Socioeconomic disparities in access to ART treatment and the differential impact of a policy that increased consumer costs

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STUDY QUESTION: What was the impact on access to assisted reproductive technology (ART) treatment by different socioeconomic status (SES) groups after the introduction of a policy that increased patient out-of-pocket costs?

SUMMARY ANSWER: After the introduction of a policy that increased out-of-pocket costs in Australia, all SES groups experienced a similar percentage reduction in fresh ART cycles per 1000 women of reproductive age. Higher SES groups experienced a progressively greater reduction in absolute numbers of fresh ART cycles due to existing higher levels of utilization.

WHAT IS KNOWN ALREADY: Australia has supportive public funding arrangements for ARTs. Policies that substantially increase out-of-pocket costs for ART treatment create financial barriers to access and an overall reduction in utilization. Data from the USA suggests that disparities exist in access to ART treatment based on ethnicity, education level and income.

STUDY DESIGN, SIZE, DURATION: Time series analysis of utilization of ART, intrauterine insemination (IUI) and clomiphene citrate by women from varying SES groups before and after the introduction of a change in the level of public funding for ART.


MAIN RESULTS AND THE ROLE OF CHANCE: Women from higher SES quintiles use more ART treatment than those in lower SES quintiles, which likely reflects a greater ability to pay for treatment and a greater need for ART treatment as indicated by the trend to later childbearing. In 2009, 10.13 and 5.17 fresh ART cycles per 1000 women of reproductive age were performed in women in the highest and lowest SES quintiles respectively. In the 12 months after the introduction of a policy that increased out-of-pocket costs from ~$1500 Australian dollars (€1000) to ~$2500 (€1670) for a fresh IVF cycle, there was a 21–25% reduction in fresh ART cycles across all SES quintiles. The absolute reduction in fresh ART cycles in the highest SES quintile was double that in the lowest SES quintile.

LIMITATIONS, REASONS FOR CAUTION: In this study, SES was based on the average relative socioeconomic advantage and disadvantage of small geographic areas, and therefore may not reflect the SES of an individual. Additionally, the policy impact was limited to the 12 months following its introduction, and may not reflect longer term trends in ART treatment.

WIDER IMPLICATIONS OF THE FINDINGS: While financial barriers are an important obstacle to equitable access to ARTs, socioeconomic differences in utilization are likely to persist in countries with supportive public funding, due in part to differences in childbearing patterns and treatment seeking behaviour. Policy makers should be informed of the impact that changes in the level of cost subsidization have on access to ART treatment by different socioeconomic groups.

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Introduction

Infertility affects $\sim$9% of couples at any given time worldwide, causing significant personal suffering to millions of couples from all socioeconomic backgrounds around the globe (Boivin et al., 2007). The treatment of infertility has been revolutionized over the last three decades, primarily through the evolution of assisted reproductive technologies (ARTs) into a suite of mainstream medical treatments. Latest estimates indicate that the over 1.6 million ART cycles are undertaken each year and that $>5$ million children have been born following ART worldwide (ESHRE, 2012a), including up to 5% of all children in some countries (ESHRE, 2012b). Despite this, there are widespread disparities in access to treatment between countries (Chambers et al., 2009; ESHRE, 2012b) and among different socioeconomic and ethnic groups within countries (Jain, 2006; Hammoud et al., 2009; Smith et al., 2011).

Disparities in access to healthcare based on the principle of equal access for equal need have been widely recognized and are the subject of recent attention by major governments (Centers for Disease Control and Prevention (CDC), 2011; Marmot et al., 2011; Agency for Healthcare Research and Quality (AHRQ), 2012). However, there exists only limited knowledge on how such disparities play out in relation to ART treatment. Further, much of the previous research in relation to access to ART treatment has focused on ethnic disparities in the United States which may not reflect socioeconomic disparities and may not be applicable to other settings (Bilder and Schmidt, 2006, 2012; Inhorn and Fakih, 2006; Jain, 2006; Hammoud et al., 2009; McCarthy-Keith et al., 2010; Smith et al., 2011).

