THE IMPACT OF SUPPLY REDUCTION THROUGH ALCOHOL MANAGEMENT PLANS ON SERIOUS INJURY IN REMOTE INDIGENOUS COMMUNITIES IN REMOTE AUSTRALIA: A TEN-YEAR ANALYSIS USING DATA FROM THE ROYAL FLYING DOCTOR SERVICE

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Abstract — Aims: To assess the impact of supply reduction through Alcohol Management Plans (AMP) on the rate of serious injuries in four indigenous communities in remote Australia. Methods: An ecological study used the database of the Royal Flying Doctor Service (RFDS) to calculate trauma retrieval rates for 8 years pre- and 2 years post-AMP in four remote communities covering a period from 1 January 1995 to 24 November 2005. All serious injuries in these communities required aero-medical retrieval. Results: Serious injury resulted in a total of 798 retrievals during the observation period. One-sided analysis of variance for repeated measurements over the 10 years demonstrated a significant ($P=0.021$) decrease of injury retrieval rates after the introduction of the AMP. Similarly, a comparison of linear trends of injury retrieval rates pre- and post-AMP also resulted in a significant decrease ($P=0.022$; one-sided paired t-test). Comparisons of injury retrieval rates of just the 2 years pre- and post-AMP also revealed a significant reduction ($P=0.001$; paired t-test), with an averaged 52% decline. Identical comparisons of retrieval rates for causes other than injury revealed no significant changes. Conclusion: This impact evaluation provides evidence that AMP was effective in reducing serious injury in the assessed indigenous communities.

INTRODUCTION

Alcohol consumption by indigenous Australians

The impact of excessive alcohol consumption causing personal and communal harm on indigenous communities has been clearly demonstrated across the globe (Kraus and Buffler, 1979; Beauvais and LaBoueff, 1985; Johnson, 1991; Gray, 2000; Seale et al., 2002; Rehm et al., 2003; Connor et al., 2005). Over the last 20 years there has been an international call from indigenous leaders, their communities and others for alcohol supply reduction as a key mechanism to address the ravages unlimited access to alcohol is having on their communities (Lonnner, 1985; Landau, 1996; Eber, 2001; Fitzgerald, 2001; Seale et al., 2002).

Supply reduction on alcohol sales to Australian aboriginal and Torres Strait islander peoples had been imposed by governments from the early 1800s through the early 1970s. Following the 1967 Federal referendum effectively granting indigenous Australians equal status and rights with all other citizens, these laws were repealed over time. Subsequently, there has been a dramatic increase in consumption within the aboriginal and Torres Strait islander population, with a corresponding increase in personal and communal harm (Aboriginal Drug and Alcohol Council (SA) Inc, 1996; Siggers and Gray, 1998; Gray, 2000; Australian Bureau of Statistics, 2004).

The devastating impact of alcohol use in the 1970s and 1980s led governments, with the cooperation of indigenous communities, to return towards a policy of alcohol restriction, facilitated by the amendment to liquor licensing laws to consider harm minimization objectives (Bourbon et al., 1999).

This gave licence to indigenous leaders and their communities to instigate alcohol supply reduction through amendments to liquor licensing laws, while remaining cognizant that excessive drinking was at least in part related to long-standing political and economic disadvantage (Johnson, 1991; Race Discrimination Commissioner, 1995; Siggers and Gray, 1998). The focus was on decreasing trading hours, minimising take-out sales and access to low-cost/high-alcohol drinks (especially cask wine) (Gray et al., 1999).

Supply reduction strategies

A variety of studies have considered the effectiveness of supply reduction in reducing harm to indigenous people. Wood and Gruenewald (2006) found that Alaskan native villages that prohibited alcohol had lower age-adjusted rates of serious injury (Wood and Gruenewald, 2006). An earlier study by Landen et al. (1997) in Alaska found that of remote indigenous communities with populations lower than 1000 people, those with alcohol restrictions had lower injury-related death rates when compared with those without alcohol restrictions (Landen et al., 1997). An Australian review by d’Abbs and Togni (2000) concluded that supply reduction was effective in reducing alcohol consumption and related harm including drunkenness, interpersonal violence, and property damage (d’Abbs and Togni, 2000). However, another Australian review by Gray et al. was less conclusive that alcohol supply reduction resulted in decreased consumption and improved health and social outcomes (Gray et al., 2000).

