GOVERNMENT EXPENDITURE ON IVF PROGRAMS: AN EXPLORATORY STUDY*

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The technology of IVF not only presents society with a range of social and ethical difficulties, but also consumes vast resources from the 'public purse'. This paper provides an estimate of recent government expenditure on IVF programs and argues that the $32 million figure arrived at is far short of the actual sums involved. Pregnancy rates are also examined, and the conclusion is reached that on average 34 treatment cycles are required to produce one pregnancy which results in the birth of a baby that is is not premature, defective or dead at birth.

Keywords: IVF, reproductive technology, government funding, public costs.

INTRODUCTION

In Australia we spend about 7.5 per cent of the gross domestic product on medical care.[1] Over the last ten years this expenditure has remained relatively stable, even though a variety of high cost, high technology practices have been introduced. As a result there have been severe shortages and stresses in the system, particularly in regard to the provision of standard care to disabled and elderly people. In this situation, which is by no means unique to Australia, there is an obvious need to assess the newer high technology practices so as to determine just where their costs and benefits for the community lie.

In addition to the competition for resources between high technology practices and routine medical care, there has been considerable public concern about some of the newer technologies for reasons of ethics and morality. This concern also has an international dimension and is not limited to Australia. It has surfaced over heart transplants, including the use of artificial and animal hearts, over neonatal intensive care, and in particular regarding the new reproductive technology of in vitro fertilisation (IVF).

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When public concern about the ethics of a new medical technology overlaps with questioning about its financial cost to the community, it is time to bring both aspects into the public arena. In the case of IVF the ethical and social issues have been aired quite adequately,[2] and legislative responses to the technology have been initiated both at the state and federal level.[3] But discussions about the costs of the technology to the community are still lacking. In part this is explained by the difficulty of determining government expenditure on the numerous IVF treatments that have been carried out in Australia. The committee of inquiry into IVF set up by the Family Law Council under the chairmanship of Justice Asche has commented that:

> Both reproductive technology and technological conceptions are only made possible through the allocation of substantial resources by the community . . . Despite extensive enquiries, this Committee has been unable to elicit any accurate figures as to the cost to the public purse of reproductive technology research and programs.[4]

The cost of an IVF treatment to an individual patient is known somewhat better. Carl Wood and Alan Trounson, the leaders of Australia's foremost IVF program operated through Monash University and the Queen Victoria Medical Centre in Melbourne, put this figure at around $4000.[5] Part of this sum is recovered by the patient through Medicare, and if she is insured privately, her personal outlay for IVF treatment is reduced further still. But this three-way funding arrangement is currently under threat. The Medicare Review Committee chaired by Judge Robyn Layton recommended at the end of 1985 that Medicare benefits should not be payable for IVF, and that the Health Insurance Act should be amended so as to preclude the "payment of Medicare benefits for medical services included in or associated with IVF programs".[6] Instead, according to this Committee, the appropriate mode of government funding would be through Health Program Grants to a limited number of IVF centres.

The IVF practitioners are not satisfied with these recommendations and have attempted to lobby the government for an increased contribution by Medicare to IVF:

> Patients who suffer from motor-car or bicycle accidents, often self-inflicted, may require multiple medical treatments of a complex nature, which are far more expensive than is in vitro fertilisation and yet gain government rebates for medical treatment. Why should a couple, who want to add another child to our population, be discriminated against? Most often the cause of infertility is unavoidable.[7]

As yet the Australian government has not decided how it will fund IVF in the future and is at present carrying out investigations to determine what sums are involved.[8] Until now the situation has been that in the absence of an explicit government policy on IVF,

government funding for the treatments has come largely through Medicare rebates. But in view of the considerable public concern about the extent and implications of IVF technology, the issue of government expenditure on this technology should be brought out into the open. It is in this spirit that the present paper is offered. It sets out to calculate at current prices the cost of a typical IVF treatment cycle, and in particular the direct contribution to this cost by the government. Furthermore, an estimate is made of the number of such treatment cycles performed in Australia in the first five years of the technology's operation, that is, in the period 1980 to 1984. Multiplying these two amounts, that is the cost to the government per treatment cycle and the number of such cycles, yields the direct government expenditure in Australia for IVF treatments in the period considered. This estimate turns out to be of the order of $32 million, indicating that IVF technology involves a considerable amount of government expenditure. It is argued also that this amount is in fact an underestimate in that it does not take into account a variety of hidden costs. In addition there is also a non-government public contribution to the funding of IVF, primarily through private health insurance schemes, but this aspect of public funding is not considered in the present paper.

In a subsequent part of the paper we go on to consider the number of babies born as a result of IVF and the nature of the pregnancies brought about by the treatment. It will be seen that IVF pregnancies are frequently problematic. Multiple pregnancies are a direct consequence of the technology and they lead to a high proportion of premature babies, who generally require expensive neonatal intensive care. There is an enormous cost borne by the community in this regard as well, and in any comprehensive account of the public expenditure on IVF these complications should be included. As yet the data are not available to carry out such a calculation, and so we merely point out the numbers of babies involved.

