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Project FORESIGHT: A ten-year retrospective

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ABSTRACT

Forensic service providers fulfill a fundamental role in a criminal justice system by providing scientific information that aids investigations and court proceedings. While the focus is often on the science aspect of these organizations, the provision is also of paramount importance. Historically, calls for more and better information about forensic laboratory performance (in essence, benchmarking) have gone unheard. Project FORESIGHT, created in 2008, filled this need through engagement with the forensic management community to build a needs-based process for providing operational data that can be used to enhance a laboratory's performance. With over 10 years of industry data, Project FORESIGHT is the de facto standard for benchmarking forensic service provision.

1. Introduction

Conducting good science is only part of the task of being a forensic science laboratory. The provision of those services using public funds is as much a part of running a laboratory as the science, especially when other agencies compete for the same funds. Forensic laboratories face the classic economic problem—how to allocate limited resources with increasing demand for services while maintaining high-quality standards. All organizations must address the economic problem and determine how to allocate scarce resources. And once a strategy has been implemented, how does the organization know whether its choices are appropriate? That is, how does the laboratory measure and monitor its attempts to make optimal decisions in meeting the mandates of its mission?

Benchmarking is improving performance by recognizing, understanding, and integrating best—or at least better—practices from either inside the organization or from outside entities. Benchmarking can help laboratory managers answer questions like:

- Are resources appropriately allocated?
- Is the laboratory performance efficient?
- Will alternative practices result in improved, high-quality services?
- Are sufficient safeguards in place to assure the quality of analysis?
- Is the investment in equipment, training, and development to enhance performance sufficient?
- Is the laboratory optimizing the return on investment for its constituency?

Government studies in the late 1960s and early 1970s addressed the issue of forensic laboratory performance metrics and discussed many of the factors that have now become more broadly accepted and used. Yet, for any number of social, economic, political, and organizational reasons, the process of benchmarking was not embraced by the forensic community until the late 2000s, also due to a government-funded project called Project FORESIGHT [19].

This article looks at the history of management data in forensic laboratory management and how benchmarking has become a major force in the improvement of forensic services and the rational stewardship of public resources.

2. History of forensic business analysis

The Law Enforcement Assistance Act (LEAA) of 1965 provided grant funds for the study of criminal justice needs, determining priorities, and offering guidance to law enforcement planners and administrators. One of the key needs was greater access to forensic laboratories and corresponding increases in the personnel to staff those laboratories. An early report confirmed "the disparity between the extensive need for forensic analysis in the solution of

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major crimes and those limited instances in which scientific evidence is effectively employed in present criminal investigations." [1]; page ii). An international survey of forensic service providers in 1963 found that "scientific aid in criminal investigation is a tool of negligible utility. There is no use made of this tool by investigators in over 98% of the known criminal violations" [2]; 412). Major crimes, like homicide, seemed to draw the need for science more so than other offenses [2]. found that less than 15% of all reported crimes made up more than half of the cases examined by a laboratory; for half of the laboratories surveyed (n = 45), homicides made up 20% of the laboratory caseload but only 0.1% of the police caseload. Since its inception, the FBI Laboratory Division has accepted cases from any duly authorized law enforcement agency and yet in 1970, non-federal agencies sent less than 0.1% of their cases to the FBI [3]. The situation was neatly but dispiritingly summarized by Benson and co-authors: "...the involvement of the crime laboratory in the total body of crime has been so miniscule as to preclude a judgment as to the impact of criminalistics on the criminal justice system" (1970; page 7).

Physical evidence was not routinely used by law enforcement due to a variety of factors, including insufficient scientific or technical staff ("In the U.S. it is not uncommon for scientific examinations to be conducted by high school level personnel" [2]; page 418)), little understanding of how to use physical evidence, and a lack of access to laboratories. To this last point, for example, in 1968 there were 17 states (34%) where no city, county, or state agency had a forensic laboratory and 75% of cities with populations over 100,000 had no laboratory access; the sum total of forensic laboratories in the U.S. was 105 [1]. The model regional laboratory served a population of 500,000 to 1,000,000, was no more than a 2 h drive from any point in the jurisdiction served, and had a scientific staff of 12–20; some laboratories had only 2 staff per shift for several thousand sworn officers [1]. The median laboratory budget was determined to be $116,000 ($860,720 in 2020 adjusted dollars). Between 1968 and 1974, a number of reports called for the increased use of forensic services, the creation of more forensic laboratories, and better education and training for staff.