In 2002, the Queensland State Government established the Meeting Challenges, Making Choices (MCMC) program in response to the Cape York Justice Study (Fitzgerald, 2001) into alcohol, substance abuse, and violence in indigenous Communities (Queensland Department of the Premier and Cabinet, 2002). Alcohol supply restrictions and enforcement were the alcohol management interventions chosen by the...
The relationship between alcohol and injury

Many international studies have demonstrated a clear link between alcohol, violence, and injury, especially severe injury. A meta-analysis by Cherquitel et al. (2006) found a powerful association between alcohol consumption and admission to an emergency department for injury (Cherquitel et al., 2006). A study by Borges et al. (2006) demonstrated that acute alcohol consumption was a risk factor for non-fatal injury in those attending most of the 28 emergency departments under study across 16 countries (Borges et al., 2006), while a different analysis demonstrated a strong relationship between severe injury and high blood alcohol level (Macdonald et al., 2006). A study of eye injuries in far north Queensland demonstrated that indigenous people had a very high rate of severe globe trauma such as penetrating eye injury, and alcohol-related assault was a significant cause of the ‘extraordinary high rate’ for all eye injuries in this population group (Smith et al., 2006). Hence, severe injury requiring attention at a hospital is an important outcome measure for studies assessing the impact of alcohol, including alcohol harm reduction strategies.

The 2005 government review of the impact of the AMP discusses a noted decline in hospital admissions for assault and to a lesser extent for other injuries (Queensland Government, 2005). In particular, the noted slow decline in hospital admissions for assault had been occurring since March 2000, with the largest fall in 2002 before the AMP started. The AMP for the community with the strongest downward trend had a canteen and no alcohol carriage, yet this decline was also seen prior to the AMP. There was no overall change in hospital admissions for all other injuries unrelated to assault, although there was a mild decline prior to the AMP and a subsequent rise after the AMP began. However, the analysis may have failed to find a significant difference as the data was measured on a quarterly calendar basis while the AMP were introduced on different dates from 30 December 2002 to 14 April 2004. Additionally, results were based on hospital data although only some remote indigenous communities have a hospital. Hospital data was unable to distinguish between the residential address of a person in a remote community and the geographical locations where the injury was sustained (perhaps while visiting a larger centre where alcohol is more freely available).

Aim of this study

Given the demonstrated link between alcohol use and injury and the absence of clear evidence from the 2005 government review, the aim of this study was an impact evaluation of the AMP on the rates of serious injuries in selected remote indigenous and Torres Strait islander communities in the Cape York region of Australia.

METHODS

Design

This study utilized an ecological design.

Setting

This study considered the impact of the AMP on serious injury in four remote aboriginal and Torres Strait islander communities in Cape York, Far North Queensland. These four communities were the only locations in Queensland that satisfied all the inclusion criteria listed below.

The Royal Flying Doctor Service (RFDS) is the preeminent provider of aero-medical retrieval services in Australia and the largest organization of its kind in the world. Founded over 75 years ago to overcome the ‘tyranny of distance’ it now operates a fleet of aircraft equipped with intensive care facilities and staffed by flight nurses and medical staff when required, to provide both primary aero-medical retrieval between rural and remote cattle stations, mines, small hospitals, and aboriginal and Torres Strait islander communities as well as secondary inter-facility transfers between major hospitals. For more remote locations, RFDS is often the only method for patients requiring definitive hospital care to be transferred to a major hospital. The Queensland (Qld) section of the RFDS, (Qld), aero-medical

Table 1. Community populations and alcohol management plans

<table>
<thead>
<tr>
<th>Community</th>
<th>Total population</th>
<th>Indigenous population</th>
<th>Beer</th>
<th>Spirits</th>
<th>Alcohol management plans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>(%)</td>
<td>N</td>
<td>(%)</td>
<td>Date AMP began</td>
</tr>
<tr>
<td>A</td>
<td>1047</td>
<td>919</td>
<td>30 December 2002</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>B</td>
<td>891</td>
<td>753</td>
<td>5 December 2003</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>C</td>
<td>453</td>
<td>276</td>
<td>3 October 2003</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>D</td>
<td>649</td>
<td>549</td>
<td>5 December 2003</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

*Except church use.
retrieval service provided the only means of transfer for all cases of injury severe enough to warrant assessment and/or management in a hospital, ensuring that the RFDS, (Qld), database provides a complete listing of all cases of severe injury. The staff directly involved in the transfer contemporaneously complete the data sheets.