Thus the estimate provided here of $32 million in government expenditure on IVF in its first five years of operation is a very low estimate. It does not take into account the government expenditure over and above the direct cost of treatment cycles, nor the expenditure of the government in regard to the pregnancy and birth complicatons which are frequently associated with IVF treatments, nor the non-government public expenditure on IVF treatments and babies. But in spite of these limitations, the present exercise to provide as much detail as possible on government funding of IVF programs is worthwhile, since cost is an important factor in public policy, and decision-making in this controversial area of technology should take into account not only the various medical, ethical and legal arguments, but the cost estimates as well.

THE COST OF THE IVF TREATMENT CYCLE

In the abstract, IVF technology appears quite straightforward. Eggs are collected from the prospective mother while sperm is produced by her husband. The eggs and the sperm are then placed together in a laboratory dish where conception takes place, and the resulting embryo is transferred to the woman's womb so that it can be nurtured there for the duration of the pregnancy. In practice, however, these steps are far from simple and require a great deal of technical control and fine-tuning. As with other sophisticated technologies, in order to estimate the financial costs of IVF it is necessary to elaborate the multitude of technical details involved. For this reason we shall work through the separate steps comprising the IVF treatment cycle point by point.[9] It should be noted that this technology has not yet become routinised and so different IVF programs employ somewhat different treatment schedules. Moreover, within each program the treatments can vary considerably depending on how the patient's own metabolism interacts with the medication administered and the procedures applied. But basically the IVF treatment cycle consists of the same four stages and we shall now deal with each of these in turn.

Many of the steps in an IVF treatment are similar to procedures in other areas of obstetric and gynecological care. So while IVF at present does not draw a specific Medicare benefit, and indeed the Layton Committee of Inquiry has recommended that it not do so, many of the steps comprising the IVF treatment cycle are routinely charged through the Medicare system. So in addition to listing the various procedures involved in an IVF treatment cycle, we will also examine in current prices the cost of the treatment and the direct contribution by the government to it. This information is summarised in Tables 1 and 2.

Pre-laparoscopy

As is well known, the ova or egg cells are produced in the ovary. More specifically, they are produced in pretruberances on the surface of the ovary called Graafian follicles, or follicles for short. Under normal circumstances, in the sexually mature woman one egg ripens every month and is released from its follicle in a process called ovulation. Both the growth of the follicle and the timing of ovulation are tightly controlled by hormones which are produced in the pituitary gland of the brain. Moreover, as the follicle grows, it too produces a hormone. This is oestrogen and its level in the blood is indicative of how far the development of the follicle has progressed.

IVF programs are of two basic types. In one of these, follicle growth is closely *monitored,* but it is not interfered with through

additional hormonal input. However, just before the ripe egg would be released from its developing follicle, an operation called laparoscopy is performed in which the follicle is punctured and the egg is withdrawn. This removes the ripe egg from the woman's body so that fertilisation outside the body can then be carried out. In the second type of IVF, the same operation is performed, but here the growth of the follicile is not just observed but also *controlled.* This is achieved by administering additional ovulatory hormones and so the process is often referred to as superovulation.

Although the first IVF birth in the world was achieved by the method of monitoring only, the alternative method of external hormonal control is now the preferred option. This method has the additional feature that due to the higher than normal levels of hormones, not only one egg is produced during the cycle, but quite a number of them. Several eggs can then be collected from the woman undergoing laparoscopy and following fertilisation of these eggs, this yields quite a number of embryos per treatment cycle. In general, more than one of the embryos is then transferred to the woman's uterus, and this is the reason for the high incidence of multiple pregnancies in IVF programs.

Superovulation is usually brought about by two hormone preparations given either separately or jointly.[10] One of these is clomiphene citrate (trade name Clomid) and the other is human menopausal gonadotrophin (HMG, trade name Pergonal). Hormone treatment generally proceeds for five to six days. During this time the patients consume two boxes of Clomid tablets and are injected with up to twenty ampoules of Pergonal. Generally Pergonal is made available by the IVF clinic to the patients free of charge, while Clomid is purchased by the patient. The current bulk price of Pergonal is $14 per ampoule, and the Clomid tablets cost patients $25.65, with a pharmaceutical benefit payable by the government of $1.02. In addition, the patients are normally billed for about six clinical visits, with a scheduled fee of $23.50 and a rebate of $20 (Medicare Benefits Schedule (MBS) item 94).[11] This information is summarised in Table 1.

