Optimal Utilization Of Advanced Diagnostic Imaging Equipment: Principles and Implications

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Executive Summary

Diagnostic imaging services performed in independent diagnostic testing facilities (IDTFs) or physicians' offices are reimbursed under the Medicare Physician Fee Schedule. Payments for the direct costs of these services are determined in accordance with Medicare's policy that beneficiaries should have access to these services during standard business hours, and that imaging equipment should be in use 50% of the available time. MedPAC recently recommended increasing this utilization factor to 90% for medical equipment costing over $1 million, such as computed tomography (CT) and magnetic resonance (MR) imaging systems. Although MedPAC's stated intention is to improve "payment accuracy" and base payments on costs borne by an "efficient provider," increasing the utilization factor to 90% contradicts basic workflow principles, is not supported by any currently available data, and has significant potential to disrupt the balance between patient access and health care costs.

Basic tenets of operational research suggest that adopting MedPAC's recommended 90% utilization factor would have significant negative consequences for patients. Clearly, amortization of fixed costs is a function of utilization, and increased utilization is beneficial, to a point. However, as utilization continues to rise, equipment becomes congested and access is degraded. On average, at a 90% utilization factor patients would likely need to travel farther at less convenient hours, suffering longer delays in scheduling appointments, in the waiting room and ultimately in getting their results. All of these factors carry serious risks of causing patients to delay or even forego critical diagnostic care.

It is clear that striking an appropriate balance between intensity of use and patient access to imaging is in the interest of all stakeholders; it is essential to achieving good patient outcomes, well-run systems of care, and maximum cost-effectiveness. It is equally clear that achieving these goals will require accurate and robust information for decision makers. Therefore, we propose the creation of two new mechanisms for better informing the debate over payment for imaging services:

- **First, harness existing data from imaging manufacturers.** Detailed data on imaging equipment utilization is already collected remotely and electronically by equipment manufactures and could be used to measure actual equipment utilization rates across a large and geographically diverse number of imaging facilities.
- **Second, leverage existing information technology systems to monitor access to care.** A new public-private partnership leveraging the capabilities of existing IT systems could inexpensively produce **timely and accurate** data on patient access to medical imaging services.

Increasing the utilization factor is a significant policy decision that should be based on evidence. Because meaningful data on imaging utilization and access exists and would be relatively easy to extract, Congress and the Centers for Medicare & Medicaid Services should defer any changes to the advanced imaging utilization factor until these data have been analyzed. A more informed approach to evidence-based policy making will ensure Medicare's success in balancing efficiency and access.

Optimal Utilization of Advanced Diagnostic Imaging Equipment: Principles and Implications

David A. Butz PhD and David W. Lee PhD

Since 2006, The Medicare Payment Advisory Commission (MedPAC) has repeatedly urged Medicare to increase the "utilization factor" used to establish payment rates for high-cost diagnostic imaging services under the Medicare Physician Fee Schedule. The utilization factor, currently pegged at 50%, codifies Medicare's target for how intensely imaging systems should be utilized (i.e., time in use as a percentage of total available time) and is meant to reflect a balance between the need to ensure beneficiaries' access to care and the equally compelling need to minimize health care costs. MedPAC's latest recommendation, however, threatens to tilt this balance dramatically towards cost savings by increasing the utilization factor to 90% for advanced medical imaging equipment such as computed tomography (CT), magnetic resonance (MR), and positron emission tomography (PET) imaging systems,[i] that cost providers over $1 million to purchase. If adopted, MedPAC's recommendation would have serious consequences for Medicare beneficiaries' access to appropriate imaging services.

The relationship between the utilization factor, beneficiary access to care and costs is not widely understood, but each has a direct bearing on Medicare's payment formulas. Specifically, payments for direct costs of imaging services are determined by three factors—the cost of the equipment, the time needed to perform a procedure with the equipment, and the desired level of access to the equipment. Although equipment costs and procedure time can and do vary, access is a normative component in this equation and where policy changes can directly impact costs and quality of care.

If equipment is used more intensely, less capacity is required in aggregate to meet patients' needs. But as intensity rises and capacity falls, equipment becomes congested and access is degraded. On average, patients will need to travel farther, at less convenient times, suffering longer delays both in the waiting room and in getting their results, all factors that may ultimately cause patients to delay or even forego critical diagnostic care. This is a textbook tradeoff scenario, and common across nearly all industries. In diagnostic imaging, however, it carries unusually high stakes clinically, financially, and operationally.

It is clear that striking an appropriate balance between intensity of use and access to imaging systems is in the interest of all stakeholders; it is essential to achieving good patient outcomes, well-run systems of care, and maximum cost-effectiveness. In this paper, we explore the role of the utilization factor in establishing this difficult, but essential equilibrium between access and costs by:

1. Decoding the complex formula Medicare uses to determine payment for diagnostic imaging services under the Medicare Physician Fee Schedule;
2. Reviewing MedPAC's rationale for proposing an increase in the utilization factor; and
3. Explaining the association between utilization factors and economic efficiency.

This paper also calls for the development of two new mechanisms for collecting accurate and unbiased data to help better inform decisions regarding Medicare's diagnostic imaging payment policy:

1. Measurement of actual imaging equipment utilization data using existing information technology systems that continuously and automatically monitor equipment so it can be optimally serviced; and
2. A new public-private partnership that would harness existing information technology to automatically and continuously monitor Medicare beneficiaries' access to advanced diagnostic imaging services. Such "access telemetry" will inform refinements in Medicare's access policy, provide all stakeholders with transparent, durable, and credible reimbursement methodologies, and foster continuous improvements in care.

