HMPI | HEALTH MANAGEMENT, POLICY & INNOVATION
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Auction Pricing for Medicare Services: Could It Be Applied to Cataract Surgery?

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Abstract

What is the message? Many government goods and contracts are priced competitively through auctions. However, one U.S. industry sector that hasn't implemented this competitive pricing effort at scale is the healthcare sector. In this paper, we explore potential ways of allocating cataract surgery contracts through auction models. Using auction theory, we suggest it is possible to decrease prices compared to the current administered pricing scheme, while maintaining the quality of cataract surgery.

What is the evidence? A review of game theory literature and a literature review of auction model applications.

Timeline: Submitted: March 7, 2022; accepted after review: March 31, 2022.

Cite as: Laszlo Bollyky, Kevin Schulman. 2022. Auction Pricing for Medicare Services: Could It Be Applied to Cataract Surgery? *Health Management, Policy and Innovation* (www.HMPI.org), Volume 7, Issue 2.

Introduction

Cataract surgery is the most frequent surgical procedure in the United States. Because most recipients of cataract surgery are over the age of 65, Medicare is the predominant payor for this service. Currently, cataract surgery reimbursement is based on CMS' administered pricing model. The resulting rules are clear and payments are predictable. Cataract surgery is a dynamic procedure, with ongoing advances in surgical technique and resources required to perform the service. Thus, the administered pricing model may lag improvements in clinical efficiency, leading to overpayment by Medicare. Competitive pricing models for other CMS benefits such as durable medical equipment have shown promise as a means to reduce costs. In this paper, we examine whether pricing cataract surgery through a competitive auction would lead to a more appropriate pricing model for Medicare. We suggest that implementation of an auction pricing model may be a more efficient method for determining reimbursement levels for cataract care, assuming quality of care and access to services would remain at current standards.

Overview of Cataract Surgery

A cataract is an opacity of the lens of the eye that may cause blurred vision, or, in very advanced cases, blindness. Cataracts occur frequently in older individuals. Poor nutrition, certain diseases, and medications such as corticosteroids can speed up cataract development. (1) Cataracts continue to be an important cause of blindness, accounting for 12.7% of blindness cases in North America. (2) There are no medical therapies for cataracts, making surgery the primary intervention for patients with this condition.

Cataract microsurgery combined with intraocular lens implantation can restore normal vision for most patients. (1) Cataract surgery is typically performed on an outpatient basis under local anesthesia. Monitored intravenous sedation is also commonly used; general anesthesia is only rarely necessary. Cataract surgery can be performed in 10 to 20 minutes by experienced doctors but typically patients spend 30 to 60 minutes in the operating room. (3) Patients often undergo cataract surgery in both eyes, but typically the surgery is sequenced to treat one eye at a time.

The most commonly used technique in the United States for cataract extraction is phacoemulsification. In this procedure, a small incision is made through which a vibrating probe

is inserted to break up the existing aged lens. The fragments are removed, and a new, clear lens is inserted through the same incision. Most patients will have synthetic intraocular lenses (IOLs) implanted during this procedure. (4)

Patients are typically seen one week after surgery and then again one month after surgery to monitor for complications and to ensure wound healing. Corticosteroid or nonsteroidal anti-inflammatory drug drops are often prescribed postoperatively to reduce pain and inflammation. Modern cataract surgery is extremely safe, with very few major complications (5). Post-surgery, over 60% of patients reported 20/20 vision and 94.3% of patients reported 20/40 or better. (6)

Economics of Cataract Surgery

As of 2019, roughly 24.4 million people were affected by cataracts in the United States; more than 2 million cataract surgeries are performed in the United States each year and nearly 24,000 surgeons are qualified to administer the procedure. (7) Approximately 80% of these surgeries were covered by Medicare (8). Average cash prices for cataract surgery on a single eye are advertised as $3,500 per eye (9). The 2021 Medicare fee schedule provided a total facility payment amount of $2,079.16 for cataract surgery in the hospital outpatient department, and $1,039.30 in an ambulatory surgery center (10), with physician fees of $544.70 (CPT code 66984). (11) Medicare pays for 80% of this amount, and patients pay the remaining 20%.