After superovulation it is essential for the IVF practitioners to keep a close watch over the growth and ripening of the ovarian follicles, so that the time of ovulation can be predicted accurately. Several tests have been developed to achieve this. The most reliable of these tests measures the level of oestrogen (or oestradiol) in the blood stream, based on the knowledge that as the follicles develop, they release increasing amounts of oestrogen. Second, the level of luteinising hormone (LH) is also indicative of the approach of ovulation. In the natural system the concentration of this hormone rises dramatically one and a half days before ovulation, a phenomenon which is known

TABLE 1
Typical costs associated with the Pre-laparoscopy stage of the IVF treatment cycle.[a]

Treatment[b]		Cost of treatment[c]		Government contribution	
	Number	Unit cost $	Total $	Unit cost $	Total $
Superovulation					
Pergonal	20	14.00	280	14.00	280
Clomid	2	26.00	52	1.00	2
Consultations(#94)	6	23.50	141	20.00	120
Hormone monitoring					
Oestradiol (#1476)	8	42.75	342	36.35	291
LH (#1453)	11	25.90	285	22.05	243
Progesterone (#2295[5])	7	25.90	181	22.05	154
Ultrasound (#793)	2	102.00	204	86.00	172
Gonadex			20		20
Semen analysis (#2216)	1	25.90	26	22.05	22
Hospitalisation	5	230.00	1,150	125.00	625
Total			2,681		1,929

(a) Expenditures are calculated in 1987 prices based on information supplied by the Commonwealth Department of Health. Also see Department of Health. *Medicare Benefits Schedule Book,* 1 November 1986. Details of the calculations are provided in the text.
(b) Where appropriate Medicare Benefits Schedule (MBS) items are shown in brackets.
(c) The difference between the cost of treatment and the government contribution is met by the patient and/or her private health insurance.

as the LH surge. In IVF programs the approach of the LH surge is monitored by measuring the level of luteinising hormone.

There is considerable variation in the number of oestradiol and LH diagnostic tests carried out in a treatment cycle by the various IVF groups. For example, one centre administers 24 tests measuring oestradiol (MBS item 1476, scheduled fee $42.75, rebate $36.35) and 12 tests measuring LH (MBS item 1453, scheduled fee $25.90, rebate $22.05). In another centre only 8 tests at MBS item 1453 are billed. A third centre administers 12 tests at item 1453 and 22 tests at item number 2295(5) which carries the same cost. For the purpose of our calculation shown in Table 1 we have taken an average for the number of tests done at these three centres.

In addition to checking the onset of ovulation by hormonal means, ultrasound detection of the growing follicles is also employed. Two ultrasound techniques are now available in Australia for assessing the increase in size of the follicles on the surface of the ovary. In the traditional method the bladder is fully inflated and the ultrasound device is passed across the abdomen. By contrast, in the newer method the ultrasound probe is inserted into the vagina, which obviates the need for a completely filled bladder. The change in methodology has been brought about by a change in the design of the equipment. The new ultrasound equipment has been developed quite recently, around 1985, by two companies working in close association with established IVF teams. General Electric has collaborated on this project with the IVF team at Monash University under the direction of Professor Carl Wood and Dr. Alan Trounson, and the Australian company Ausonics has developed its equipment in association with the Royal North Shore Hospital IVF Clinic headed by Professor Douglas Saunders. The two ultrasound methods also have different institutional settings. Whereas abdominal ultrasound screening is traditionally performed in a hospital setting, the newer so-called 'vaginal tracking' method, tends to be carried out in the private rooms of radiographers and sonographers. The frequency of administration also differs. Abdominal screening is generally performed twice during an IVF cycle, and vaginal tracking is conducted on a daily basis for ten days. Since the newer diagnostic method does not yet have an MBS item number, patients are billed according to the traditional technology (MBS item 793, scheduled fee $102, rebate $86).

There are thus three methods which are used jointly in IVF programs to monitor and assess the growth and ripening of the ovarian follicles and of the eggs within them. They are measurement of the oestrogen level, detection of the LH surge, and examination of the size of follicles by ultrasound. On the basis of the various estimates obtained, the time of ovulation, that is the release of the ripe eggs from the follicles, can be predicted. Further, by knowing the expected time of ovulation, the IVF clinician can schedule the operation for egg retrieval, that is the laparoscopy, to take place just before ovulation.

But as we have noted in regard to the induction of follicle development by hormonal superovulation, so here too, monitoring alone is increasingly giving way to monitoring augmented by external control. To ensure that the follicles and the egg cells within them are actually ripe for collection, general practice now is to precede laparoscopy by the injection of a further hormone which is known to induce the final step of follicle maturation. The hormone is called human chorionic gonadotrophin (HCG, trade name Gonadex) and the laparoscopy operation is scheduled for 35 hours after this injection.

Gonadex is provided to the patient free of charge by the hospital and the cost to the government per treatment is around $20.

By contrast to the woman undergoing IVF treatment, her husband is not involved to anywhere near the same extent, and therefore there are only minimal charges associated with his participation in the program. However as part of the program a semen analysis is generally carried out (MBS item 2216, scheduled fee $25.90, rebate $22.05).

By the end of the monitoring stage in the IVF treatment cycle, the patients have generally entered hospital where they stay for about five days. For both private and public patients the government now contributes to the cost of hospitalisation through Medicare grants and identified health grants to state governments. Until recently the government contribution was calculated on the basis of a bed-day subsidy set at $125.

We are now in a position to determine the typical cost of the pre-laparoscopy stage of the IVF treatment cycle. Table 1 above shows that this cost amounts to $2,681, with a direct government contribution of $1,929.