Inclusion criteria
The inclusion criteria for communities were: (i) an AMP in force (ii) presence of a government funded primary health care centre, which provided an emergency 24/7 service including x-ray facilities (iii) no hospital inpatient or operative services (iv) all retrievals were transferred by RFDS, Qld, fixed-wing aircraft as road or helicopter transfer was not feasible due to long distances and perennial poor road conditions and (v) a degree of isolation from other aboriginal and Torres Strait islander communities and rural towns to help ensure that the origin of the retrieval listed on the database accurately reflected where the person was at the time of the incident.

Although there were 19 indigenous communities in Queensland with an AMP in place by 2006, only 13 had an AMP place during the time frame of this study. Of these, seven were excluded as they commonly used road ambulance retrieval and two were excluded as they had substantial inpatient facilities. Hence only four communities were used in this study.

These criteria address some of the issues discussed earlier concerning the MCMC evaluation. The health services provided to each of these four communities were from the same regional providers; Queensland Health Cape York District and RFDS, (Qld), Cairns base. Although no other major alcohol or injury program was implemented during the study period, each of the four communities experienced similar day-to-day changes in policy, management, logistics, and delivery of health care. In particular, there was no change in the utilization of aero-medical retrieval for those requiring injury retrieval during the study period.

Potential control groups
A range of locations was considered as potential control groups for this study. However, there was only one location in Queensland with a predominantly indigenous population that also satisfied the other inclusion criteria. Positive features for use as a control community included being located in Cape York in reasonable geographical proximity to the study communities and having very similar health services from the same providers as the study communities. However, this community is located on the major highway that connects the regional city of Cairns to three of the four communities that formed the intervention group and could be considered a staging point for travel across the Cape York region. Another concern was the very small population size with an indigenous population of 241 (78% of total population). As this is less than 10% of the intervention group in size, this control group would not have satisfied statistical power requirements.

Data
‘Serious Injury’ was defined as any injury that required attention at a hospital and as such could not be managed within the study communities where onsite health care was provided at primary health care centres staffed by nurses, and at times doctors, with limited x-ray services (limbs and chest only), no onsite pathology services, no facility to admit patients, and no formal operating theatre or facility to administer general anaesthesia.

The population data for each of the study communities are taken from the 2001 census and detailed in Table 1 (Australian Bureau of Statistics, accessed on 20 September 2006). Population data from the 1996 census was not used as the data on the aboriginal and Torres Strait islander communities in Cape York is considered unreliable (Taylor and Bell, 2002). No reliable annual data exist on the age structure of the study community populations that could be used for standardization.

All retrieval data was extracted from the electronic de-identified database of the RFDS, (Qld), which covered the period 1 March 1994 to 28 February 2006. This medical, demographic, logistic, and aircraft dataset was compiled entirely from the handwritten records completed at the time of the aero-medical episode by the doctor or nurse as well as the pilot and crew of the aero-medical flight. Each retrieval record included up to three clinical diagnostic categories and up to one external cause of injury. Prior to 1 July 2004 diagnoses and external causes of morbidity and mortality were recorded in the database according to the World Health Organisation (WHO) International Classification of Disease (ICD) Version 9 (Centre for Disease Control, accessed September 1 2006), and subsequently the WHO ICD Version 10, 3rd Edition (World Health Organization, accessed 1 September 2006). In particular, this meant that all cases of injury were included as the database did not distinguish between alcohol-related injuries and others. However, this avoided the difficulty associated with attempting to map alcohol causation from ICD 9 to ICD 10 (Chikritzhs et al., 2002).