Even with the high price of cataract surgery in the United States, studies suggest that it is still economically attractive. One analysis suggested that cataract surgery provides 1.6212 QALYs over a 13-year timeframe, while bilateral cataract surgery provides 2.8152 QALYs. (12) At current Medicare payments, this suggests a cost per QALY of $1,618 for the first surgery.

Most Medicare fee schedules are determined through cost-based or administrative pricing of goods and services and are broken down into technical and professional components. The technical component pays for space, equipment, and other resources used for the service. The professional component pays for the services of the physician (or advanced practice provider). Each component of the payment can be paid separately (e.g., to an ambulatory care center and a physician), or combined into a global payment to one entity. For cataract surgery, technical fees can be set under Medicare’s Outpatient Prospective Payment System (OPPS) or Ambulatory Surgery Center (ASC) payment system (13). Prices for physician services are based on the

Resource-Based Relative Value Scale model (RBRVS), assigning relative value units to each medical and surgical visit or procedure.

By definition, CMS uses an administered pricing payment model. In other words, CMS works to estimate the resources involved in the procedure and set a fair price for the service (rather than a cost-plus system, CMS attempts to provide payment based on the practice of an "efficient" provider. (14). These payment models often have complex features that adjust the payment rates to clinical severity, but these documentation requirements increase the burden on providers to ensure that they receive a fair payment for their service. Finally, these models are adjusted on an annual basis.

Advances in technology have dramatically changed cataract surgery as a procedure over time. This raises a question of how Medicare can set an appropriate price for a procedure in a dynamic and evolving clinical environment. Further, how does Medicare set a payment rate to provide incentives for further clinical and process improvements related to this surgical procedure. (15)

Auction Models

One conceptual model to consider in setting payment rates is an auction model. Auction models are useful ways to price transactions amid uncertainty over the true value of a good or service. Auctions are generally used by sellers when they lack a good estimate of the buyers' underlying values for an item, such as when pricing fine art or when the government prices the sale of assets such as licenses for cellular spectrum or land-leases for oil or gas production. Reverse auctions can be useful when a buyer wants to purchase similar goods or services from multiple sellers. For example, federal agencies such as the Departments of Homeland Security and Veterans Affairs use these reverse auctions to obtain commercial items and services, mainly information technology equipment. (16) Reverse auctions have the power to drastically increase consumer surplus as competition among the suppliers drives down costs for the buyers.

Auction models are considered part of Game Theory. William Vickrey won the Nobel Prize in economics for his early work in describing auction models (17) while Robert Wilson and Paul Milgrom won the 2020 Nobel for their work advancing auction theory. (18)

The five main types of auction models are described in Table 1.

Table 1. Auction Models

Auction Model (Ref)	Description	Example	Compared to Admin Pricing for Medicare Services?
English auction (11)	Bidders openly bid against one another, with each subsequent bid required to be higher than the previous bid; multiple bids can be submitted per buyer. Bids are commonly called by an auctioneer or submitted electronically and displayed.	Commonly used for selling goods such as antiques, artwork, other secondhand goods and real estate. The simultaneous ascending auction model created by Wilson and Milgrom for FCC auction of electromagnetic spectrum auction is a complex variation of this model allowing for simultaneous bidding.	This model would not be practical for Medicare's procurement of services from multiple providers
Blind Auction (12)	Known as a "Sealed bid, first-price auction", all bidders in this type of auction submit sealed bids. The highest bidder wins and pays the price they bid for the item.	Auctions for mining leases are often blind auctions (with the potential for the "winner's curse."). Procurement auctions are often reverse blind auctions frequently run by governments to purchase goods or secure services from the lowest qualified bidder.	A "reverse" blind auction would consider different provider offers to perform cataract surgery. Would need a mechanism to ensure that bidding was competitive (in other words, that the lowest bids would gain market share).
Vickrey auction (13)	Also called "Sealed bid, second-price auction," bidders in a Vickrey auction submit sealed bids just as in a Blind Auction. The highest bidder wins but pays the price of the second highest bidder.	Vickrey auctions are commonly used in automated contexts such as real-time bidding for online advertising.	Similar to blind auction but "winner's curse" would be decreased.
Dutch auction (14)	Also known as a "open descending price auction", the price in a Dutch auction begins at a high value and lowers incrementally until it hits a predetermined price floor or all items are bid. This auction type is used to sell some quantity of like items.	The Dutch auction model serves to achieve the highest possible price for sellers within the shortest possible time, ideal when dealing with a perishable product such as cut flowers. Each sale at the Aalsmeer tulip auction in the Netherlands starts with a predetermined highest asking price, lowering it until a bid is made or a reserve price is reached. Prices are shown on a clock and buyers typically have mere seconds to make a decision.	A Dutch auction could optimize reimbursement for providers because bidding information is shared, providers place bids at differing rates based on individual valuation thereby decreasing consumer surplus and moving average reimbursement closer to market equilibrium
Walrasian auction (15)	A type of "double auction", in a Walrasian auction the auctioneer takes bids from both buyers and sellers in a market of multiple goods. The auctioneer progressively either raises or drops the current proposed price depending on the bids of both buyers and sellers, The price is ultimately set so that the total demand across all agents equals the total amount of the good.	The Walrasian market model is used regularly in the financial markets. The NYSE looks at all the collected orders for a particular stock and selects the price that will clear the greatest number of trades before the opening bell to determine opening prices.	This model is not applicable with a single buyer (CMS) and multiple sellers (providers) but if market was opened up to other healthcare payers/insurers then this model with a clearinghouse is potentially very efficient