Although forensic laboratories were seen as "not autonomous" and "a tool organized to serve the law enforcement officer," [4]; 26) their similarity to the private sector was not overlooked:

> "In one sense, the crime laboratory can be considered and compared with a business operation which has three basic operating elements: production, distribution, and marketing. The crime laboratory production capacity is more analogous to that of a business which provides services rather than one manufacturing a specific product. If the business is to prosper, it must advertise or market the availability of its services, it must have a location that is convenient to its users (or provide a pickup and delivery services), and it must do quality work on a timely basis if it is to enjoy the confidence and repeat business of its customers." [4]; p26.

The goal of many of the early LEAA reports was, in essence, marketing, trying to convince police to use the new scientific and technical services available to them. Unless the services were readily available, timely, and reliable, they would be of little use to the police (the laboratories customers). Therefore, the frequency of the police's use of and value for forensic services is directly related to the effectiveness of the laboratory operations (Rosenthal and Travnicek, 1974). Nonprofit organizations, like forensic service providers, and for-profit organizations are similar in some ways, like money being an input for both, yet different in others, such as that money, in the form of profits, is an output only for the private sector. Nonprofits must, therefore, measure success in other ways, like effectiveness. Effectiveness is the capability of producing an outcome. While it is good to be effective, public nonprofits are held to the higher standard of efficiency, that is, being effective in the most economical way: The least amount of input produces or exceeds the desired output [5]. An organization's effectiveness is a complicated, dynamic concept that combines the effectiveness of all its individual operations in addition to those externalities that may not relate to money, people, or time, such as social responsibility, professional ethics, and corporate stewardship. In the private sector, profit is an easy single indicator of effectiveness; in the public sector, no such single metric exists.

In the search for metrics of effectiveness, often the scientific laboratory would default to measures that signaled effectiveness for its parent agency's goals. "As part of the total police function, the laboratory is expected to justify the resources budgeted for its scientific services. This pressure has led, in some instances, to record keeping which stresses convictions, clearances, or positive findings–a practice which, to some, contradicts the theoretical goals of scientific objectivity and impartiality" [6]; 5). As an example, Rosenthal and Travnicek (1974) suggested an "effectiveness equation" for forensic laboratories:

$$\frac{\text{Guilty pleas: As charged/to reduced charge (Physical evidence cases)}}{\text{Guilty pleas: As charged/to reduced charge (All cases)}}$$

Arguably, as Peterson notes, factors like guilt and innocence should have no bearing on the scientific results provided by the laboratory; those are *legal* decisions, not scientific ones. The concern in using such measures would be that the laboratory would adopt a police or prosecutorial mindset and become biased in that regard. A policing bias is to be avoided as is cherry-picking or slanting measures to present the laboratory in the best possible light. "All criminal justice researchers have observed the tendency of agencies within the system to stress performance measures which are impressive and "look" as good as possible," Peterson states and "[t]his practice of projecting an amplified image of caseloads and competence may have an adverse effect on the laboratory's contribution to the criminal justice system." (1974; p5). As Goodwin's Law states, "When a measure becomes a target, it ceases to be a good measure" [7]. If a nail manufacturer measures productivity by the number of nails, they may get thousands of small nails but if they measure productivity by weight, they may get a few very small nails. Thus, if an organization's metrics are determined by one entity for their own purposes, it likely will be a bad metric for other units in the organization. Metrics must be chosen carefully and in context.

If the methods of assessment of laboratory efficiency are focused on policing or judicial metrics (arrests, suspects identified, guilt, etc.) rather than on the internal processes that would affect quality and turnaround times, the stated determinants in those reports of police use of forensic services, then the process is self-defeating. If the numbers used to improve the laboratory's efficiency, and, hence, its usefulness to the police, are the wrong ones, the laboratory is doomed to failure and the police have lost a valuable resource. These factors make it abundantly clear that the metrics used to evaluate a laboratory must be relevant, accurate, and free from influence or bias. Otherwise, why bother?