Time frame
The date of onset and restrictions imposed for the AMP in each of the four communities is detailed in Table 1. As these dates varied across communities and with available data covering a 10-year span from 1994, the 8 years pre- and post-introduction of each AMP were calculated as multiples of 365 days from the date of introduction in that particular community. This resulted in an overall sampling time frame from 1 January 1995 to 24 November 2005.

Potential confounders
Using a pre/post intervention methodology increases the risk that factors other than the introduction of the AMP could have had a significant influence on injury-related retrieval rates. Health care services at each of the four study communities were provided by the same two regional providers, Queensland Health and RFDS, (Qld). The structure of health care services for serious injury did not change through the study period. Road and helicopter retrieval were not used for retrieval of serious injury from study group locations throughout the duration of the study. Although health care services did slowly evolve towards a more primary
heath care focussed model, there were no specific public health measures/intervention strategies/educational sessions during the study interval that directly addressed alcohol reduction.

**Methodology**

SPSS (Statistical Package for Social Sciences) version 14 was used. Rates of injury retrieval are expressed per 1000 people per year. Standard bivariate analytical tests such as paired (pre- vs post-) t-tests and paired (pre- vs post-) as well as unpaired (between communities) chi-square tests were used. An analysis of variance with repeated measurements over the whole time period (10 years) was conducted for the retrieval rates where the introduction of AMP was entered as a dichotomous within-subject effect.

**Ethical approval**

This study of de-identified data was approved by the Human Research Ethics Committees of the University of Queensland, Australia, and James Cook University, Australia.

**RESULTS**

**Overall retrieval data**

During the study period from 1 January 1995 to 4 December 2005, RFDS, (Qld), performed 68 324 retrievals of which 23 433 (34.3%) originated in a location with a tertiary hospital. Of the remaining 44 891, there were a total of 14 487 (32.0%) retrievals for injury. Of all the retrievals from the four study locations, 798 (28%) were for injury, while for all other locations without a tertiary hospital there were 13 634 (32.5%) retrievals for injury (P = 0.001).

A comparison of the demographics of those with injury being retrieved from the four communities under study between 1 January 1995 and 24 November 2005, with those originating from all other locations without a tertiary hospital demonstrated that the four study communities injury retrievals had a lower proportion of males (56.3 vs 68.9%; P = 0.0001), a younger population (29.7 ± 16.0 vs 35.7 ± 22.1; P < 0.0001), a lower proportion with critical or high severity at uplift (24.8 vs 30.6%; P < 0.0001), were far more likely to be on a weekend (i.e. Friday, Saturday, Sunday) (54.2 vs 47.5%; P < 0.0001).

The average age, ratio of males to females, severity of uplift, and weekday to weekend ratio of those retrieved from each of the four communities under study was not significantly different. Almost all were retrieved from the nearest RFDS, (Qld), base in Cairns (97%) with 96% transported to the nearest major hospital located in Cairns (approximately 700–1000 km distant), 1.4% to the major hospital in Townsville (approximately 1000–1400 km distant), 2% to the regional hospital in Weipa (approximately 400 km distant) and 0.6% elsewhere. In community A, the proportion of those who identified as a member of the aboriginal and Torres Strait islander community was higher post-AMP than before (94.9–98.3%; P = 0.006); there were no significant changes of this proportion for study communities B, C, and D.

**Changes in retrieval over the 8 years pre- and post-AMP introduction**

The injury retrieval rates for the four study communities are detailed in Table 2. A statistically significant reduction in retrieval for injury was noted after the introduction of the AMP. A one-sided analysis of variance with repeated measurements over the whole time period (10 years) revealed a significant decrease of injury retrieval rates after the introduction of AMP (P = 0.021). The slopes of the linear trends of injury retrieval rates over the time period before the introduction of AMP (8 years) and for the time period over the last observation before and the 2 years after the introduction were calculated and are tabulated in Table 3. A test comparison of these slopes reveals a significant decrease (P = 0.022; one-sided paired t-test) in retrieval rates.