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Auction models vary according to the number of bidders (potential buyers) and sellers, the number of bids each bidder can place, the amount of information known by bidders prior to placing the bid, and the direction of the bidding from the opening bid (higher or lower). Auctions also vary based on the obligations of the bidders to purchase the items at the auction price. In other words, different auction models are designed to optimize the exchange between buyers

and sellers under various market conditions. (19)

The English auction model is commonly used for selling goods such as antiques, artwork, and real estate. An auctioneer guides bidders who openly bid against one another, with each subsequent bid required to be higher than the previous bid. All bids are commitments to pay the price for the item, and an essential feature of the model is that the bidder must be aware of the current price of the item. The highest bid when the bidding stops, “wins” the auction and the final bid price is the transaction price. (20)

A Blind auction, also known as a “sealed-bid, first-price auction,” is commonly used for auctions of mining leases (20). It requires bidders to submit sealed bids that are commitments to purchase the item. The bidder offering the highest price wins and pays the price bid for the item; usually only one bid is placed per buyer. The bidder’s valuation of the good is considered heavily in this model. However, the lack of transparency regarding other bids results in the high likelihood of “winner’s curse” where bidders pay more than necessary to obtain the item. (21) For example, two gold mining companies are inspecting a mining tract for lease. Company A estimates the land to contain gold valued at $750,000 whereas Company B estimates the same land contains gold valued at $675,000. Both have the same strategy in bidding to make a $25,000 profit. In this case, Company A would bid $725,000 whereas company B would bid $650,000. Company A won the bid, but after excavation, the plot contained only $700,000 in gold. Company A suffered the “winner’s curse” by overbidding, ultimately suffering $25,000 in losses.

Vickrey auctions have been thoroughly explored in literature. This model is similar to a Blind auction, but the winner pays the price of the second highest bidder rather than their own bid price. With this formulation, bidders are incentivized to bid their true value as they are guaranteed a return if they bid their true value. If they win the auction, they will pay less than the value they perceive (their bid price) since they pay the second highest bid price through this model.(17) While there are psychological effects that may result in irrational bids from individual buyers, the concept of “strategy-proof” uses game theory insights to understand how to create incentives for accurate bidding by the participants. This incentive to bid the true value has been dubbed “Vickrey’s Truth Serum.”

However, the strategy-proof feature of the Vickery model may not be readily apparent to

bidders. One interesting experiment found that with proper dissemination of information about the model, i.e., providing a detailed outline to buyers within the market, bids were optimized (the net advice effect), and sincere bidding increased from 20.6% to 46.9%. When applied to large scale markets (such as government contracts and healthcare), such an approach could improve the efficiency of the auction model in establishing prices for a market. (22)

A Dutch auction, also known as an “open descending price auction”, is a model used to see large quantities of products such as bulbs at the Aalsmeer tulip auction in the Netherlands. Here, the first lot is offered a high price, and the price is lowered incrementally until it hits a predetermined price floor or all items are purchased. (23)