HOW MEDICARE PAYS FOR NON-HOSPITAL DIAGNOSTIC IMAGING SERVICES

Diagnostic imaging services performed in independent diagnostic testing facilities (IDTFs) or physicians' offices are paid under the Medicare Physician Fee Schedule. In contrast, imaging services provided in the hospital outpatient setting are paid under the Hospital Outpatient Prospective Payment System (HOPPS). The Deficit Reduction Act of 2005 capped payment for imaging services under the Medicare Physician Fee Schedule at the HOPPS amount, meaning that reimbursement for medical imaging conducted at an independent center cannot exceed the established reimbursement rate for that same medical imaging service when conducted as an outpatient hospital service.[ii]

There are two components used to determine the Medicare Physician Fee Schedule payment amount for imaging services (Figure 1). The "technical component" pays providers for acquiring the image, and the "professional component" pays providers for interpreting the image. Both components compensate providers for the amount of physician "work" (time, skill, effort and stress), practice expense (direct and indirect) and professional liability expense associated with each procedure.

MedPAC's proposed change to the utilization factor for advanced medical imaging specifically affects the technical component payment for direct practice expenses. As shown in Figure 2, payment for direct costs depends on three factors:

- Fixed costs. The fixed costs of purchasing, financing and maintaining the imaging equipment
- Procedure time. The duration of time that the equipment is occupied for each imaging study
- Desired access. The desired level of patient access to imaging services

Figure 1: MPFS Payment

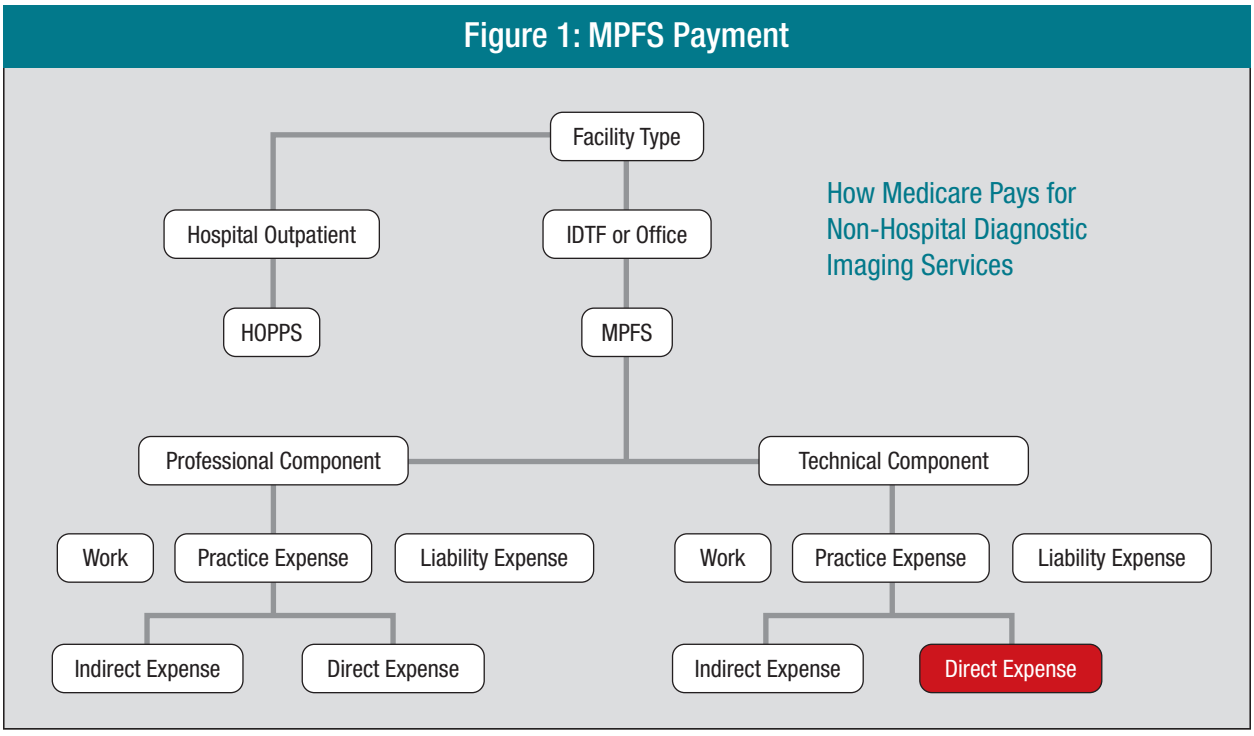
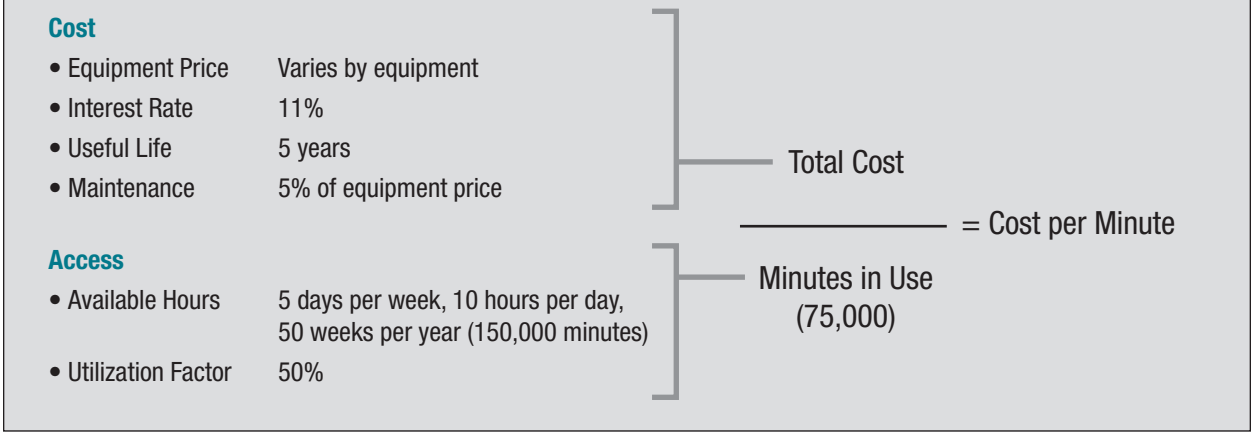


Figure 2: Cost per Minute



Fixed Costs

Medicare computes an annual amortized fixed cost for each type of imaging equipment using the following formula.[iii]

$$\text{Annualized Cost} = P^* \left(\frac{r}{1-(1+r)^{-N}} \right) + (M^*P)$$

Where:

P= The equipment's purchase price

r= The interest rate, currently set at 11%

N= The equipment's useful life, currently fixed at 5 years

M= Maintenance costs as a percentage of the equipment's price, currently fixed at 5%

Procedure Time

Medicare estimates the amount of time necessary to conduct each imaging procedure as the elapsed number of minutes between the time that the patient enters the imaging room and the time the patient leaves the room.