Despite the clear connection between effectiveness and the use of forensic services, many of the early reports also spoke of the dearth of administrative information available to help evaluate service levels, costs and expenditures, and efficiency. "Many crime laboratories do not accurately know their budgets," with some only tracking expenditures, like consumables, and not personnel costs [1]; page 6). The lack of knowledge, or rather the lack of *business* knowledge may have exacerbated the situation. Most supervisors in forensic laboratories are scientists with enough seniority to have been promoted but that does not mean they had any understanding of the management of scientific operations. Benson and co-authors note that, "[w]hile this is desirable in the sense that a laboratory supervisor should have extensive technical knowledge, it would also seem advisable to provide supplementary training in management techniques in order that the greatest utilization of personnel and materials can be achieved" (1970; 11). The main obstacle, however, to evaluating the forensic industry at that time was a lack of standard reporting of productivity metrics. It was thought by Benson and co-authors that the nature of the relationship between a jurisdiction and the laboratory it served was "so unique so as to preclude the common basis for exchange of management-type information" [3]; 7). This notion may have prevented pursuing the standardization that was clamored for: "Just as there is the FBI Uniform Crime Reporting Program, there is a need for a reporting program dealing with cases and examinations involved in the work and activities of non-federal crime laboratories" [1]; 21). Such a program would have required a standardized format to enter data, however; this format was lacking at all levels of laboratory governance [1]. Laboratories could not keep an accurate account of their business metrics or of "customer demand." Benson and co-authors stated, "We are forced to conclude that the number of offenses of laboratory interest is not available at national, regional, or state levels and is only available for a limited number of cities" (1970; 14). The inability to collect and collate laboratory management data created "substantial barriers to a systematic analysis of crime laboratory operations" [3]; 7) and "revealed a paucity of management information concerning what crime laboratories do, or more properly, what crime laboratories should do. There are few or no data on which to evaluate the performance of a crime laboratory" [3]; 11).

Early attempts to produce a standardized format hit snags almost immediately. Each laboratory had a particular, local way of accounting what numbers they did collect but they varied from laboratory to laboratory, and even section to section: "Frequently, the total number of examinations performed is reported; however, in one laboratory the examination of six samples of handwriting from a suspect may be counted as six examinations, while in another it may be reported as only one" [4]; 44). Without a standardized format, with defined terminology, any hope of gaining information about the forensic industry was dashed. Nevertheless, one report recommended:

> "...the establishment of a system for collecting information on crime laboratory operation and effectiveness, performing management analyses on these data, and furnishing the results to all other laboratories. The impact of this program on criminalistics would be both immediate and far-reaching. Participating laboratories will receive early benefit from the project in the collection of more complete data. This improved data base will permit greater insight into each laboratory's own operations and, also, a comparison on a uniform basis with the operations of other laboratories. The results from these would serve as the first step in developing industry standards for laboratory performance. By establishing a mechanism for recording and obtaining results of the use of a laboratory, initial measures of effectiveness could be established" [4]; 45).

It would be nearly four decades before such a system was created.

2.1. Benchmarking

The crux of benchmarking is learning by sharing information between businesses using standardized terminology. Benchmarking is not measuring for the sake of measuring or even merely gaining information about an organization's operations. By comparing work processes, inputs, and outputs, valuable information is gained that can help improve an organization's quality and efficiency. By measuring products, services, and processes against other organizations in the same or analogous industries, leaders can be identified as high performers. While performance indicators can be used to compare performance and quality among peers over time, benchmarking improves specific processes by comparing to high performers and adapting techniques [8]. Benchmarking helps organizations determine units, systems, or processes for incremental improvements (continuous quality operations) but significant business process re-engineering improvements are nearly impossible without benchmarked reference to industry leaders (Fig. 1).

Robert Camp, an early researcher on benchmarking, developed a 12-stage approach to benchmarking. The 12 stage methodology consists of (1995):

1. Select subject
2. Define the process
3. Identify potential partners
4. Identify data sources
5. Collect data and select all partners
6. Determine the gap
7. Establish process differences
8. Target future performance
9. Communicate
10. Adjust goal
11. Implement
12. Review and recalibrate

At a very high level, the process of benchmarking can be broken down into three steps:

1. Evaluate and measure your own operation or specific process to identify weaknesses and strengths.
2. Initiate a benchmarking study and document processes that are more productive or efficient than yours.
3. Determine how to adapt successful processes and procedures from those who may be doing it better than your process.

It is an easy step to move benchmarking into a continuous quality process, like the PDAC cycle [9].