Laparoscopy

As was mentioned before, laparoscopy is the name given to the operation in which the ripe eggs are removed from the ovarian follicles. In fact, the technique of laparoscopy was not developed for purposes of IVF, but was used initially for examining the ovaries and the Fallopian tubes, and also for sterilizing women by means of cutting through these tubes. Laparoscopy came into the domain of IVF, and indeed made this scientific and clinical domain possible, when the British embryologist Robert Edwards of Cambridge University learned about the high level skills of the obstetrician Patrick Steptoe at the then newly developed technique of laparoscopy.[12] The collaboration between Edwards and Steptoe started in 1975 and is still continuing at their very successful private IVF Clinic in Cambridge, UK. Laparoscopy necessitates a general anaesthetic and is performed in an operating theatre. The operation requires the services of a surgeon and an anesthetist (MBS items 514 and 4194, with scheduled fees of $225 and $65, and rebates of $205 and $55, respectively). The costs involved in this step and in the subsequent steps of the IVF treatment cycle are summarised in Table 2.

So far we have detailed and costed the IVF treatment cycle up to the point where the ripe eggs have been collected from the ovary and are available for fertilization *in vitro*. Before proceeding to this next stage it might be informative to pause and consider the success rates that are

generally achieved up to this stage of egg collection. Usually IVF practitioners present their data on successes achieved in terms of pregnancies, and thus there is not much data available on the proportion of cases in which the hormonal workup and laparoscopy actually lead to the collection of viable eggs. Recently, however, a study was published by a Swedish IVF group working at the University of Lund which pertains directly to this issue.[13]

In this Swedish study 30 women went through the first two stages of IVF described above. But only in 22 of these women were one or more ovarian follicles actually accessible for perforation at the laparoscopy operation. In a further subset of this group comprising 17 women, egg cells could then be collected from the material that was removed from the follicles. This means that in this study only 17 out of 30 women (56.7 per cent) could proceed to the next stage of the treatment cycle. In other words, 43.3 per cent of women reached a point of failure at this early stage without any eggs being collected from their ovaries at laparoscopy. The Swedish team which conducted this study is one of the foremost IVF groups in the world, and there is no reason to assume that this data is not widely applicable. Even if in Australia the ratio of women failing at this early stage of the treatment cycle is lower than 43 per cent, as we have seen expenditure in regard to their treatment is still quite considerable.

Fertilization in vitro

At this stage we have arrived at the point in the IVF treatment cycle where the eggs have been collected. Due to hormonal superovulation more than one egg tends to be obtained from a patient, with the numbers going as high as a dozen. We have mentioned that in the IVF treatment the ovarian follicles have to be punctured for egg collection just before these follicles would burst of their own accord and release the ripe eggs contained within them. This means that the eggs collected at laparoscopy are not as fully ripe as those released during the normal process of ovulation. This inherent shortcoming of the technology has been overcome by means of knowledge gained during the early phases of IVF development. Indeed, one of the technical skills of IVF teams hinges on the group's experience in how to bring about successful egg maturation. This depends on both the fluid in which the eggs are cultured and on the length of time that they are allowed to remain there prior to fertilisation.

During the period of egg culture, a sperm sample has to be produced for use in the external fertilisation step. In the natural process of conception, sperm travels right up the female reproductive tract from the vagina, through the uterus, and up into the Fallopian tubes where fertilization normally takes place. During this journey the

sperm undergoes a process called capacitation which enables it to praticipate in the fertilization event. Indeed, early attempts at human IVF failed because sperm capacitation could not be mimicked in the laboratory. But as a result of extensive research this limitation has now been overcome, with precise methods worked out for the preparation of fertilizing sperm samples.

When the ova are judged to be properly matured, each egg is placed with over a hundred thousand sperm in a culture dish containing a well-defined liquid medium. Here too, extensive research was required to perfect the culture conditions. After the sperm has penetrated the egg, the resulting embryo is cultured for a period of about forty hours. In most IVF programs, the conditions for culturing the embryos are different to the culture conditions of the fertilization step and to those for ovum maturation. Though by now all these conditions are quite well defined, a great deal of research has fed into this knowledge. This was expensive research, since it was both labour intensive and highly skilled. Moreover, each IVF group has had to go through this learning and experimenting process quite separately, as this kind of hands-on localized knowledge is difficult to share and pass on. It would be very interesting to know how much it has cost the community to set up the 13 IVF centres currently operating in the country. But as in most areas of research and development conducted in universities and hospital research centres, the costs involved in setting up and maintaining a particular program are largely untraceable.

Although the culture conditions for eggs, sperm and embryos have by now been standardised in the various programs as a result of the research we have outlined, nevertheless each clinical treatment requires a great deal of manipulation of these delicate biological materials. Even at a routine level, this is highly exacting work. In the United States, the American Fertility Society has been particularly conscious of this and has recommended the following minimal standards for IVF teams:

> Everyone agrees that it takes a large experimental team of 12 to 20 people to run a successful program. It is very labor intensive. . . A team should include a person with formal training in reproductive technology, a reproductive biologist who is experienced in sperm and egg collection, fertilisation and early cleavage in both humans and animals, a person with extensive experience in gynecological laparoscopy who is technically capable of getting eggs, and a person with experience in male infertility and egg handling.[14]