Desired Access

Medicare establishes a desired level of patient access to imaging services by determining how available imaging equipment should be, and how intensely it should be utilized when available.

- Availability. Current Medicare policy states that imaging equipment should be available for use 10 hours per day, 5 days per week, 50 weeks per year (150,000 minutes per year).
- Intensity. Current Medicare policy states that imaging equipment should be utilized for patient care 50% of the time it is available for use (i.e., the utilization factor), or 75,000 minutes per year.

Using current Medicare rules, the formula below illustrates how the direct expense payment ($21.37) would be determined for a five-minute procedure performed on an imaging device costing $1,000,000.

From this formula, it is clear that increasing the number of desired minutes of utilization from 75,000 has the short-run impact of reducing payment. Specifically, increasing the utilization factor to 90% (135,000 minutes) reduces the payment by 44%, to a new level of $11.87.

$$\text{Technical Component Direct Cost Payment} = 5^* \frac{\left(\frac{\$1{,}000{,}000^*11\%}{1-(1+11\%)^{-5}} \right) + (5\%^*\$1{,}000{,}000)}{75{,}000} = \$21.37$$

PROPOSED INCREASE IN THE UTILIZATION FACTOR

Background

MedPAC first raised the question of adjusting Medicare's utilization factor in its 2006 Report to Congress.[iv] MedPAC's stated goal in revisiting the utilization factor was to ensure that Medicare payments for services under the Medicare Physician Fee Schedule were "accurate," meaning that they should reflect the actual cost of providing each service. It is worth noting here that while MedPAC's 2006 review of existing policy did not mention how Medicare originally determined that advanced imaging equipment should be available for use 150,000 minutes per year, MedPAC did comment that the currently mandated 50% utilization factor is based on scant and outdated data.

MedPAC's 2006 Report included results from a survey of 133 physician practices and independent diagnostic testing facilities (IDTFs) located in six markets that provided information on:

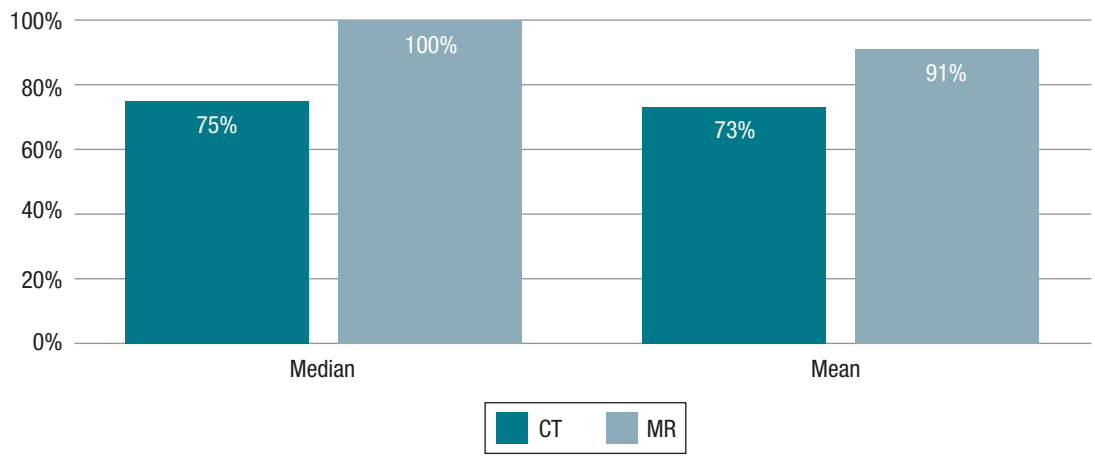
- Availability. Hours per day, days per week, and weeks per year the facility is open; and
- Intensity of use. Hours per week that the equipment is in use.[v]

Using these data, MedPAC calculated utilization factors by dividing the number of hours per week each of the surveyed systems was reported to be in use by the corresponding number of weekly hours the facility reported being open. As shown in Figure 3, average intensity rates were 73% for CT (95% confidence interval 65%-81%) and 91% (95% confidence interval 85%-97%) for MR. Median equipment intensity rates reported by MedPAC were 100% for MR and 75% for CT.[vi]

Ironically, the accuracy of these survey data meant to allow Medicare to "pay accurately" for services is highly questionable for a number of reasons:

- The sample size is small (133 providers in only 6 markets)
- The sample is likely biased because the markets selected are not representative, particularly as facilities in rural areas were not included
- The results are implausible; based on the reported medians, the MedPAC survey draws the impossible conclusion that one-half of MRI facilities are "in use" more hours than they are "open for business"

Figure 3: MedPAC Survey of Equipment Utilization



A lack of clarity and specificity in the wording of the survey instrument appear to have significantly limited the usefulness and accuracy of these results. For example, the survey asks respondents "how many hours each week would you say that your CT is in use?" but does not define what is meant by "in use." Did respondents interpret "in use" as time patients are actually in the imaging room, as any time the imaging room was available for use, or something in between? These and other deficiencies in the survey have already been acknowledged by MedPAC staff who stated that the survey, "…was not nationally representative and it was not designed to determine equipment use rates."[vii]

Despite these acknowledged data limitations, MedPAC's 2006 report to Congress:

- Suggested that equipment utilization was likely higher than the current 50% rate
- Offered examples showing that increasing the utilization factor to 75% or 90% would dramatically lower payment
- Did not address potential implications for patient access and quality of care
- Importantly, introduced a policy of basing advanced imaging payments on the characteristics of an "efficient provider," meaning that Medicare could assume that equipment is used most of the time a provider is open for business. As we discuss below, a policy of basing payment on a hypothetical, or one-size-fits-all "efficient provider" construct has far-reaching implications for patient access to imaging services not only in IDTFs and physician offices, but in hospitals as well.