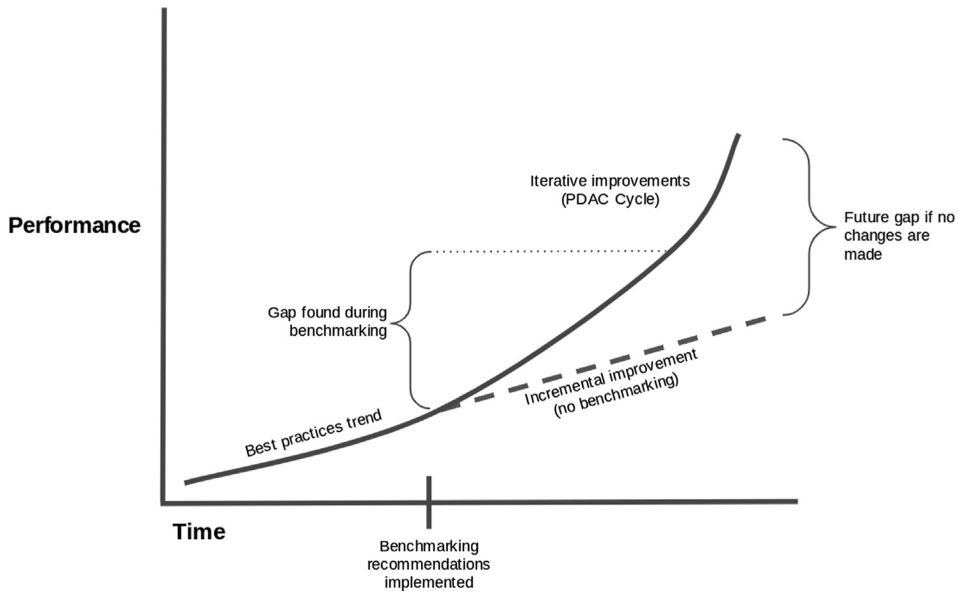

Fig. 1. Without benchmarking, organizations may make incremental improvements but lack the capability to create significant improvement based on industry best practices. Redrawn from asq.org.

3. Project FORESIGHT

3.1. Origin

A 2003 study conducted by the European Network of Forensic Science Institutes (ENFSI) conducted an in-depth analysis of four forensic laboratories in the European Union (Sweden, the Netherlands, Poland, and Finland). The project looked at various metrics across the forensic service providers to yield a cross-comparison for the purpose of learning about better practices. At a 2006 International Forensic Business and Economics Colloquium, sponsored by the West Virginia University Forensic Science Initiative and funded by the National Institute of Justice, a similar study of North American forensic laboratories was proposed. The initiative, called Project FORESIGHT, created what is now the industry standard for forensic laboratory benchmarking and analytics, with 178 laboratories or laboratory systems participating globally by the 2019 fiscal year. Numerous papers have been published in a variety of journals on the Project (Appendix 1). Annual reports provide not only data on the industry but also changes to the Project as requested by participants over time (Appendix 2).

3.2. Purpose

As discussed, benchmarking is improving performance by recognizing, understanding, and integrating best—or at least better—practices [10]. Comparison of any type requires standardized units that are salient, structurally aligned, and systemically related [11]. The FORESIGHT Project, with input from the forensic management community, created standard terminology and methods to collect management data. The terminology laid the foundation for broad, yet deep, comparisons between forensic laboratories using robust measures relating to work processes and linking financial information to work tasks and functions. The metrics allow the assessment of resource allocations, efficiencies, value of services, and return on investment [12,13]. The mission of Project FORESIGHT is to help forensic managers measure their laboratory's functions, preserve what works, and change what does not through cross-laboratory data comparisons to identify and examine processes, strategies, resources, and allocations at a detailed level.

The metrics used are collected through the Laboratory Reporting and Analysis Tool (LabRAT). LabRAT is a condensed, active, data-collection tool that allows for easy entry of information most forensic laboratory directors should have or be able to get readily (Appendix 3). With LabRAT, examples are offered to assist in the counting of items, samples, cases, and tests. Standardization of data collection is paramount in benchmarking, especially early in the process when the collected data are more variable. For example, in the first year of FORESIGHT, one forensic science service provider turned in data for latent fingerprint case work that was ten times that of the other submitting agencies; they had counted tenprint cards as ten items, not one as was required. The mistake was easily rectified due to the nature of the information (ten times, ten fingers) but other data entry and cataloging errors might not have been so easy to identify and fix. At this point in the study, with over 10 years of data, the range of the submitted data is so well characterized that out of range data are spotted relatively easily. The data collected from LabRAT is collated and compared to produce annual reports; tailored reports are also possible. Some LIMS vendors provide the capacity to automatically translate laboratory production data into the LabRAT form; third-party software is also available to perform this task.