With these inbuilt costs, it is undoubtedly the case that in the Australian health care system the public purse subsidises the patients' treatment in regard to the highly skilled laboratory procedures of egg maturation, sperm preparation, fertilisation in vitro, embryo culture

and embryo assessment. In addition to the staff time involved, the cost of the equipment and of the consumable culture media is quite substantial. This is not to say that the individual patients do not pay at all for the laboratory part of their IVF treatment cycle. But their contribution probably covers only a fraction of the real cost. Moreover, the patients are not billed directly for the complicated laboratory steps enumerated above, since currently there is no Medicare rebate in respect of these steps. Because of this, if the patients were billed directly, they would incur considerable out-of-pocket expenses. The IVF practitioners aim to avoid this, and so they recommend to their patients that they pay for the laboratory steps by means of a tax-deductible 'donation' made out to the research program associated with the IVF clinic. This device obviously ensures that individual IVF patients do not have to pay the entire bill out of their own resources. Instead, depending on the taxation bracket that they are in, they can recoup a significant part of their expenses from the government by means of a tax deduction. At the Royal North Shore Hospital IVF Clinic the donation is set at $500,[14] which we will take as indicative. Assuming that patients recoup half their donation through a tax deduction, the direct cost to the government is $250 per treatment.

Embryo transfer and the assessment of pregnancy

During the process of in vitro embryo culture, the IVF practitioners have to judge whether or not the embryos are developing satisfactorily in their culture vessels. If the embryos appear to be viable, the treatment then proceeds to the insertion of the embryos into the woman's uterus through her vagina and cervix. It should be mentioned again that it is now usual practice to transfer two, three or four embryos in a single treatment cycle.

Embryo transfer is a delicate operation replete with pitfalls. If the embryos are introduced into the uterus in too much culture fluid it is likely that the uterus will contract and expel them. By contrast, if the embryos are suspended in too little fluid, it is more difficult to propel them out of the transfer machinery and into the uterus. It can also happen that one or more of the embryos introduced into the uterus do not remain there but rather lodge themselves in the Fallopian tubes which connect the uterus to the ovaries. This leads to a so-called ectopic pregnancy, which has to be terminated as promptly as possible for fear that the Fallopian tube will burst and endanger the woman. The next section on pregnancy rates notes the high number of ectopic pregnancies in IVF programs.

There is no specific MBS item number for the transfer of embryos into the womb, and so patients are charged under a variety of

substitute items such as 88, 94 and 963. A typical cost for the embryo transfer procedure is $47, with a rebate of $40. After embryo transfer has been performed, a pregnancy may or may not establish itself. Even when an early pregnancy is detected, a menstrual period often occurs in the next two weeks and flushes out the inserted embryos. In a normal conception a woman first suspects that she may be pregnant if her menstrual period does not arrive at the expected time. By contrast, in IVF programs pregnancy tests are conducted well before the time of the expected period. These are chemical tests, and they are based on the levels of the hormones chorionic gonadotrophin, oestrogen and progesterone. If they yield a positive result, the woman is considered to have achieved an IVF pregnancy. In most cases an ultrasound examination is also conducted at this stage of the treatment. The typical cost involved in the assessment of pregnancy, based on an average of treatments carried out at several IVF centres, is shown in Table 2. (Relevant MBS items for the hormonal tests have been mentioned before; they are 1453, 2295(5) and 1476.)

TABLE 2

Typical costs of IVF treatments from laparoscopy to assessment of pregnancy[a]

Treatment	Cost of treatment $	Government contribution $
Laparoscopy		
Surgeon (#4194)	225	205
Anaesthetist (#514)	65	55
Fertilisation (Donation)	500	250
Embryo transfer	47	40
Assessment of pregnancy		
LH (#1453)	26	22
Progesterone (#2295[5])	26	22
Oestradiol (#1476)	43	36
Consultation (#94)	23	20
Ultrasound (#793)	102	86
Total	1,057	736

(a) Explanatory notes: see Table 1.

With this we come to the end of our discussion on the steps involved in a single IVF treatment cycle. We have distinguished the various stages involved and estimated the costs of treatment and the direct government contributions. It should be recognised that the real costs

borne by the community will be considerably higher than the direct government contribution since there are a variety of hidden costs. Especially in relation to the laboratory steps of IVF, the set-up costs and overheads of clinical treatments mingle with general running expenses of hospital laboratories and research activities. We have also noted a number of accounting devices used to minimise the out-of-pocket expenses of IVF patients. These include billing for procedures which do not have an MBS item number in terms of procedures which do have such a number, and paying for clinical services by way of tax-deductible donations. It could well be that additional mechanisms are available to transfer the payment for IVF services from individual patients to the government. As it is, we are not in a position to attach figures to these hidden costs of IVF treatments to the public. So we shall simply note that the up-front IVF treatment costs are:

Cost of treatment	$3,738
Direct contribution by the government	$2,665

In the next part of the paper we shall consider the number of treatment cycles required to achieve viable pregnancies. We will also discuss how many babies have been born as a result of Australian IVF programs in the period 1980 to 1984. We can then estimate the number of IVF treatments performed in Australia during this period, and this will allow us to provide at least a rough figure for the expenditure by the government on IVF treatments during this time.