Since issuing this Report, MedPAC has taken no action to collect better data, but has repeatedly urged Medicare to "revisit how it estimates the per service price of equipment, in particular the assumption that all equipment is operated half the time that practices are open for business."[viii, ix] Further, MedPAC staff published an article in 2008 suggesting that Medicare either adjust the utilization factor based on practice expense information currently being collected by the American Medical Association and specialty medical societies, or collect its own information.[x] The Congressional Budget Office also recommended increasing the advanced imaging utilization factor to 75% or 90% in its 2008 report on budget options in healthcare.[xi] To date, Medicare has understandably not tightened its access policy by increasing the advanced imaging utilization factor, citing insufficient evidence and inadequate budget resources to collect the additional data it needs.[xii]

UTILIZATION FACTORS AND ECONOMIC EFFICIENCY

Data issues aside, there are sound reasons to question MedPAC's recommendation for nearly doubling the utilization factor and its overall approach of tying payment to the concept of an "efficient provider." In this section, we consider MedPAC's proposal from the perspective of several fundamental economic and operational principles. Specifically, we examine how basic tenets of operations research apply to the delivery of diagnostic imaging services, and explain how the level of "efficiency" assumed in MedPAC's proposal is not only generally unattainable, but—even if achieved by some small segment of providers—would actually diminish patient access. This conclusion follows from a thoughtful application of fundamental economic principles to MedPAC's proposal. These principles provide a framework for:

- Defining the concept of "optimal utilization" within the context of MedPAC's goal of basing payment on an "efficient provider"
- Examining the tradeoffs between increased utilization and efficiency
- Understanding how the number of patients served (i.e., "throughput") is determined by the scheduled availability of the equipment, expectations about utilization levels and the amount of time required to provide each service
- Assessing the likely effects of implementing MedPAC's proposed utilization threshold, and of using the hypothetical "efficient provider" to benchmark real world performance

Through this framework, we will ultimately show that:

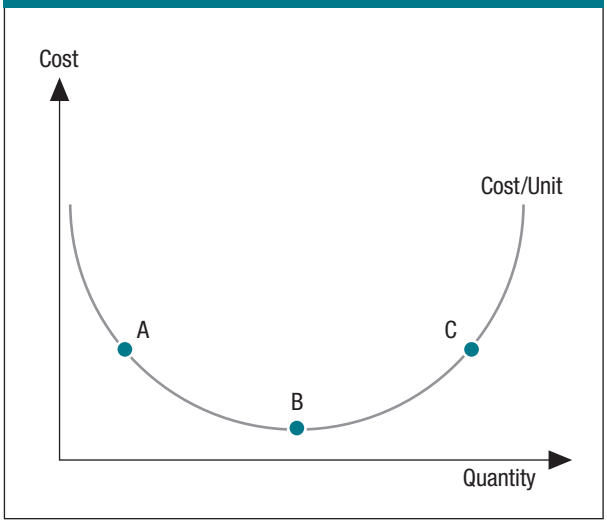
- Increasing the utilization factor may initially lower the cost per service; however, there is a tipping point beyond which increased utilization becomes counterproductive, increases costs and can overwhelm the system.
- The congestion that results when utilization factors are too high can restrict access and have a variety of other significant, systemic negative consequences that more than offset the intended cost-saving benefit.

What is Optimal Utilization?

Optimal utilization of advance imaging is a complex but intuitive function of equipment cost, expected timing and variation in demand, and their potential impact on patient access. To help explain this function, we'll use staplers and fire trucks as examples to show how we think about "optimal utilization" in two very different situations.

In both cases, the "workflow" or "demand" for these products occurs randomly and in both cases "optimal" utilization encompasses a significant amount of idle time. Because staplers are cheap, we can easily provide ample capacity to ensure that work will never be delayed because a stapler was unavailable. The fixed costs are so low that it would never occur to anyone to worry about the stapler sitting idle most of the time. At the other end of the spectrum, fire trucks are very expensive equipment that are also idle most of the time. In this case, we are willing to fund the "excess" capacity

Figure 4: Hypothetical Average Cost Curve



because the consequences of delayed access are likely catastrophic. The lesson from these two examples is that the optimal utilization of an asset depends not only on its cost (cheap staplers vs. expensive fire trucks), but also on the consequences of not having it available when needed.

More formally, the textbook "U-shaped" hypothetical average cost curve (at right) shows that increasing utilization can have significant benefits when utilization or output levels are low. The benefits from amortization (i.e., lower cost per unit) are significant with initial increases in output (from Point A) and the incremental benefit of each increase in output (or utilization) diminishes until we minimize costs (Point B). Beyond this point, however, increased output actually results in "congestion," forcing the cost per unit up again (Point C).

In a similar way, increasing utilization also exponentially increases waiting times and delays. As shown in Figure 5, "queue length" (i.e., waiting times and congestion) increases dramatically at higher utilization levels.[xiii]

MedPAC's proposal to increase the utilization factor to 90% implicitly assumes that lower costs can be achieved without negative consequences, yet this assumption has not been tested against the current imaging services environment or past experience. Without this benchmarking, there is a definite risk that MedPAC's proposal could actually increase costs, as illustrated in Figure 4. Further, the negative consequences of congestion as shown in Figure 5 are likely to ripple throughout the patient care process with potentially negative impacts on patient outcomes. For example, patients may delay or forego necessary and appropriate imaging services with significant clinical consequences, or experience long waiting times in obtaining imaging appointments, having imaging services performed or obtaining imaging results. These consequences come not only at serious personal cost (in terms of less-timely care), but also carry larger cost implications, such as time lost from work or other activities.