3.3. Scope

The goals of the FORESIGHT Project were to improve the efficiency of the science offered to the criminal justice system from a business perspective while also maintaining quality. In FORESIGHT, the intent was to distinguish between "know that" (data or information) and "know how" (putting "know that" to use) (Ryle, 1949) [18]. The former, when available, was to be found in LIMS but used more on a case-by-case or case tracking basis; by distinguishing between "know that" and "know how," standardization, collaboration, and analysis were facilitated while cultivating innovation to solve complex problems. The scale of the data covers financials, productivity, and staffing. The staffing is divided into scientific and administrative only. While more demographic data might be of use eventually, it is currently burdensome for the laboratories to collect. Several laboratories indicated they wanted to know more about staffing issues between degree types and gender (as women make up the majority of forensic laboratory staff [14] and maternity leave could create scheduling issues); once they realized dividing staffing data into three degree levels (BS, MS, Ph.D.) and two genders would result in far more multidimensional data collection (doubling the data entry, in essence, by separating it into "male" and "female") for the laboratory managers, the idea was shelved.

One common misconception is that the data will "look bad" for the laboratory, raising issues of poor performance. This is not necessarily the case. The data serve to flag areas that require further investigation. If a laboratory's budget categorization differs significantly from the norm, laboratory management should dig further to develop an understanding and explanation; similarly with productivity or other metrics. This is the distinction between "know that" (spending is too high or productivity too low in a unit) and "know how" (the process churns through reagents inefficiently or the paperwork is duplicative). Recognize, however, that merely being different from the average does not indicate that a problem exists; it may be the case that the difference is expected due to the nature of the unique mission of a laboratory. Also, note that the industry average includes all organizations in the industry, both the efficient and the inefficient, and does not necessarily represent the ideal budget situation but only the average.

Some of the data reported in the early benchmarking analyses do offer some insights that, while certainly to be viewed with caution and firmly in their historical context, may be instructive for comparison purposes. In 1964, there were 105 state and local forensic laboratories that completed 312,459 cases. The FBI Laboratory Division completed 284,304, including 61,968 non-federal cases (for a total of 374,427 non-federal cases) [1]. Between three and 10 tests were conducted per case [1]. Based on data from Ref. [2]; the cost per case was between $22 and $110, with an average of $51 (1963); that would be between $186 and $930 in 2019 adjusted dollars, averaging $465. Parker calculated the expenditure per 100,000 population to be $2100 to $24,000 ($17,595 to $201,089 in adjusted 2019 dollars), with a median cost per 100,000 population of $7410 ($62,086 in adjusted 2019 dollars) [2] (Tables 1 and 2).

Any forensic science laboratory can participate in the FORESIGHT Project. The participating laboratory managers see the value of this type of project and how it can aid them in managing their laboratories' resources, communicating achievements and needs up and down the hierarchy, supporting and justifying decisions, and laying the groundwork for improvement processes. Ultimately, the more laboratories that participate, the more statistically significant and representative the data become and, therefore, the greater benefit to laboratories who participate.

4. Implications

4.1. Research

While FORESIGHT was undertaken as a means for individual laboratories to gain insight into their own performance, it yields a great deal of insight into the collection of all forensic laboratories as a group. The FORESIGHT project began with a collection of 17 laboratories who guided the direction of the project. Determining what data to collect was an outcome of the issues faced by these laboratories. The first decade of FORESIGHT research has been directed towards many of the problems highlighted by this group of laboratory directors and managers. It has also been molded by new issues that have arisen over the years.

4.2. Outcomes

The goal of the FORESIGHT project is improvement, not punishment—inherent in the pursuit of quality is the promise of redemption [15]. The key performance indicators can be compared to peer laboratory performance (size, scale, or jurisdiction) or be used to determine internal trends for the proper management of the scarce resources at its disposal or to provide quantitative support for the argument for additional resources. Dissemination of success stories by industry leaders and the eventual adoption of similar practices offers an opportunity for the industry to advance its operations.