**Changes in retrieval over the 2 years pre- and post-AMP introduction**

It could be argued that comparisons of retrieval rates over such a long time interval are invalid without taking structural and/or demographic changes of the communities into account. Therefore, an additional comparison of injury retrieval rates restricted to the 2 years before and the 2 years directly following the introduction of AMP was undertaken. The resulting rates are detailed in Table 3 and reveal a significant reduction after the introduction of AMP (P = 0.001; paired t-test). To explicate the effect of the introduction of AMP on injury retrieval rates the observed reduction of average

<table>
<thead>
<tr>
<th>Years</th>
<th>pre/post-AMP introductiona</th>
<th>–8</th>
<th>–7</th>
<th>–6</th>
<th>–5</th>
<th>–4</th>
<th>–3</th>
<th>–2</th>
<th>–1</th>
<th>+1</th>
<th>+2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community A</td>
<td>24</td>
<td>28</td>
<td>16</td>
<td>20</td>
<td>18</td>
<td>23</td>
<td>36</td>
<td>31</td>
<td>20</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Community B</td>
<td>42</td>
<td>30</td>
<td>28</td>
<td>28</td>
<td>37</td>
<td>35</td>
<td>29</td>
<td>26</td>
<td>9</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Community C</td>
<td>24</td>
<td>22</td>
<td>38</td>
<td>29</td>
<td>15</td>
<td>31</td>
<td>57</td>
<td>46</td>
<td>15</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Community D</td>
<td>20</td>
<td>12</td>
<td>34</td>
<td>22</td>
<td>17</td>
<td>25</td>
<td>48</td>
<td>35</td>
<td>25</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

All communities (S.E.) 27.5 (4.9) 23.0 (4.0) 29.0 (4.8) 24.8 (2.2) 21.8 (5.1) 28.5 (2.8) 42.5 (6.2) 34.5 (4.3) 17.3 (3.4) 19.3 (1.4)

* In relation to date of onset of Alcohol Management Plan in each community.
retrieval rates (2 years after vs 2 years before AMP) were expressed as percentages of those rates before the introduction of AMP and are detailed in Table 3. On average (over the four communities) a reduction of 51.9% was observed.

The retrieval rates for all other causes (i.e. other than injury) were analysed in the identical way as described above for injury retrieval rates but did not reveal any statistically significant change. The average retrieval rate for non-injuries over all communities over the 8 years before the introduction of AMP was 51.5 (per 1000 people per year) followed by 58.3 and 53.8 for the first and second years post-AMP respectively.

### DISCUSSION

**Impact of study findings**

This study has demonstrated a statistically significant reduction of injury retrieval rates after the introduction of AMP in four indigenous communities in Cape York, Australia. Positive results from intervention programs are desperately needed to help address the enormous gap in health inequality between indigenous and other Australians, especially the failure to narrow the gap over recent time in contradistinction to other countries such as New Zealand and Canada.

The introduction of the AMP has the potential to bring about a quantum change of social importance to the lives of the indigenous people living in these communities. The MCMC reported that the introduction of the AMP had other beneficial effects including strengthening community leadership and a trend towards normalising community life (Queensland Government, 2005). Reporting the positive impact of the AMP in terms of retrievals for serious injury could provide a significant boost for policy makers in encouraging their efforts to tackle the enormous disparity in health outcomes between indigenous and non-indigenous Australians. At the local level, reporting of these results has the potential to increase the momentum for grass-roots activities by local people with higher levels of support from outside agencies.

Although widely supported, the AMP program has been criticized in some quarters. From a human rights perspective there are questions of legitimacy with having different legally enforceable alcohol-related policies and laws distinctly applicable for indigenous people compared to the rest of Australia (Martin and Brady, 2004). It appears the restriction is designed to reflect the geographic location rather than any one group of people per se. However, the AMP for a nearby location not included in this study for other reasons specifically excludes guests staying at an expensive, upmarket fishing lodge within the community from being subject to the legal provisions of the AMP.