Implication: The definition of "optimal utilization" for an efficient provider of diagnostic imaging services must accommodate variable demand because the medical events and conditions that necessitate imaging do not occur on a predictable schedule. Given Medicare's mandate to balance patient access and health care costs, optimal utilization must be also be defined at a level that provides adequate amortization of fixed costs while maintaining capacity at a level that ensures the sufficient patient access to care.

Figure 5: Queue Length and Utilization

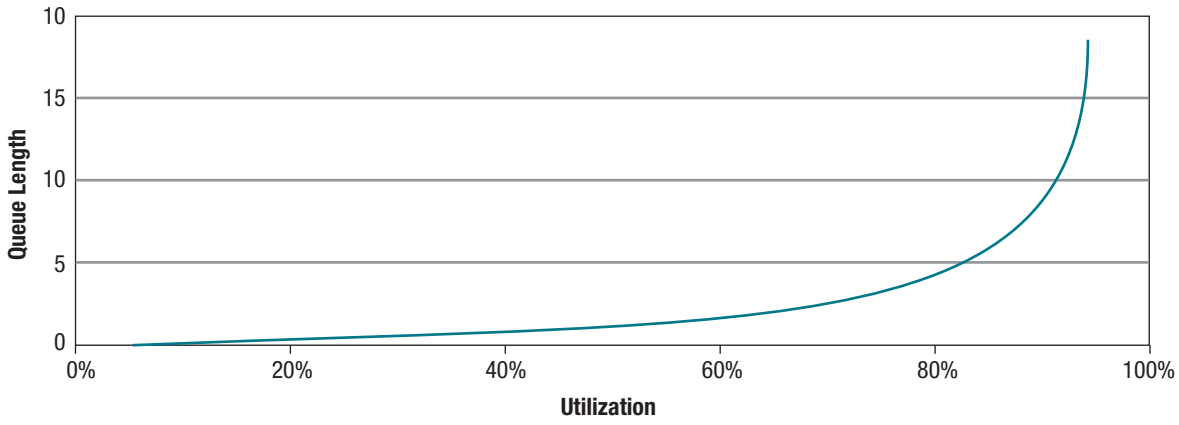


Figure 6: Little's Law for a Hypothetical Piece of Diagnostic Equipment

Average Utilization		Average flow time *(reciprocal)*		Average Schedule		Expected Throughput
$\frac{\textbf{75\%}\ \text{Patients}}{\text{Appointment}}$	x	$\frac{\text{Appointment}}{\textbf{45}\ \text{minutes}}$	x	$\frac{\textbf{60}\ \text{hours}}{\text{week}}$	x $\frac{\text{50 Weeks}}{\text{Year}}$	= $\textbf{3,000}\ \frac{\textbf{patients}}{\textbf{year}}$

What Does an Efficient System Look Like?

A clear understanding of the tipping point at which increased utilization switches from being beneficial to detrimental provides a good starting point from which we can begin understanding what's needed to create an efficient system. In order to set reasonable standards for efficiency in delivering diagnostic imaging services, we must first consider how many patients an imaging center can reasonably serve in a given year. Operations researchers refer to this as "throughput" and have developed an equation (called Little's Law) to show how throughput is determined by utilization (demand), flow time (average length of each appointment) and scheduled availability. Figure 6 illustrates Little's Law for a hypothetical piece of diagnostic equipment, 75% of appointments are utilized; appointments average 45 minutes from the start of one to the start of the next; and there are 60 hours of appointments available each week.

These assumptions yield a throughput of 3,000 patients per year. If the equipment has a useful life of 6 years, the upfront cost is amortized over 18,000 patients. For every $1 million of upfront investment, the amortized cost is $68-81 per patient (with costs of capital ranging from 6%–12%).[xiv]

Because the components of this equation are quite similar to the components of Medicare's payment formula described earlier in this document, the next three sections describe each component in greater detail and highlight the potential impacts of MedPAC's proposal to dramatically increase the utilization factor.

"Average" Schedule

Medicare's current policy dictates that diagnostic imaging equipment should be accessible during normal business hours, meaning 50 hours per week. Over a 50-week year, this translates into 150,000 minutes of availability per year. There are clear benefits to amortizing equipment using a schedule that extends beyond these normal business hours, and some independent diagnostic testing facilities and physician offices do offer extended hours to achieve greater "throughput" or efficiencies, as well as to accommodate patients' lifestyles.

These benefits, however, may be attenuated by both financial and logistical challenges. For example, it may be both difficult and expensive to staff an extended schedule. Perhaps an even more important consideration, however, is that with extended hours the imaging workflow would be out of sync with the rest of the office. Communication and oversight would be more complicated. Physicians who interpret these studies would have backlogs to start every day (especially on Mondays), and they would be called emergently at night and on weekends. This lack of synchronization means that delays in obtaining results would simply become a natural part of the process.

Implication: MedPAC's recommended utilization target will likely necessitate extended hours for the majority of IDTFs and offices. Unfortunately, as

operating hours extend further into evenings and weekends, the incremental benefits diminish and drawbacks such as staffing issues, lack of synchronization, and delays worsen, engendering negative financial and clinical consequences while at the same time making it more difficult for patients to obtain necessary care.

"Average" Utilization

Although any payment formula must include assumptions about utilization, by definition, "average utilization" obscures some important information about both the need for services and the logistics of how services are actually delivered. It is no surprise that demand for diagnostic imaging varies seasonally, within days and weeks, and also geographically. For example, equipment is in greater demand in Arizona and Florida during winter months, and in Northern vacation spots during summer months. Demand may also be more variable in facilities that serve rural areas compared to urban facilities.