Australia has a tradition of supportive public funding of ART treatment through its publically financed health insurance scheme, Medicare. Since 2001, women have been eligible for partial reimbursement of almost all ART and intrauterine insemination (IUI) cycles with no funding limits in relation to number of previous cycles, maternal age, duration of infertility, BMI, smoking etc. However, all cycles funded by Medicare attract an out-of-pocket copayment. Prior to 2010, patient copayments were approximately $1500 Australian dollars (AUD) ($1000) for a fresh embryo transfer IVF cycle (fresh IVF cycle), $800 AUD ($530) for a frozen embryo cycle and $300 AUD ($200) for an IUI cycle. In 2010, the rebates paid by Medicare for ART services were capped as part of the Extended Medicare Safety Net policy (herein referred to as the EMNSCap policy) resulting in copayments increasing to approximately $2500 AUD ($1670) per cycle for a fresh IVF cycle, $1000 AUD ($670) for a frozen cycle and $600 AUD ($400) for an IUI cycle (Chambers et al., 2006, 2012). In a previous policy analysis, we found that the number of fresh IVF cycles was reduced by 21% in the first year after the introduction of the EMNSCap policy, but the demand for cheaper IUI cycles remained unchanged (Chambers et al., 2012).

The aim of this current study was to investigate the utilization of fresh IVF cycles by different socioeconomic groups, and to extend our previous policy analysis by measuring the differential impact of the EMNSCap policy on access to treatment by different socioeconomic groups.

Materials and Methods

Aggregate annual data on the number of fresh IVF cycles between 2007 and 2010 were obtained from a national dataset of all services for which Medicare benefits were paid. A fresh IVF cycle was defined as a cycle where drugs were used to induce ovulation induction with the intention of transferring one or more fresh embryos (regardless of whether IVF or intracytoplasmic injection (ICSI) was used). The data included annual service counts for the two ART Medicare Benefits Schedule (MBS) items that identify a fresh IVF cycle: 13200 before 2010; 13200 and 13201 after 2010 (Australian Government Department of Health and Aging, MBS On line database). Service counts reflect how many times these MBS items have been funded by Medicare. Medicare pays benefits for over 95% of fresh IVF cycles performed in Australia regardless of whether they are performed in a public or private clinic, but does not pay benefits where the ART is not considered to be treatment for a medical condition (e.g. treatment of single women with donated sperm or the creation of embryos for fertility preservation) or where the person undergoing treatment is not eligible for the Australian Medicare system (e.g. patients residing overseas).

The annual service counts were stratified into one of the 667 Australian Local Government Areas (LGAs) in which a patient resided at the time of ART treatment. To preserve patient confidentiality, cell counts were suppressed for LGAs where only 1–4 fresh IVF cycles were undertaken in any given year. An upper and lower utilization range for these cells were calculated by assigning a value of either 1 or 4 based on the possible minimum and maximum impact of the EMNSCap policy.

Socioeconomic status (SES) was assigned to the LGA using the Australian Bureau of Statistics (ABS) Socioeconomic Index for Areas (SEIFA) (Australian Bureau of Statistics (ABS), 2008). SEIFAs use census data to assign summary measures of socioeconomic conditions in a small geographic area, and are used to construct four socioeconomic indices. We used the Index of Relative Socio-economic Advantage and Disadvantage (ISRAD) based on 2006 census data, which include ‘disadvantage’ variables associated with low income, unemployment, low-status occupations and low education, and ‘advantage’ variables associated with high income, well-paid occupations, high education and high wealth. The ISRAD index was chosen over the other indices because of wider differentiation across the whole socioeconomic spectrum (Australian Bureau of Statistics (ABS), 2011), and because being either disadvantaged or advantaged could influence the likelihood of accessing ART treatment.

The relative SES for women undergoing ART was categorized into quintiles, with those living in the 20% most disadvantaged areas given a quintile score of 1 and those living in the 20% most advantaged areas given a quintile score of 5. Annual utilization of fresh IVF cycles was calculated per 1000 women of reproductive age (15–44 years) within each LGA based on ABS data to assign summary measures of socioeconomic conditions in a small geographic area, and are used to construct four socioeconomic indices. We used the Index of Relative Socio-economic Advantage and Disadvantage (ISRAD) based on 2006 census data, which include ‘disadvantage’ variables associated with low income, unemployment, low-status occupations and low education, and ‘advantage’ variables associated with high income, well-paid occupations, high education and high wealth. The ISRAD index was chosen over the other indices because of wider differentiation across the whole socioeconomic spectrum (Australian Bureau of Statistics (ABS), 2011), and because being either disadvantaged or advantaged could influence the likelihood of accessing ART treatment.