The MCMC and associated AMP systems were introduced to address the impact of alcohol and associated violence in Cape York indigenous communities. The program was devised with three key arms: supply reduction strategy through the AMP, demand reduction, and separation of alcohol sale from local indigenous councils. At present, the predominant strategy being pursued is supply reduction. Local indigenous community leaders have questioned this focus and called for the simultaneous implementation of reduction strategies (Queensland Government, 2005). Other Australian authorities have made similar calls (Hunter et al., 1996). The presence of illegal smuggling of alcohol into communities, and then, unlicensed sales to drinkers is a well recognized problem (Robertson, 2000) (Australian National Council on Drugs, 2002) (Waters, accessed on 1 April 2007). This problem is currently addressed through policing but would demand reduction strategies, which would appear quite appropriate.

The third prong of intervention, disconnecting alcohol sales from indigenous community councils has been addressed by the Queensland Government (Queensland Government, 2002). The control of legal alcohol sales in indigenous communities has now passed from the local community council to an appointed community liquor licensing board. However, the majority of the profits still pass to the indigenous community council and often form a substantial part of the revenue base. This relationship could be perceived as a conflict of interest with the council’s efforts in improving the health and well-being of the community it serves.

The presence, and especially success of supply reduction could impede the roll-out of interventions (Landau, 1996). However, considering the complex interplay of forces influencing consumption of alcohol in indigenous communities and with governments having previously identified a 3-pronged approach it would appear reasonable to move towards a more multi-layered approach, where supply reduction works with complimentary strategies such as demand reduction.

**Potential limitations**

Injury retrieval was used as a proxy for alcohol-related violence in this study. There was no reason to assume that the background rate of trauma from non-alcohol-related causes would have significantly changed over the study period as the structure of work and communal life in these four
communities had experienced little change. In the absence of powerful data directly recording alcohol consumption around the time of violent episodes, an indirect measure of violence is the only realistic way to proceed. This conclusion had also been followed by the MCMC evaluators. In this study, the use of narrow inclusion criteria was employed to directly enhance the relationship between these two factors.

The absence of any available control community necessitated an uncontrolled design. However, no relevant changes (also shown above) other than the introduction of AMPs could be identified in these remote communities during the study period. Moreover, the trends of retrieval rates for all causes other than injury did not reveal any significant decrease. A purely spurious time trend for injury retrieval rates seems, therefore, unlikely.

Using RFDS, (Qld), aero-medical retrieval data rather than hospital separation data helped ensure the recorded injury was geographically related to the location with a known level of alcohol restriction. Trends were calculated from the actual date of AMP implementation rather than the usual method of the nearest fixed point in the audit calendar. The isolation of each community, the presence of only a single source of medical care, and the absence of an alternative mechanism of transfer for serious injury increases the confidence that the RFDS, (Qld), data captured all cases.

The data from the 2001 census were used for estimating the rates even though the time frame of this study extended over 10 years. If the size of the communities changes in any way over time, the estimation of the rates will be increasingly biased. However, as the indigenous population in Cape York is slowly but steadily growing, (Taylor and Bell, 2002) this means that the observed decreasing trend after introduction of AMP may in fact be an underestimation of the true picture.

One possible impact of reduction in alcohol access within individual indigenous communities may be to encourage heavy consumers to shift to other locations with higher levels of access. This would contribute to a decline in consumption in their original community but have no overall impact within the broader population. However, the absence of any reliable population data especially age and sex stratified prevent an accurate assessment of these dynamic population trends. Nevertheless, the absence of documented evidence that these population shifts are occurring would suggest that any associated population variations would be small.

There was no clear hierarchal relationship between the different levels of restriction provided by the AMP between the four study locations. Correspondingly, there was no possibility to assess a potential ‘dose-response’ relationship between percentage reduction over time and the actual form of AMP introduced. This in part reflects that each community was directly involved in choosing their own degree of restriction. There is also the complex interplay between the three separate variables differentiating the different forms of the AMP: percentage of alcohol in beer and spirits as well as take-outs.

CONCLUSION

This study addresses the critical state of indigenous health with respect to alcohol misuse, a key public health issue in Australia. The presented impact evaluation provides strong evidence that AMP was effective in reducing serious injury in these indigenous communities.

With supply reduction successful it may now be appropriate to consider reinforcing this success with a more multifaceted approach. As the focus of this study has been on retrieval of serious injury, further studies could ascertain the impact of the AMP on other aspects of remote community life, clarifying contextual information of this major intervention strategy.

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REFERENCES


