Choice Dynamics in IVF Treatment

Extended Abstract

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Introduction

In vitro fertilization (IVF) is an advanced treatment for couples with fertility problems. Most patients pay out-of-pocket, but some are insured. An IVF cycle involves several treatment stages with many decisions, and patients can decide how aggressively to treat their infertility problem. IVF treatments fail very often.

Seven states have insurance mandates that require coverage for IVF and insurance is generally unavailable otherwise. Insurance mandates appear to: Increase number of treatment cycles, reduce number of embryos transferred, reduce multiple birth rates in IVF, but increase total count.

Previous studies have relied on population (Schmidt (2007); Bitler (2008); Bundorf, Henne, and Baker (2008)) or clinic (Hamilton and McManus (2011); Jain et al. (2002); Henne and Bundorf (2008)) level data. Relying on aggregate IVF data it may be difficult to address some issues that depend on: a) changes in total patients vs. total cycles at a clinic. b) changes in fertility attributes of participating women with insurance and c) whether changes to embryo transfers and birth rates are due to shifted incentives or different populations.

In this paper we use patient microdata from an IVF clinic to estimate a structural model of IVF treatment choice. The key parameters in the model involve those characterizing utility from kids and price sensitivity. Our main contribution is bringing to bear detailed patient microdata to the analysis of IVF treatment choices.

We use the estimated model to answer several questions regarding insurance coverage of IVF.

The Data

We observe individual patient treatment histories at an IVF clinic in the St. Louis metropolitan area with IVF cycles spanning the period 2001-09. Interestingly, the St. Louis metro area includes parts of Illinois which mandates IVF coverage and Missouri, that doesn't. Therefore, our sample includes a mix of insured and uninsured patients.

We observe IVF histories for more than 1000 patients. Many of these patients are observed to go through several cycles. The histories provide the number and spacing of attempted cycles, including

decisions and outcomes in all stages of each IVF cycle. We also observe fertility characteristics and demographic information (e.g. age, prior kids).

The Mechanics of an IVF Cycle

Once IVF starts, the patient…

1. Takes drugs to stimulate egg production.
2. Gets a signal about progress of (1). Has a chance to cancel cycle.
3. Has eggs retrieved during minor surgical procedure.
4. Chooses a fertilization method, i.e. intracytoplasimic sperm injection (ICSI) or not.
5. Chooses how many embryos will be transferred back into the uterus.
6. Learns whether any births occur

In the model below we stylize this process and focus on the following treatment stages: 1) start or delay of treatment. 2) continuation vs. cancellation of treatment (once started), 3) choice of fertilization method and 4) decision regarding how many embryos to transfer back. At each stage, the patient is forward looking and considers the partially controlled stochastic process and how her actions in a given stage will determine her opportunities and possible outcomes in the next stage.

A Sketch of the Model

We specify patient preferences over: birth outcomes, price disutility, flow value from delay and terminal value at the end of the fertile period. Patient's choices at each stage of an IVF cycle are determined by preferences, patient characteristics, and information revealed during previous stages of treatment. We construct choice-specific value functions for each stage based on preferences, state variables, and treatment characteristics. The actions and timing of the model are as follows. We model decisions starting with the first IVF cycle. A period (t) is 3 months long and decisions go through age 49. IVF treatment stages occur <u>within</u> a period. At beginning of each t, a patient chooses to start IVF or delay until $t + 1$. If the patient starts IVF, she makes one treatment choice in (up to) 3 stages that may follow, as described above. We allow for discounting (β) across periods, not across stages. If there is no birth during t, the patient can choose to start treatment again in $t + 1$. If t ends with a birth, the patient must wait one year ($t + 4$) to consider starting treatment again. Patient indirect utility depends on the stock of children and the price paid at each stage of the IVF cycle. We collect the state variables in the vector Z. Some state variables such as the fertility characteristics of patient and partner, initial wealth and demographics are exogenous and fixed. Others variables evolve over time. These include exogenous (age, time) as well as endogenous (number of kids, number of remaining insured cycles, cumulative payments into IVF).

Each IVF treatment cycle consists of several stages. Before any treatment choice, the patient knows fertility characteristics and the initial values of the state variables (Z). Fertility characteristics include: Age, the AFC score (egg production), number of prior kids, diagnosed fertility problems and number of non-IVF prior treatments, e.g. IUI. We assume that the patient knows her preferences, is aware of/informed of her own fertility characteristics and has full information about (or is informed of) all stochastic processes that determine treatment outcomes as function of her choices at each treatment stage.

There are three prices in the model:

1. a cycle initiation fee. This is paid whenever a cycle is started
2. a continuation price. This can be can be avoided through cycle cancellation after observing estridiol levels.
3. a fertilization method price (with ICSI fertilization being more expensive).

Whenever a patient's cycle is covered by insurance, these three prices are substantially lower. Patients from Illinois begin with a total of four covered cycles, the number of cycles specified in the mandate. Missouri patients do not have insurance coverage for IVF.

Estimation

Estimation proceeds in two steps.

1) In the first step we recover the treatment technologies for each stage. This involves estimating the distribution of peak estridiol levels that may result from the initial dosage of follicle stimulation hormones (FSH). Second, given peak estridiol, we estimate the distribution of the number of eggs that can be retrieved. Third, for a given number of eggs harvested we estimate the distribution of successful cleavage stage embryos that are available to be transferred back. Finally, for each possible number of embryos implanted, we estimate the distribution of live births that may result. In estimating these four technologies and transition probabilities we control for all the appropriate state variables.
2) In the second step we estimate the structural parameters characterizing preferences for children and price sensitivity by maximizing the likelihood of the observed patient histories. At each trial of the estimation routine we solve for the value function using standard methods for dynamic problems with finite horizon. In doing so we adopt Rust's (1987) framework to derive closed form solutions for the choice-specific value functions and the choice probabilities that are used in the likelihood function. In the second stage, the first stage estimates of treatment technologies are taken as given. These estimates are used to repeatedly solve the dynamic programming problem inside the likelihood maximization routine. Estimation leverages exogenous price variation generated by differences in mandated IVF coverage.

Counterfactuals

With the estimated model in had we conduct several exercises:

- We examine the effects of extending insurance coverage to the full market.
- We examine the consequences of restricting within-treatment actions as a condition for coverage (e.g. imposing limits on the number of embryos that can be transferred)
- We derive the optimal mandate, which strikes an efficient balance by limiting moral hazard but providing appropriate insurance coverage.