HOW MANY BABIES? HOW MANY TREATMENT CYCLES?

We have noted that the IVF treatment cycle concludes with chemical tests designed to measure the level of those hormones which are generally associated with pregnancy, namely chorionic gonadotrophin and progesterone. If these hormone levels are above average, the woman is considered to be pregnant. Moreover, in the publications of the IVF teams, these early pregnancies, determined on the basis of hormonal assays, are used in calculations of the team's success rates in using the technology. The Monash University IVF team has published recently its cumulative data on the pregnancy rates achieved in the year period 1980 to 1984. Whether or not an IVF pregnancy had occurred was assessed in the following way:

> In this paper we define pregnancy as two positive results of titres for b-human chorionic gonadotrophic (bHCG) hormone, between the 12th and 20th day after the laparoscopy for oocyte recovery. . . A positive titre is defined as a result that is two standard deviations above the baseline sensitivity (2.5 IU/L). Therefore, a serum bHCG concentration of 5 IU/L is the minimum level that is required before a patient is reported to be pregnant.[16]

For the IVF practitioners it was of primary interest to determine whether the pregnancy rate differed between a woman's first attempt at an IVF treatment cycle and her subsequent attempts if her first treatment was unsuccessful. They found that the rate remained remarkable constant at around 13 per cent. On this basis they concluded:

> For IVF to have a significant clinical success rate, patients have to be prepared to undergo several treatment cycles. . . The probability of success is not diminished by repeated past failure; therefore, there is no evidence that there are women who are 'doomed to disappointment' and multiple attempts should be encouraged. . . In order to improve overall success rates it is important to decrease the stress that is involved in each treatment cycle, so that patients will be encouraged to try again.[17]

Half the patients in fact do try again, and over a quarter go through three or more treatment cycles. Altogether in the five year period 1980 to 1984, the Centre performed 1,775 treatment cycles. These resulted in 229 pregnancies, which gives a ratio of treatment cycles to pregnancies of 7.75 to 1. It should be remembered that these are very early pregnancies, defined by a raised level of the hormone b-HCG. The Monash team has not reported how many of these early pregnancies actually led to the birth of babies. But fortunately information of this kind is now available from data assembled by the National Perinatal Statistics Unit located at the University of Sydney under the direction of Dr. Paul Lancaster.

The report published by this Unit in 1985 covers the same five-year period as the paper from the Monash IVF Centre considered above, that is 1980 to 1984.[18] For this period the Unit provides cumulative data on 11 IVF centres in Australia and one in New Zealand. Altogether 909 early, hormonally defined pregnancies had been reported from these centres for the period covered. As mentioned, a considerable proportion of early IVF pregnancies terminate with a menstrual period which occurs at about the normal time in the woman's cycle, as though no treatment had taken place. Several terms have been used to describe this situation, such as chemical pregnancy, biochemical pregnancy, menstrual abortion and preclinical abortion. Out of the 909 pregnancies recorded, 174 or 19.1 per cent terminated in this way. We have also noted that on occasion the embryos transferred into the woman's uterus during an IVF treatment can lodge themselves in her Fallopian tubes. This gives rise to an ectopic pregnancy which has to be terminated immediately by surgery, since otherwise the woman's health is seriously endangered. Out of the 909 early pregnancies recorded, 45 or 5.0 per cent were ectopic.

A further 172 pregnancies or 18.9 per cent terminated by spontaneous abortion before twenty weeks of gestation were completed. If we then subtract from the starting point of 909 early

pregnancies the preclinical abortions, the ectopic pregnancies and the spontaneous abortions, we are left with 518 pregnancies which proceeded beyond twenty weeks of gestation. Traditionally these are referred to as 'viable pregnancies'. However, not all of these resulted in the birth of live babies either, since in 22 of them stillbirths occurred. Thus the original 909 hormonally defined pregnancies reduced to 496 pregnancies (or 54.6 per cent) in which live babies were born.[19] We can tabulate these data as follows:

TABLE 3

Pregnancy outcomes following IVF treatments 1979-1984[a]

Hormonally defined pregnancies		909
preclinical abortions	174	
ectopic pregnancies	45	
abortions before 20 weeks	172	
stillbirths	22	
Unsuccessful outcomes		413
Pregnancies resulting in live births		496

(a) National Perinatal Statistics Unit and Fertility Society of Australia, *In vitro Fertilisation Pregnancies in Australia and New Zealand 1979-1984*, Sydney, 1985, Table 1.

On the basis of these data we can now carry out some interesting costing calculations. As we have seen, at the Monash University IVF Centre 1,775 treatment cycles gave rise to 229 hormonally defined pregnancies, yielding a ratio of 7.75 to 1 for the average number of IVF treatment cycles per hormonally defined pregnancy. During the period 1980 to 1984 a total of 909 hormonally defined pregnancies were recorded for all of Australia, if we leave out as negligible the contribution of New Zealand's single IVF centre. Now with the ratio achieved by the Monash Centre of 7.75 to 1, this would mean that 7,045 treatment cycles would have been required in all of Australia to yield the 909 hormonally defined pregnancies recorded for the period 1980 to 1984. But the Monash University IVF Centre is well known to be by far the most successful centre in Australia, and probably in the world, in regard to hormonal superovulation and monitoring, egg collection, fertilisation in vitro and embryo culture. It stands to reason that the other, less successful IVF centres in Australia have ratios of treatment cycles to hormonally defined pregnancies which are much less favourable, that is greater than 7.75 to 1. In turn, this would mean that overall in Australia considerably more than 7,045 IVF treatment cycles would have been performed in the five year period 1980 to 1984 in order to yield the 909 hormonally defined pregnancies recorded.