A Walrasian auction is a type of “double auction” used in setting opening prices for newly listed shares for the New York Stock Exchange. In this model, the auctioneer takes bids from both buyers and sellers in a market of multiple goods (in the sock example, shares). The auctioneer sets a price so that the total demand across all agents equals the total amount of the good. (24)

Auction Models Used in Healthcare

The use of competitive bidding in healthcare started in 2006 when Medicare set plan payments for its privately administered plans (“Medicare Advantage”) based on insurer bids. (25) Medicaid programs also use competitive bidding to determine payments for their managed care plans (26). In 2011, Medicare introduced competitive bidding among suppliers for durable medical equipment. There have also been proposals to introduce competitive bidding programs for clinical lab tests and for physician-administered drugs. (27, 28)

The competitive auction bidding process is used for the procurement of DMEPOS items (defined as durable medical equipment, prosthetics, orthotics, and supplies such as oxygen tanks, walkers, and other smaller items). The bidding process works as follows: DMEPOS suppliers submit bids to the Centers for Medicare & Medicaid Services (CMS). Suppliers must bid separately for each product (including the price and quantity being offered) in each Medicare Service Area (MSA) they intend to service. Importantly, there is a ceiling price, the administrative price that would have been paid absent competitive bidding. CMS then choses suppliers based on an assessment of the bids across all of the categories and then builds the required level of supply at an MSA by offering contracts starting at the low bid and working up

until the expected quantity of goods or services are procured. To maintain competition, each supplier is capped at 20% of the market, with a small business set-aside in the contracting process. Contract prices are set based on the median price offered by the winning bids for a three-year contract period. (29)

This auction framework used for DMEPOS combines features of a Vickrey auction, where contracts are offered to the lowest bidder but at the median price of all of the winning bids, and a Walrasian auction, in which the auctioneer or, in this case, the federal government, sets a price that meets the market demand.

Competitive pricing for healthcare services has the potential to drastically decrease the out-of-pocket cost to patients, as well as the cost to Medicare. Yunan Ji, a Ph.D. Candidate in Health Policy and Economics at Harvard University, estimates that competitive pricing reduced the price of DMEPOS by as much as 46% for Medicare. (26)

Auction Pricing for Cataract Surgery Reimbursement

Medicare could use an auction model to set the price for cataract surgery services to address potential overpayments in the administered pricing model.

The first step in the process would be to carefully define the service on offer: technical and professional fees, included services such as anesthesia, and the type of lens to be used in the procedure. Included pre-operative and post-operative services would also have to be described (for example, the professional services would include pre-operative, operative, and post-operative services for a 90-day period).

At the end of the day, paying a lower price for a lower quality service is not a savings (Mark Pauly has called this concern a “quantity illusion”, paying less and getting less does not represent an increase in value). CMS could require bidders to submit quality data for entry into the program (pre-qualified bidders), or could condition payment on quality metrics. Of note, CMS does not have a quality threshold for payments in the fee-for-service market. When analyzing the efficacy of health insurance auctions, researchers from the University of Minnesota and George Mason University suggested that insurers should submit quality assurances prior to auctions. (30) A combination of pre-auction quality assurances and post-auction quality reports

would allow buyers, in this case CMS, to maintain the quality of the service. Information feedback plays a crucial role in establishing long-term relationships between buyers/sellers and in forming successful markets. (30) The auctions would then be run from a combination of historical reports and projected reports, with additional credibility given to previously successful service providers.

In this auction, there would be many sellers but only one buyer, CMS. CMS could use bids to establish a national price under an Walrasian model (for example, CMS would use the bids to set a benchmark price but then offer that price to all providers), or CMS could use sealed bids with a quality projection to allocate services. In both scenarios, the quality assurance plan is a necessity. For example, in the Walrasian model, bidders would be required to fulfil and maintain a quality benchmark for inclusion in the market. In the latter option, CMS would assess each bid individually and, based on a bidder's historical consistency, proposed success, and projected volume/price, could then accept or reject the bid. The use of the blind auction approach would restrict providers to only those with successful bids to encourage more aggressive bidding by providers. CMS could also use the current price as a ceiling to ensure that the program would reduce costs for Medicare.

In a market characterized by continuous improvement in technology and efficiency, auction models could provide a novel approach to pricing of cataract surgery for CMS. If successful, such an approach could transform the pricing of healthcare services for public payers in the United States.

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