On the delivery side, average utilization can obscure important differences even in what appear to be "apples-to-apples" settings. Consider, for example, two scanners offering identical scans that require 20 minutes each to perform:

Time	Scanner A	Scanner B
8am-10am	3	6
10am-Noon	3	6
Noon-2pm	3	0
2pm-4pm	3	0
4pm-6pm	3	3
Utilization Rate	50%	50%

Both scanners operate at 50% utilization on average, yet patients arriving at Scanner B during the morning are almost certain to suffer the consequences of congestion, including long waits and delayed access to results as each part of the imaging process becomes backlogged. For some patients the consequences may be even more extensive as they may arrive late to or even miss other doctor appointments they may have scheduled with other physicians.

Implication: The average utilization levels that MedPAC is proposing are unrealistic because they do not allow for the known variability in the demand for diagnostic imaging services. In the face of such variation, the only way that an IDTF or office-based practice could attain the proposed high utilization threshold is to consistently "overbook" appointments (as we see with commercial airlines). This, in turn, would significantly degrade patient access through delays in getting on schedule, long waits once patients arrive, delays in reading the images and providing clinical results, and substantial backlogs following any unanticipated down time. Ultimately any utilization factor that is codified in Medicare's reimbursement formulas must be realistic and informed by these known limitations.

"Average" Flow Time

Flow times are determined independently of anticipated utilization levels and scheduled availability, but care must be taken to ensure that the assumptions for these three components of the process are internally consistent when applied within "real world" constraints.

For example, MedPAC proposes that equipment in IDTFs and physician offices should be scheduled 50 hours each week, for a total of 150,000 minutes of available appointments each year. It also proposes that every piece of imaging equipment should be in use for 90% of this available time. Unfortunately, these targets do not allow sufficient "down time" to cover staff breaks (which would normally consume roughly 15% of a ten-hour workday), appointments lost to "no shows," scheduled and unscheduled maintenance, accommodations for disabled, elderly or other special needs patients, ongoing communications among technicians, nurses, and physicians, and various other time "leakages."

Implication: Experience in other areas of medicine underscores the importance of making evidence-based decisions. Even the brief thought experiment above strongly suggests that MedPAC's recommended utilization factor is unattainable. In actual practice, logistical constraints must be considered in order to accurately set targets for capacity and utilization. These constraints can be met either by extending the facility's schedule beyond 50 hours per week, lowering utilization below 90%, or by somehow adjusting flow times in order for the system to be functional. Under MedPAC's recommendation, the only option would be for facilities to extend hours.

Additional Implications

MedPAC is clearly struggling to establish an enduring principle for guiding payment decisions, as evident from the divergent approaches described in its 2006 and 2008 reports to Congress. Presently, MedPAC suggests basing payment on costs incurred by an "efficient" provider. As stated in its most recent report to Congress, **"The basic concept of accuracy is the efficient provider's average cost of furnishing a service."** [xv] While this concept seems simple, its implications are potentially far-reaching, and a number of outstanding questions must be addressed before any of MedPAC's recommendations are implemented.

Implication 1: By definition, setting payments at the average cost of efficient providers means that any future payment reductions (e.g., to remediate budget shortfalls) are likely to discourage the capital investments necessary to maintain sufficient levels of patient access and quality of care.

Implementation of the proposed standard automatically precludes Medicare and the Congress from further payment reductions to meet sustainable growth rate targets or remediate budget shortfalls, as it has in the past.[xvi] MedPAC can effectively implement average cost pricing only if there is a firm commitment that equipment owners should be paid no more but also no less than what is required to ensure an adequate and secure supply of imaging services.

Implication 2: MedPAC's approach requires a definition for an "efficient provider" that encompasses several operational dimensions.

- **Scheduling:** Given the tradeoffs described previously, MedPAC must provide a rationale for setting 150,000 minutes/year as the minimum threshold for availability.
- **Utilization Factor:** MedPAC must clarify how it measures utilization, provide justification for its 90% recommendation, and demonstrate that this scenario can exist in the "real world" while concurrently guaranteeing an appropriate level of patient access.
- **Flow Time:** MedPAC must test its scheduling and utilization assumptions against its calculated flow times to ensure internal consistency and account for all relevant aspects of imaging workflow. To avoid long patient waits, MedPAC must build reasonable "white space" into these flow times.[xvii]
- **Applicability Across Diverse Settings:** The efficiency standards that MedPAC has recommended are "one-size-fits-all," and do not appear to sufficiently accommodate patient access in rural or other low-volume areas. MedPAC must investigate whether its standards disproportionately affect certain patients or certain types of imaging providers. If the standards do have differential impact, MedPAC must determine what measures, if any, are warranted to ensure that all beneficiaries have adequate access to imaging services.[xviii] Clearly, government policy must avoid even the perception of supporting disproportionate access to services.

Implication 3: MedPAC's recommendation will have predictable, but unintended negative consequences for Medicare beneficiary access to care.

If Medicare adopts MedPAC's recommendation, many outpatient imaging centers will be classified as "inefficient" and will have no choice but to close. Beneficiaries affected by these closures will be forced to turn to hospitals for imaging services, which threatens to overwhelm hospital imaging centers. This in turn would have systemic consequences for patients treated on either an outpatient, emergent or inpatient basis. Operationally, imaging equipment becomes the "bottleneck" to efficient patient care, clinical outcomes may be compromised and costs will rise both up and downstream.

Requiring imaging centers to operate at 90% capacity may also affect how willing certain imaging centers will be to treat Medicare patients. Older patients are more likely to be frail or lack mobility, implying that their procedure times—patient positioning, scanning time, and patient exiting—will be longer and more variable than those of younger patients. Consequently, an "efficient provider" would logically schedule Medicare patients at the end of their queue, or even choose not to provide services to them at all. In either case, patient access diminishes while burden increases.