Unfortunately no specific information is available on this point, since the Perinatal Statistics Unit does not collect data for the number

of treatment cycles performed in Australia and no IVF centre other than that at Monash University has published any relevant material. However recently the *Business Review Weekly* has suggested that currently between 10,000 and 12,000 treatment cycles are conducted each year.[20] Even if we take into account that in the last couple of years there has been an increase in the number of treatments performed, this estimate supports our view that over the five year period 1980 to 1984 considerably more than 7,045 treatments would have been carried out. Let us then make the reasonable assumption that on average in the IVF programs other than that at Monash University about twice as many treatment cycles per hormonally defined pregnancy were required as at the Monash Centre. This would lead to around 12,000 treatment cycles performed in Australia in the five year period 1980 to 1984.

Now if we multiply this figure with our previously calculated direct contribution by the government for one IVF treatment cycle — that is $2,665 — then we arrive at the staggering figure of $31.98 million for the direct government expenditure on IVF treatments in Australia during the period 1980 to 1984. It should be said again that this is certainly not an overestimate. Our calculations do not include the hidden costs associated with the highly skilled laboratory steps of IVF treatment cycles, in particular the set-up costs and the capital and recurrent costs which are absorbed by the institutions providing the treatment. It is therefore likely that the actual government expenditure is considerably higher than our estimate of $32 million.

It will be recalled that this direct government expenditure was incurred in regard to a dozen IVF programs which resulted in a total of 909 hormonally defined pregnancies. In turn, these pregnancies reduced to 496 which resulted in the birth of live babies. On average therefore, the direct government expenditure for each such pregnancy amounted to $64,500 not including the hidden costs mentioned before. But even if we could include these hidden costs we would still not have arrived at a total government expenditure figure for the IVF babies produced in the period 1980 to 1984. The reason is that even the IVF pregnancies leading to the birth of live babies involve a greater number of complications than normal. For a more accurate estimate of government expenditure, these complications also need to be considered and included in the costing exercise. In the next section we make a start in this direction.

The babies born in IVF programs: deficiencies and costs

In addition to the data we have already used, the Perinatal Statistics Unit also provides valuable information on the pregnancy and birth

complications which accompany IVF pregnancies. We shall turn our attention to multiple pregnancies, premature deliveries and congenital defects. It should be noted that the first two problem areas are linked to each other and are an inherent difficulty of IVF technology. The reason is that in order to raise the chances of pregnancy, it has become standard practice to insert into the woman's uterus more than one embryo at each treatment cycle. But with the insertion of several embryos, multiple pregnancies are frequent, and in turn this often leads to the birth of premature infants.

It has already been mentioned that according to the data provided by the Perinatal Statistics Unit, 518 IVF pregnancies proceeded for longer than twenty weeks of gestation. These were referred to as 'viable' pregnancies, even though a sizable proportion of them — namely 22 — resulted in stillbirths. The data of the Perinatal Statistics Unit are provided in terms of these 518 pregnancies and the following table shows the proportion of multiple pregnancies amongst them.

TABLE 4

Multiple pregnancies following IVF treatments[a]

Type of pregnancy	No. of pregnancies	No. of babies
Single	395	395
Twin	105	210
Triplet	17	51
Quadruplet	1	4
Total	518	660

(a) National Perinatal Statistics Unit and Fertility Society of Australia, *In vitro Fertilisation Pregnancies Australia and New Zealand,* 1979-1984, Sydney, 1985, Table 29.

It is apparent that the proportion of multiple pregnancies is indeed very high following IVF treatment, with almost a quarter of the viable pregnancies being multiple. Multiple pregnancies are considerably more costly than single pregnancies, since in such cases a series of ultrasound examinations are routinely performed and the births are generally by caesarean section. Unfortunately we are not in a position to provide an estimate in respect of the costs associated with multiple pregnancies, but in a more complete study of the total public expenditure on IVF programs, these costs should be taken into consideration as well. Turning now to the babies born, we note that 40 per cent of them result from multiple pregnancies. As can be expected from this, IVF babies are frequently premature. The following table demonstrates this point:

TABLE 5
Prematurity of babies resulting from IVF treatments[a]

Duration of pregnancy	No. of pregnancies	No. of babies
20 - 29 weeks	14	19
30 - 37 weeks	187	301
over 37 weeks	317	340
Total	518	660

(a) National Perinatal Statistics Unit and Fertility Society of Australia, *Fertilisation Pregnancies Australia and New Zealand 1979-1984*, Sydney, 1985, Table 24.

