmitted infection. ◆

**2 Age-adjusted prevalence rates of chlamydial infection, gonorrhoea and syphilis among 14–40-year-olds on the APY Lands, 1996–2006**




APY = Anangu Pitjantjatjara Yankunytjatjara. ◆

supplementary gonorrhoea PCR test varied over the period, but the screening test remained the same (Amplicor PCR, Roche, Branchburg, NJ, USA), and its results are presented here.

Treatment of signs or symptoms suggesting an STI or a diagnosis of gonorrhoea, chlamydial infection or both was a single dose of amoxycillin (3 g), probenecid (1 g) and azithromycin (1 g).

Clinical management of STIs between 1996 and 2006 was audited by extracting information from a database that contains all testing, treatment and contact-tracing history since 1996.

From 2005, data were collected on the location of members of the target population who were travelling during the first 2 weeks of the annual screening through interview of health workers and community liaison people.

### Gonorrhoea culture study, 2006

Before the 2006 annual population-wide screen, selected NHC clinic staff were trained to inoculate low vaginal swabs in Amies medium and urine sediment onto GC agar plates (Oxoid Australia, Adelaide, SA). Plates were incubated in a high $CO_2$ atmosphere in candle jars and forwarded to Medvet Laboratories, Alice Springs, for further incubation, interpretation and antibiotic sensitivity testing of gonococcal isolates.

During the 2006 population-wide screen, a microbiologist from the Institute of Medical and Veterinary Science, Adelaide, was based at an NHC clinic for 10 days. Samples were transported by car from clinics on the APY lands to this site. Amies low vaginal swabs and urine sediment were cultured on HB/GC agar plates suitable for gonococcal culture (Oxoid Australia).

### Data analysis

Prevalence rates were adjusted for age and sex using the population of the APY Lands in 2006 as the standard population. Multivariable logistic regression analysis was used to assess the change in prevalence over time, adjusting for age with both a linear and a quadratic term. Ages were grouped into 5-year periods because of the limited data available for 1997 and 1998. A test of interaction was used to determine whether the changes in prevalence of each of the diseases were the same for men and women. Data were analysed for two periods: 1996–2003 and 2003–2006. A two-tailed $P$ value of 0.05 was considered significant. Statistical analysis was performed using SAS version 9.1.3 (SAS Institute, Cary, NC, USA).

## RESULTS

The multivariable logistic model indicated no difference between the sexes in change in prevalence of gonorrhoea, chlamydial infection or syphilis, so a combined model was used.

Between 1996 and 2003, the age-adjusted prevalence rates of gonorrhoea and chlamydial infection decreased by 67% and 58%, respectively (Box 2). The decrease in prevalence of gonorrhoea was more rapid at the beginning of the period. After 2003, the prevalence of gonorrhoea increased significantly (Box 3).

For chlamydial infection, there was strong evidence of a reduction in prevalence between 1996 and 2003, with the odds of infection decreasing 12% each year, but no evidence of a change between 2003 and 2006. Syphilis prevalence declined linearly from 1996 to 2006 (Box 3).

**3 Multivariable logistic regression analysis of prevalence of sexually transmitted infections among 14–40-year-olds on the APY Lands, 1996–2006**

| Infection | Period | Effect | Odds ratio | 95% CI | *P* |
|---|---|---|---|---|---|
| Gonorrhoea | 1996–2003 | Linear | 0.67 | 0.56–0.80 | < 0.001 |
| | | Quadratic | 1.03 | 1.01–1.05 | 0.005 |
| | 2003–2006 | Linear | 1.34 | 1.21–1.48 | < 0.001 |
| Chlamydia | 1996–2003 | Linear | 0.88 | 0.84–0.92 | < 0.001 |
| Syphilis | 1996–2006 | Linear | 0.81 | 0.75–0.88 | < 0.001 |

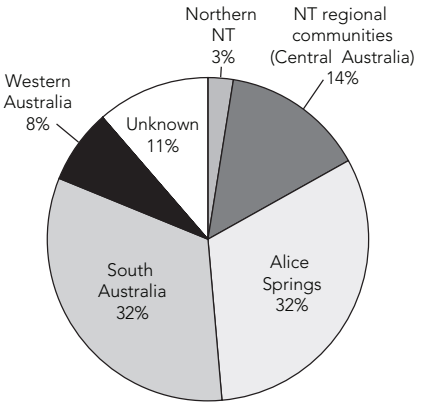
APY = Anangu Pitjantjatjara Yankunytjatjara. ◆

**4 Indicators of clinical management of sexually transmitted infection, Nganampa Health Council, 1996–2006**

| | Annual screening | | | Between-screen tests* |
|---|---|---|---|---|
| Year | Participation rate | Treatment rate | Days to treatment | (mean no. per week) |
| 1996 | 61% | 91% | 17 | 29.2 |
| 1997 | 73% | 80% | 11 | 38.4 |
| 1998 | 68% | 94% | 14 | 42.6 |
| 1999 | 69% | 97% | 12 | 52.6 |
| 2000 | 71% | 91% | 13 | 62.6 |
| 2001 | 72% | 100% | 14 | 60.8 |
| 2002 | 65% | 90% | 12 | 71.8 |
| 2003 | 69% | 100% | 15 | 61.2 |
| 2004 | 72% | 97% | 12 | 78.2 |
| 2005 | 75% | 99% | 16 | 79.2 |
| 2006 | 75% | 95% | 13 | 74.2 |

*Combined number of tests for chlamydia or gonorrhoea in the period between annual screens. ◆

**5 Location of individuals travelling outside APY Lands in the first 2 weeks of the 2006 population screen**




APY = Anangu Pitjantjatjara Yankunytjatjara.
NT = Northern Territory. ◆

The audit of clinical care between 1996 and 2006 showed consistently high participation and treatment rates, and short intervals to treatment in the annual screening, as well as large numbers of interval screens (Box 4).