The relative SES for women undergoing ART was categorized into quintiles, with those living in the 20% most disadvantaged areas given a quintile score of 1 and those living in the 20% most advantaged areas given a quintile score of 5. Annual utilization of fresh IVF cycles was calculated per 1000 women of reproductive age (15–44 years) within each LGA based on ABS Resided Estimated Population by 5-year age groups and sex (Australian Bureau of Statistics (ABS), 2009). To measure the impact on ART utilization after the introduction of the EMNSCap policy in January 2010, the absolute and percentage changes in fresh IVF cycles from 2009 to 2010 were calculated for each SES quintile.

In addition to the cost of treatment, a number of other factors are likely to influence the utilization of ART treatments among SES groups, in particular the ‘need’ for fertility treatment and treatment seeking behaviour. In developed countries such as Australia, need for ART is correlated with trends in the maternal age of childbearing with age-related subfertility being a major driver of need for ART treatment. To investigate differences in the need for fertility treatment among SES groups in Australia, we obtained data from the National Perinatal Data Collection on the proportion of mothers...
aged 35 or older among first time mothers by SEIFA derived SES quintiles during the study period. This proportion served as a proxy for the need for infertility treatment among SES groups and also allowed us to assess if the need remained constant (time-invariant) before and after the policy. Both observations provide a basis for interpreting the impact of the EMSNCap policy on utilization (Gertler et al., 2011). In addition, we included national time series data on clomiphene citrate prescriptions and IUI cycles between 2007 and 2011 to measure the overall background demand for fertility treatment and to detect treatment substitutions for ARTs as a result of the EMSNCap policy. Clomiphene citrate is not subject to the EMSNCap policy, and while IUI is subject to the EMSNCap policy, it remains a significantly cheaper treatment than ART and, in cases of non-tubal infertility, can act as a potential substitute. Aggregate quarterly data on the numbers of scripts for clomiphene citrate tablets claimed through the Pharmaceutical Benefits Scheme (PBS) were obtained from the Australian Government’s Medicare Information Service Branch (PBS Code 1211R). IUI utilization was sourced from the national dataset of all services for which Medicare benefits were paid, and has been described as part of our previous policy analysis (Chambers et al., 2012).

Ethics approval for this project was obtained from The University of New South Wales, Human Research Ethics Committee and the Australian Government, Department of Human Services External Request Ethics Committee.

Results

The number of fresh IVF cycles undertaken in Australia during 2007–2010 was 30,603, 34,270, 40,017 and 31,504, respectively. The corresponding upper and lower estimates of fresh IVF cycles undertaken per 1000 women by SES quintiles for the same years are presented in Fig. 1. Women in the two higher SES groups used fresh IVF cycles more than women in the lower SES groups regardless of the

EMNSCap policy introduced in 2010. For example, women in the highest SES quintile (SES Q5) were almost twice as likely to undertake ART treatment as those in the lowest SES quintile (SES Q1), with 2009 upper estimates of 5.17, 6.04, 5.92, 7.38 and 10.13 cycles per 1000 women of reproductive age for SES quintiles 1 to 5, respectively. Lower SES groups displayed wider upper and lower utilization ranges because of the greater proportion of LGAs with suppressed small cell sizes (Table I).

The proportion of mothers aged 35 years or older among all first time mothers was increasingly greater in higher SES quintiles (Fig. 2). For example, of all first time mothers in 2009, the proportion aged 35 years or older ranged from one in twelve (8.3%) in SES Q1 to almost one in four (21.5%) in SES Q5. This indicates that the need for fertility treatments, particularly relating to age-related subfertility, is likely greater in higher SES groups and may partially explain the higher rates of ART utilization in these groups. The fact that these trends were stable across time suggests that any changes in utilization rates in 2010 were related to the EMSNCap policy.

Prior to the introduction of the EMSNCap, all SES quintiles showed increasing annual utilization of fresh IVF cycles. Following the EMSNCap, the mid-range estimate for the decrease in fresh IVF cycles in 2010 was 21% for quintiles 2 and 5, 22% for quintiles 1 and 4 and 25% for quintile 3. However, the absolute numbers of fresh IVF cycles performed after the introduction of the EMSNCap decreased more in the higher SES quintiles; 1.07, 1.22, 1.43, 1.63 and 2.08 fewer fresh IVF cycles per 1000 women of reproductive age in SES quintiles 1 to 5, respectively (Table I). There was also a statistically significant (paired t-test; \( P < 0.01 \)) decrease in the number of fresh IVF cycles per 1000 women of reproductive age across the average of all individual LGAs for each of the SES quintiles. Therefore, in relative terms all socioeconomic groups were similarly adversely impacted by the EMSNCap policy but