INFORMING THE DEBATE WITH BETTER DATA

Fundamentally, MedPAC's recommendation to significantly increase the utilization factor is based on its belief that the utilization factor should only be used to lower costs, not to ensure patient access. By attempting to measure current equipment utilization rates and suggesting that payment be set at the level of an "efficient provider", it is clear that MedPAC considers the utilization factor to be only a technical input into a payment formula, rather than its true role as a statement of Medicare patient access policy. It is telling that MedPAC's 2008 Report included no measures of beneficiary access to advanced diagnostic imaging services.[viii]

Rather than focus exclusively on costs, we believe that all stakeholders are best-served with rigorous, predictable and transparent payments set just high enough to call forth a secure, long-run supply of readily available diagnostic imaging services.

Medicare patients obviously benefit from a payment system that results in adequate access to appropriate imaging services, just as taxpayers and the Medicare program benefit when this access is maintained at the lowest payment rate possible. What may be less obvious, or perhaps even surprising, is that imaging equipment manufacturers also benefit when payments are predictable, and are set at the minimum level needed to ensure appropriate patient access.

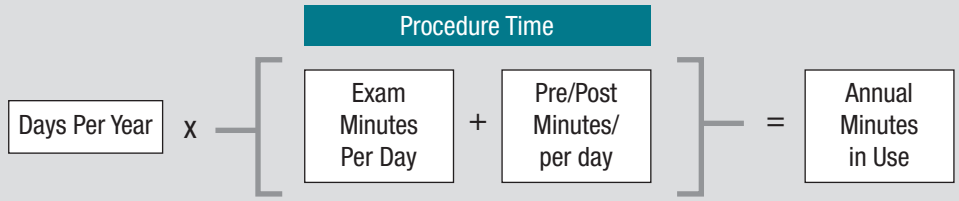
Long-term, manufacturers have no more interest in creating "excess profits" for imaging providers than software manufacturers would have in advocating for artificially high prices for PC microchips. High microchip prices would not be required to call forth the requisite supply and instead would be passed along to downstream consumers, thereby dampening demand for software. By the same reasoning, auto companies have little interest in excessive margins for their dealers, golf club manufacturers have no interest in high-priced golf balls, and so forth.

The price of imaging equipment is determined through rigorous competition among multiple manufacturers. As such, higher provider reimbursement does not translate into higher equipment prices—not even in the short run. High reimbursement may induce modestly higher equipment sales in the short run, which of course redounds to manufacturers' immediate benefit, but the resulting excess capacity makes for a precarious environment over the long term.

What equipment manufacturers seek is a rigorous, adaptable and transparent methodology that takes a prospective view, with reimbursement set "just" high enough to call forth a secure long run supply of the requisite imaging services. To invest in imaging equipment, providers must have confidence that over the life of the equipment reimbursement will provide a "fair" rate of return that reflects the providers' cost of capital and the ongoing risks of ownership. Equipment manufacturers ask for nothing more or less than to have such a methodology, consistent both with economic theory and the stated aims of MedPAC.

The preceding discussion makes it clear that establishing appropriate payment for imaging services requires two essential pieces of information that measure the tradeoff between efficiency and access. First, unbiased and representative data on actual equipment utilization is needed for setting the utilization factor at a level that ensures cost efficiency. Second, information on beneficiaries' access to imaging services must also be available to ensure that payment reductions resulting from increases in the utilization factor do not harm access to care. Below, we explore how existing information technology systems could be harnessed to routinely and inexpensively collect and report these data.

Figure 7: Equipment Utilization Calculated From Service Log Data



Equipment Utilization Data

Diagnostic imaging manufacturers have developed IT systems that remotely monitor imaging system utilization so they can remotely service the equipment. This information is used to test equipment, anticipate routine maintenance needs and ensure that parts are available when service is needed. For example, the use of monitoring systems enables equipment service providers to anticipate when scheduled maintenance based on hours in use is required. In principle, these same data can also be aggregated across equipment manufactures and used to measure actual equipment utilization from a large and geographically diverse sample of imaging equipment.

Procedure time information contained in these "service log" databases represents "exam time," a term that denotes the amount of time elapsed between the machine's first activation during a procedure and the last time it is turned off.[xix] It excludes time associated with patient ingress, positioning, or egress. In short, exam time from the service log data is "machine" time, not "room" or "procedure" time. This distinction is important because the Medicare Physician Fee Schedule is based on "procedure time," which is defined as the time from the point at which the patient enters the imaging room to the time the patient exits that room. This limitation can be overcome by augmenting exam time data with benchmark data on pre-and post-exam times from other sources.[xx]

The following equation illustrates how equipment utilization can be directly measured from equipment service log data.

Definitions for each term in this equation are summarized in the accompanying table:

Days per year Number of days per year the equipment is available for us (approximately 250 non-holiday business days)
Exam minutes per day Number of minutes per day that the scanner is being used to acquire images. This information is available from IT-enabled service log databases
Pre/Post minutes per day The amount of time needed to prepare and position the patient for the scan in the scanner room, and escort the patient out of the scanner room. Benchmark values for these data are available.
Annual minutes in use The estimated annual total minutes the equipment is in use. The current estimate in the fee schedule is 75,000 minutes, and MedPAC is proposing raising this to 135,000 minutes.

Equipment manufacturers, working through the Medical Imaging and Technology Alliance (MITA), are currently working to collect, aggregate, analyze and report actual equipment utilization data from a large sample of scanners across then US. Once this effort is complete, we will have much better data available for assessing how intensely imaging equipment is being utilized. Moreover, this effort will allow equipment utilization data to be periodically updated at very little expense.