If we take prematurity as birth before 37 completed weeks of gestation, we see that almost half the babies born in IVF programs (48.5 per cent) are premature. Huge costs are associated with prematurely born infants, since they are usually treated in neonatal intensive care units. In 1983 Elisabeth John and her colleagues at Westmead Hospital in Sydney conducted a study on the costs of babies in such units. They found that at that time, and in 1983 dollars, the average cost per baby in an intensive care unit was $8,600, with babies weighing less than 1500 grams at birth costing over $14,000.[21] In the case of the IVF babies, almost half of them were premature and would have required intensive care. Moreover, around 10 per cent were of very low birth weight — that is 1,500 grams or less[22] — and these fall into the particularly costly category. For a precise costing of the prematurity associated with IVF treatment, the proportion of infants in the various weight categories amongst IVF babies and naturally conceived babies should be compared. This will not be attempted here, but we can note that with the high proportion of prematurely born, low birth weight babies in IVF programs, there is a considerable cost involved in their neonatal care which should be taken into account in the full costing of IVF treatments. In regard to the severely premature babies there is also an ongoing community cost, in that such babies often have health problems in later life including respiratory disease, deafness and learning difficulties.

Furthermore, it should also be mentioned that of the 660 babies born as a result of the 518 viable IVF pregnancies, 32 were stillborn or died soon after birth, and a further 10 babies were born with congenital defects. If we include the premature infants, we can then say that only 401 babies (or 61 per cent) were neither dead, defective or premature at birth. By working through the tables in the report of the Perinatal Statistics Unit, we can reconstruct that these 401 babies resulted from 350 pregnancies out of the total 518 so-called viable pregnancies. Therefore almost one third of the IVF pregnancies going

beyond 20 weeks of gestation had the problematic outcome of a premature birth, stillbirth, neonatal death or congenital defect. In the previous section we estimated that around 12,000 IVF treatment cycles would have been performed in Australia in the period 1980 to 1984 to yield 909 hormonally defined pregnancies. Of these 12,000 treatments we are now down to 350 pregnancies which resulted in neither premature infants nor stillbirth, neonatal death or congenital defects. Thus according to our calculations the ratio of IVF treatment cycles to a non-problematic birth outcome is 34 to 1.

CONCLUSION

This paper has focused on the financial contribution of the Federal government to IVF programs. The analysis has been restricted to the five year period 1980 to 1984, since for this period both the Perinatal Statistics Unit and the IVF Centre at Monash University have made relevant information publicly available. We have proceeded step by step through a typical IVF treatment cycle, enumerating for each step both the cost of treatment and the direct contribution by the government. On this basis it was then possible to estimate the total direct expenditure by the government on IVF treatments in the five year period considered.

This came to $32 million, and all along it was noted that this is an underestimate. Not included are a multitude of hidden costs, mostly associated with the actual fertilisation in vitro. It will be recalled that during this stage of the treatment cycle the delicate laboratory steps take place, that is egg maturation, fertilisation itself and the development of the embryo. This is the high technology core of IVF, and it does not overlap with standard practices in the gynecological and obstetric repertoire. Thus Medicare rebates would only cover the procedures involved if a special government decision were made in this regard. As we have noted, the Medicare Benefits Review Committee of 1985 specifically recommended against this course of action. In the absence of a Medicare rebate, the patients pay for this stage of their treatment by way of a tax-deductible donation, and we have attributed half of this to the government. Thus in our calculation the government contributes $250 for the laboratory steps of IVF.

But even the full donation of $500 does not cover the real cost of this part of the treatment, let alone the costs involved in setting up the skilled teams and the necessary laboratory equipment. As was mentioned, each of the dozen Australian IVF teams had to go through the expensive learning phase on its own, since hands-on tacit knowledge is required in gaining the necessary skills at manipulating the fertilisation event and the in vitro culturing of the embryo. The costs were borne by the hospitals — mostly university affiliated —

where IVF centres were established. Thus the costs were met through public and mostly government expenditure, but in the present exercise no figure could be put on this expenditure. It would, however, inflate our estimate of $32 million considerably.

A further element in public funding of IVF programs which could also not be quantified here hinges on the dual problem of multiple pregnancies and premature babies. While the current practice is maintained of inserting three or four embryos into the patient's uterus, multiple pregnancies and premature babies will keep being associated with IVF. The community bears many of the costs that arise, particularly in regard to neonatal intensive care. We have not put a figure on the amounts involved, but it is clearly the case that here we have a second inflating factor on our government expenditure estimate of $32 million.

Finally, it should be remembered that since our cut-off point at the end of 1984 many more IVF treatment cycles have been performed in Australia, all with government contributions along the lines indicated. Thus in terms of government expenditure on IVF to date, we are now well in excess of the estimates provided. As a component of health care expenditure, IVF is clearly no longer an insignificant part. It is therefore important to continue the assessment of this technology in terms of its public costs, and to take this assessment into account in the broader public discussion about our involvement as a community in this technology.

NOTES AND REFERENCES

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10. It should be noted that treatment schedules vary from centre to centre and from patient to patient and so each particular treatment cycle costs a different amount. The figures provided here should be taken as indicative.
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