![Figure 1](https://academic.oup.com/humrep/article-abstract/28/11/3111/627667)

**Figure 1** Utilization of fresh ART cycles by socioeconomic status (SES), Australia 2007–2010. Source: Medicare Information Service Branch. Notes: The upper and lower range of the Extended Medicare Safety Net Cap (EMSNCap) policy impact is shown by the narrow vertical lines. This is based on minimum and maximum values for suppressed cell counts for Local Government Areas (LGAs) recording between 1 and 4 annual fresh IVF cycles.
Table I  Fresh IVF cycles per 1000 women of reproductive age (15–44 years) by SES quintile, Australia 2007–2010.

<table>
<thead>
<tr>
<th>SES Q1 (most disadvantaged)</th>
<th>SES Q2</th>
<th>SES Q3</th>
<th>SES Q4</th>
<th>SES Q5 (most advantaged)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2007</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Range</td>
<td>3.15–4.00</td>
<td>4.29–4.80</td>
<td>4.85–5.28</td>
<td>5.63–5.69</td>
</tr>
<tr>
<td>Suppressed cells (%)</td>
<td>24.1</td>
<td>47.8</td>
<td>36.1</td>
<td>18.7</td>
</tr>
<tr>
<td><strong>2008</strong></td>
<td></td>
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<tr>
<td>Suppressed cells (%)</td>
<td>24.1</td>
<td>43.3</td>
<td>36.8</td>
<td>20.2</td>
</tr>
<tr>
<td><strong>2009</strong></td>
<td></td>
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<tr>
<td>Suppressed cells (%)</td>
<td>24.1</td>
<td>47.8</td>
<td>36.1</td>
<td>18.7</td>
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<tr>
<td><strong>2010</strong></td>
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<tr>
<td>Range</td>
<td>3.38–4.05</td>
<td>4.35–4.77</td>
<td>4.11–4.49</td>
<td>5.71–5.75</td>
</tr>
<tr>
<td>Suppressed cells (%)</td>
<td>25.6</td>
<td>45.5</td>
<td>39.1</td>
<td>17.9</td>
</tr>
<tr>
<td><strong>Change in utilization 2009–2010</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>−1.02 to −1.12</td>
<td>−1.18 to −1.27</td>
<td>−1.42 to −1.43</td>
<td>−1.62 to −1.63</td>
</tr>
<tr>
<td>Avr percentage change</td>
<td>−22%</td>
<td>−21%</td>
<td>−25%</td>
<td>−22%</td>
</tr>
</tbody>
</table>

Range is the upper and lower bound of the number of fresh IVF cycles per 1000 women of reproductive age after assigning values of either 1 or 4 to suppressed cells, indicating the minimum and maximum impact of the EMSNCap policy. Suppressed cells are those Local Government Areas (LGAs) recording between 1 and 4 annual fresh IVF cycles. SES, socioeconomic status.

Figure 2  Proportion of mothers aged 35 or older among first time mothers by (SES), Australia, 2007–2010. Source: Australian Institute of Health and Welfare (AIHW) National Perinatal Data Collection. Socioeconomic status Quintiles (SES Q) based on the Australian Bureau of Statistics (ABS) Socioeconomic Index for Areas (SEIFA) Index of Relative Socioeconomic Disadvantage 2006, population-based, using Australian cut-offs.
the higher socioeconomic groups experienced a greater reduction in absolute numbers of cycles, with the decrease in the highest SES quintile being two times that of the lowest SES quintile.

To assess if overall demand for fertility services, not just ARTs, altered over the study period of the study and whether the EMSNCap policy caused a substitution effect between different types of fertility treatments, we assessed clomiphene citrate scripts and IUI cycles between 2007 and 2011 (Fig. 3). We found that utilization of both these forms of fertility treatment did not change, indicating that the underlying demand for fertility treatment did not change as a result of the EMSNCaps and that substitution between ART and IUI did not occur.