Beneficiary Access Data

We propose the creation of a new public-private partnership that will build the infrastructure needed to ensure that Medicare payments are set at the minimum needed to achieve the desired level of beneficiary access to advanced imaging services regardless of provider type (outpatient, IDTF or physician office). The principle objectives of this new initiative would be to:

- Define access to care
- Establish standards for access to care
- Create an infrastructure to accurately monitor changes in access to care over time

Defining Access and Access Standards

Before access can be measured, it must be defined with input from a broad range of stakeholders, including providers, patients, MedPAC, Medicare and others. As a starting point, we believe that the following patient-centric definitions for appropriate imaging access could be established:

- Appointment waiting time: The number of days the beneficiary must wait for an appointment at an imaging center
- Waiting room delays: The difference between the scheduled start time and the actual start time for a procedure
- Off-hour service: The frequency with which imaging services are provided during non-business hours
- Travel distance: The number of miles the beneficiary had to travel to the imaging center

Based on these definitions, we believe that MedPAC should advise Congress on patient access standards for each definition, utilizing broad stakeholder input. For illustrative purposes only, one could imagine a hypothetical access policy defined as follows:

Monitoring Access

Imaging equipment manufacturers have already developed the basic information technology needed to collect and measure data on beneficiary access to advanced imaging services on a near real-time basis. Almost all facilities that perform diagnostic imaging services use a radiology information system (RIS) to schedule, track, store and report information about patients who received services at their facility. For access measurement purposes, RIS systems typically store information needed for the access measures defined in the preceding table: the date the facility was contacted for an appointment, the date the procedure was performed, the time the patient arrived, the amount of time the patient waited in the waiting room, and the patient's zip code.

Figure 8: Hypothetical Access Policy

Parameter	Policy
Appointment waiting time	Mean appointment waiting time for all non-acute imaging services should be less than X days for all modalities and all geographic areas
Waiting room delays	Mean waiting room delays for all non-acute imaging services should be less than X minutes for all modalities and all geographic areas
Off-hour service	Mean percentage of procedures performed outside of normal business hours for all non-acute imaging services should be less than X percent for all modalities and all geographic areas
Travel distance	Mean travel distance for all non-acute imaging services should be less than X, Y and Z miles for beneficiaries located in rural, suburban or urban areas for all modalities

Over the next several months, the Medical Imaging & Technology Alliance will be working to identify and overcome any technical or regulatory obstacles to collecting relevant data from imaging providers in outpatient facilities, IDTFs or physician's offices. Our goal is create a working prototype of an Access to Imaging Monitoring System (AIMS) by the close of 2009, and to then validate the data and expand the facility collection network in 2010.

Reporting

Reporting AIMS data to Medicare, MedPAC and perhaps the public is an important issue that should properly be determined with input from key stakeholder groups. Reporting options range from periodic reports to MedPAC and/or Medicare, to real-time posting of access "telemetry" on a patient-oriented website. Information enabling Medicare to monitor access to care, coupled with separate and necessary initiatives to ensure appropriateness of imaging can have the potential to ensure that the right Medicare beneficiaries get the right image at the right time.

Endnotes

[i] Payment determination for PET is complicated and set at the local level; consequently, our discussion focuses on MR and CT.

[ii] Moser JW. The deficit reduction act of 2005: policy, politics, and impact on radiologists. J Am Coll Radiol 2006 October;3(10):744-50.

[iii] Essentially, Medicare assumes that providers finance the equipment by taking out a mortgage with zero down payment.

[iv] Medicare Payment Advisory Commission (MedPAC). Report to Congress: Increasing the Value of Medicare, 2006.

[v] National Opinion Research Center (NORC). Survey of Imaging Centers: Use of MRI/CT Equipment in Five Markets. Final Report Submitted to the Medicare Payment Advisory Commission. May 2006.

[vi] Median rate splits the sample in half; one-half of facilities surveyed had utilization rates above the median value, and one-half had utilization rates below the median value.

[vii] Medicare Payment Advisory Commission (MedPAC). Public Meeting Transcript. April 19, 2006 (p 301-808-0730)

[viii] Medicare Payment Advisory Commission (MedPAC). Report to Congress: Medicare Payment Policy. March, 2008 (p. 97)

[ix] Medicare Payment Advisory Commission (MedPAC). Report to Congress: Promoting Greater Efficiency in Medicare. June, 2007 (p. 229).

[x] Winter A, Ray N. Paying Accurately for Imaging Services in Medicare. Health Affairs. 27(6): 1497-1490.

[xi] Congressional Budget Office. Budget Options Volume I: Health Care. December, 2008 (pp 117-118)

[xii] CMS. Medicare Program: Revisions to Payment Policies for CY 2007 (pp 69623-70274)

[xiii] Hypothetical data for illustration purposes only.

[xiv] A reader can experiment by first typing "=PMT(0.1,6,-1000000)/3000" into Microsoft Excel®. Here 0.1 represents the cost of capital (10%), 6 denotes the equipment life in years, -1000000 denotes the capital outlay, and 3000 refers to annual throughput. By varying these numbers the reader can see the impact of changes in any one of these assumptions.

[xv] Medicare Payment Advisory Commission (MedPAC). Report to Congress: Medicare Payment Policy. March, 2008 (p. 9)

[xvi] See General Accounting Office, Medicare: Trends in Fees, Utilization, and Expenditures for Imaging Services before and after Implementation of the Deficit Reduction Act of 2005, September 26, 2008, GAO-08-1102R, page 2.

[xvii] Suppose, for example, that a provider "schedules to the mean." This is a common methodology. The provider, in other words, budgets appointment time equal to the average time it has taken historically to complete a particular kind of study. This implies that roughly half of all appointments finish early (thereby yielding significant "white space") and roughly half of all patients run long (thereby delaying the next appointment). More aggressive flow times can reduce white space, but only by creating even more frequent and on average longer delays, especially as utilization rates rise toward 100%. Where arrival and processing times are uncertain, this tradeoff can be quite vexing and may explain why some facilities schedule hourly appointments.

[xviii] Utilization rates are widely reported. Consider, for example, these recent MRI figures from the Certificate of Need Section of the Michigan Department of Community Health: http://michigan.gov/documents/mdch/mrilisthospital_177096_7.pdf and http://michigan.gov/documents/mdch/mrilistfreestanding_177095_7.pdf.

[xix] Note that the time between the beginning and end of an exam may incorporate multiple scans (e.g., a 'scout' scan)

[xx] Benchmark data on pre- and post-exam times are available from equipment manufactures who offer consulting services to their customers.