4.3. Backlog, demand, service issue

The economic problem of limited resources versus unlimited demands for services requires some mechanism for rationing. The services provided by the forensic laboratory must yield to the laws of supply and demand and work towards an optimal rationing mechanism. In the for-profit sector, that rationing mechanism is price. Rarely is the public sector in a position to use the same rationing mechanism and instead must rely on some other method for rationing its scarce resources. That typically becomes a reliance on wait time.

What happens to the demand for services when the rationing mechanism changes? The Law of Demand shows that when prices get higher, the quantity of services demanded falls. Conversely, when prices fall, the quantity of services demanded will rise. Without price to ration, laboratories still experience the reaction predicted by the Law of Demand. However, instead of price changes, the demand for a laboratory's services will increase as turnaround time (TAT) falls and requests for services will fall if turnaround time is increased.

Because of this, attention must be paid to the dynamic nature of service requests. The better a laboratory becomes in the quality processing of evidence, the greater will be the demand for the laboratory's services. Monitoring caseloads, turnaround times, backlog, personnel allocation, and available resources permits the laboratory to predict future resource needs. Too often, simple requests are viewed in static terms. What resources are needed to eliminate the backlog of SAKs? Or, how many more toxicologists are needed to meet the fallout from the opioid crisis or from DUI-drug cases? The demand for these services is dynamic in nature. The faster the laboratory can process quality analysis, the more the demand for services will grow in response to faster throughput.

FORESIGHT data permits such an analysis to take place through

Table 1
Cost per case and cost per 100,000 population served, 1963 (Parker), 1968 (OLEA), and 2019 (Project FORESIGHT). The low value (DNA databasing) and the high value (Explosives) were removed. Values are medians.

	1963			1968 (adjusted)			2019*			% Increase (2019 dollars)		
	Low	Median	High	Low	Median	High	25th percentile	Median	75th percentile			
Cost/Case	$22	$51	$110	$186	$465	$930	$916	$1411	$2450	392%	203%	163%
Cost/100 K	$2100	$7410	$24,000	$17,595	$62,086	$201,089	$245,114	$360,431	$671,114	1293%	481%	234%

Table 2
Case loads, populations served, scientific and clerical staffing for select laboratories in the 1968 OLEA study; this data is compared with cases per full-time equivalent (employees) and cases per 100,000 population served for 2019 Project FORESIGHT data.

OLEA, 1968								
Laboratory	Case Load	Pop	Scientific Staff	Clerical	Cases/FTE 1968	Cases/FTE 2019[a]	Cases/100 K 1968	Cases/100 K 2019[b]
Texas	9696	9,000,000	32	4	269	355	108	446
Los Angeles (city)	1973	7,000,000	85	7	21		28	
Ontario	6061	7,000,000	67	9	80	149	87	144
New York (state)	5030	7,000,000	21	4	201		72	
Massachusetts	7800	5,400,000	7	4	709		144	
Chicago	13,441	5,000,000	59	9	198		269	
Los Angeles (county)	13,000	5,000,000	27	4	419		260	
Florida	1756	5,000,000	11	3	125	248	35	457
Philadelphia	5223	3,500,000	35	4	134		149	
Connecticut	4982	2,900,000	8	4	415		172	
Cleveland	5006	1,500,000	5	1	834		334	
San Diego	5822	1,200,000	10	1	529		485	
San Francisco	6732	750,000	13	3	421	80	898	254
				Median	269	95	149	50
				Average	335	138	234	74

[a] Cases/FTE for ALL investigative areas except DNA Databases (3,353) and Explosives (7), 2019.
[b] Cases/100,000 population served for ALL investigative areas except DNA Databases (187) and Explosives (0.26), 2019.
Source: OLEA, 1968 (page 85)

the measurement of the elasticity of demand. Rather than finding a price elasticity of demand, a TAT elasticity of demand may be calculated for any area of investigation. For example, the TAT elasticity of demand for DNA casework exceeds 1.0. That means that for every 1% decline in TAT, the requests for DNA analysis will increase by more than 1%.