**Discussion**

We found that fresh IVF cycles were concentrated in the two highest SES quintiles regardless of the introduction of the EMNSCap policy, which increased out-of-pocket costs for ART treatment. The rate of utilization was almost twice as high in the highest SES quintile as in the lowest SES quintile. This may reflect a greater ability to pay for treatment as well as a greater need for fertility treatment in higher socioeconomic groups who tend to exhibit delayed childbearing patterns and thus are at greater risk of age-related subfertility. Further, a recent study from the UK found that while the incidence of infertility was similar among SES groups, there were significantly higher age-specific estimates for women aged 25–40 years in higher SES groups, likely exaggerated by delaying conception (Dhalwani et al., 2013).

The 21–25% decrease in the uptake of ART treatment among all SES groups suggests that out-of-pocket costs per ART cycle of $2500 AUD (€1670), the estimated average out-of-pocket costs in 2010, remain financially prohibitive for many couples requiring treatment. However, while financial factors such as income and insurance status undoubtedly play a pivotal role in the likelihood of accessing expensive fertility treatments such as ART, studies have shown that disparities in fertility treatment persist even after adjusting for financial factors, with ART treatment more likely to be used by older, more educated Caucasian women (Bitler and Schmidt, 2006, 2012; Jain, 2006; White et al., 2006; McCarthy-Keith et al., 2010). This phenomenon is not restricted to fertility treatment, with disparities in access to healthcare and health outcomes persisting in a number of areas of healthcare despite financial barriers being minimized, such as vaccination and screening (Gornick, 2000). A number of studies using national data have shown that despite lower SES groups making significantly more frequent visits to publically-insured primary care services, they are significantly less likely than the higher socioeconomic groups to make use of publically-insured specialist services, of which ART services would be categorized (Dunlop et al., 2000; Van Doorslaer et al., 2008). Public health policies additional to those that increase healthcare affordability are needed to reduce such disparities in equity of access.

The aim of the EMSNCaps was to reduce the rate of growth in Medicare payments for out-of-hospital services where there was evidence of excessive increases in fees. An analysis of EMSN payments prior to the introduction of the caps on Medicare benefits found that women in higher socioeconomic groups were over-represented among EMSN payments and that the EMSN had not made Medicare services more affordable for those living in poorer areas (Australian Government Department of Health and Ageing, 2006). Our analysis shows that the
introduction of the EMSNCaps did not ameliorate this phenomenon in relation to ART treatments, with all SES quintiles being equally impacted in terms of the percentage reduction in women accessing treatment in the first 12 months after the policy. Indeed trends in the age of childbearing among SES quintiles suggests that the need for fertility treatment and thus access to ARTs would be expected to be greater in higher socioeconomic groups. The fact that demand for IUI and clomiphene citrate scripts did not alter as a consequence of the EMSNCap policy indicates that demand for fertility treatment remained steady over the 4-year period of the study, that there was little substitution between ART and less advanced forms of fertility treatment, and most importantly, that women who were not successful with either clomiphene citrate or IUI were less likely to progress to ART. Similar findings in relation to demand for clomiphene citrate after the introduction of ART co-payments have been reported in Germany (Connolly et al., 2009).

There has been a focus in recent years on the pressing need to ameliorate disparities in the use of many healthcare services (Centers for Disease Control and Prevention (CDC), 2011; Marmot et al., 2011; Agency for Healthcare Research and Quality (AHRQ), 2012). Our study shows that even in a country that has supportive public funding for ART, socioeconomic disparities in access to treatment persist, and while financial factors are important, disparities in utilization are also likely due in part to differences in childbearing patterns and treatment seeking behaviour.

The findings from this study may not be generalizable to other settings because of different funding systems and population characteristics, but to our knowledge this is the first study to assess the differential impact of increased ART consumer costs on women from different socioeconomic groups. Policy makers should be informed that the demand for ART treatment among socioeconomic groups likely varies, and that when the level of cost subsidization for ART treatment is reduced, all socioeconomic groups can be expected to be adversely affected to a similar degree. Finally more studies are needed to fully understand differences in the burden of infertility among different socioeconomic groups and effective ways of ameliorating inequalities in access to care.

Authors’ roles
All authors were responsible for the study concept and design and interpretation of the data. Drs G.M.C. and V.P.H. were responsible for acquisition of data and data analysis. Dr G.M.C. was responsible for drafting the manuscript, and all authors were responsible for critically revising the manuscript.

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Conflict of interest
V.P.H. is employed as an Economics Research Associate on the same grant. P.J.I. is Medical Director of the IVF Clinic, IVFAustralia and has a financial interest in the parent group, Virtus.

References