In 2006, 39 gonococcal isolates were obtained through on-site culture during the screening, and 89 were obtained overall in the first 6 months of the year. These isolates all had the same antibiotic resistance profile, and fell in the less-sensitive category for penicillin resistance.

In 2005 and 2006, 28% of the target population was reported to be travelling outside the APY lands in the first 2 weeks of the annual STI screen, mainly to SA and Alice Springs (Box 5).

## DISCUSSION

The study found a significant reduction in prevalence, and sustained control of chlamydial infection between 1996 and 2006. The gonorrhoea prevalence rate also significantly decreased between 1996 and 2003, but this was followed by a sharp rise, despite maintenance of excellent case management. A major reduction in syphilis prevalence was recorded before this study began, largely as a result of annual screening,[2] and a further significant linear reduction was achieved over the study period.

We found no change in the sensitivity of gonococcal isolates to penicillin in this population to explain the isolated rise in gonorrhoea prevalence. Although there was a change in the sample used for gonococcal detection in females, from urine to low vaginal swabs, increasing test sensitivity, this change occurred in 2001, 3 years before the observed rise in gonorrhoea prevalence.

In Australia as a whole, gonorrhoea diagnoses in Indigenous people increased by 48% between 2002 and 2006, and chlamydial diagnoses by 61%.[5] For meaningful interpretation of our results, it is necessary to consider how much prevalence rates would have risen without the comprehensive program. While there are few published data comparable with our population-wide data, population-wide STI screening was also recently undertaken in selected communities in regions of the Northern Territory adjacent to the APY Lands, assisted by the Tri-State STI/HIV Project. The project reported higher prevalence rates for gonorrhoea than for chlamydial infection among young people between 2001 to 2005,[6] with prevalence rates of 14% and 10% reported in 2004 for gonorrhoea and chlamydial infection, respectively, among 15–35-year-olds.[7]

The gonococcal genome is hypervariable, allowing it to change continually to avoid host immune responses,[8] and contributing to its greater outbreak potential compared with chlamydial infection. According to "core transmitter theory" for gonorrhoea,[9] there may be frequent interaction within a core group of people, but because a significant proportion are already infected, a rise in new cases is limited by preemption (ie, the disease is already present).[9] By 2003, after 8 years of population-wide screening and comprehensive STI control, gonorrhoea prevalence rates had fallen by 67% in the APY Lands. This left an increased population susceptible to acquiring infection because of their negative status. One explanation for the rapid increase in gonorrhoea in 2004 is an increase in travel of core transmitters or bridge populations susceptible to infection to and from regions that lacked comprehensive STI control programs. This implies that health promotion and education had failed to create behaviour change among this group.

There is some evidence of considerable intercommunity and community-to-regional centre mobility among Indigenous people in the NT[10] and SA. The yield of positive gonorrhoea tests in the APY Lands in the second half of 2003 was 4.3% (95% CI, 3.0%–5.5%). In the first quarter of 2004, just before the first annual screening that found a rise in gonorrhoea prevalence, the test yield rose to 9.8% (95% CI, 7.0%–12.6%). During this period, over 1000 non-residents were estimated to be camped on the APY Lands for over a month to participate in ceremonial activity, in what was regarded as the largest congregation of this type for a decade.

Another contributing factor to the sudden rise in gonorrhoea might have been the emergence of a gonococcal clone with greater virulence and infectivity. Molecular studies have suggested that a small number of successful gonococcal subtypes with superior virulence factors dominate and can then persist for a considerable period within particular patient groups.[11,12] A rise in prevalence through this mechanism would depend on the presence of sexual partners from outside the usual network (facilitated by mobility) and lack of behaviour change among core transmitters allowing the introduced clone to become endemic.

To investigate further the rise in gonorrhoea prevalence, we intend to undertake molecular testing of gonococcal strains obtained during the 2006 culture survey. These techniques have been used to evaluate transmission chains in other settings.[11,13,14]

There are significant opportunities for STI control among Indigenous people in Australia, given the development of PCR testing for chlamydia and gonorrhoea and culturally acceptable sampling techniques.[3,15] These allow intensive screening and treatment, even in remote settings. Both chlamydial infection and gonorrhoea remain curable by single-dose antibiotics in central Australia. In contrast, PCR testing is largely unavailable in other areas of the world with high gonorrhoea prevalence because of the significant costs, necessitating greater reliance on a syndromic approach. There is also high penicillin resistance among gonococci in these areas. However, the hypervariability of the gonococcus and its outbreak potential mean sustained long-term control will probably require a broad reduction in prevalence across interrelated Indigenous populations. While fundamental behaviour change is clearly necessary, in the shorter term, successful control of STIs in Indigenous communities may well require the implementation of comprehensive STI control programs with a focus on increasing testing activity across more regions of remote Australia.

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## COMPETING INTERESTS

None identified.

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