Just like the distance a police officer had to drive to deliver evidence to a laboratory affected submission rates, it was also recognized that the laboratory's timeliness and quality also determined whether the evidence would ever make it to its benches. As far back as 1970, it was realized that

> "[t]he crime laboratory itself influences its own volume of work. If the laboratory is able to satisfy investigators' request for laboratory examinations, then that investigator and others will continue to make similar requests. Conversely, if requests for service are denied, response time is inordinately long, or consistently inconclusive results are provided, the tendency will be to reduce the number of requests for service that the investigators make to the laboratory" [3]; page 29)

Perception of the laboratory's ability to deliver quality results quickly also lead to a "use disparity" of the laboratory between violent crimes, judged to be more detrimental to society, and property crimes. The desired and perceived difference between turnaround times in case types led to a push for or reliance on forensic services in only those cases deemed the "worst" (Rosenthal and Travnicek, 1974). Nevertheless, while officers learned to accept the reality of turnaround times due to overburdened laboratory resources, laboratory management realized, but did not always have the tools to achieve, that more and better resources were needed (Rosenthal and Travnicek, 1974).

The recent report to Congress on the resource needs for forensic laboratories, suggests that the static demand for services falls short in funding by $640 million annually [16]. Lacking sufficient funding, "[t]urnaround time has grown dramatically in nearly every area of investigation over the last six years. The average area of investigation has seen a 60% increase in turnaround time, and some areas have had even more dramatic increases" [16]; p. 179).

Although laboratories have experienced higher productivity over the past decade, "[t]he average 30-day backlog is growing faster than the growth in case submissions; the average backlog across all areas of forensic science has grown nearly 250% over the past six-year time period from 2011 to 2017" [16]; p. 179).

[17] highlights the systemic nature of the backlog problem. Current funding methods are reactive to current systemic failures and often fail to consider the long-term solutions. For example, appropriating funding for the backlog of untested SAKs helped to identify and test the current backlogs but does not address the increases in submissions that will result from the decreases in TAT once the laboratory's customers realize they are getting results faster than before. The TAT elasticity of demand will result in greater reporting of sexual assaults and more SAK submissions to the laboratory, demanding greater long-term funding. Even funded mandates for testing of all SAKs may not be scaled appropriately to fund the surge of submissions due to elasticity.

Additional economic analysis suggests a targeted systemic approach to additional funding. Not all jurisdictions are created economically equal. As with the provision of any good or service, there is an optimal scale of provision of that good or service associated with perfect economies of scale. Many jurisdictions lack the population or the crime rate to achieve perfect economies of scale [12]. details the expected return on investment related to the volume of DNA casework. The project FORESIGHT annual report for Fiscal Year 2018 highlights similar optimal size and productivity for other areas of investigation [13].

5. Future of the project

Project FORESIGHT continues to work towards tools that will provide laboratory managers with the information they need to effectively and efficiently run their operations. For example, in 1970 it was well known that "...the planners of criminalistics operations remain in need of a simple algorithm whereby readily available data could be applied to yield meaningful guidelines for structuring a crime laboratory" [3]; page 16). Today, laboratory managers in Project FORESIGHT have a workforce calculator. The Forensic Technology Center of Excellence houses the beta version of the workforce calculator (https://forensiccoe.org/workforce-calculator-project/). This is a first pass analysis of the production capabilities that is jurisdiction specific. The calculator responds with staffing needs, given the caseload, population served, and local crime rates. From the initial testing of existing laboratories, more sophisticated econometric techniques will be applied to refine the workforce calculator for future use. The collection of annual data across forensic laboratories has permitted the identification of best practices. This includes observations of the most cost-effective laboratories and their allocation of limited resources.

6. Conclusions

Issues and challenges in managing forensic laboratories are not new and many of today's concerns were voiced over 5 decades ago. Project FORESIGHT provides resources to do the job of management, what Mintzberg called "the messy stuff—the intractable problems, the complicated connections" (2005, p. 13)[20]. It is not that the data collected for the project provides direct answers but rather offers the information necessary to feed judgment. The phrase "forensic science service providers" is instructive, in that it acknowledges that science is the service being provided, like any other public good or service. Good science must be provisioned effectively and efficiently for it to fulfill its purpose. Publicly funded forensic services must compete with other governmental entities for resources and unless a cogent argument can be made for why monies should go to the laboratory and not another sibling agency, the laboratory will remain under-resourced. Using the data Project FORESIGHT provides to laboratories and laboratory systems about their performance and that of the industry to monitor and improve operations, the resourcing for and provision of forensic laboratory services can lead to more effective science informing the criminal justice system and good stewardship of the public's investment in forensic science.

Declaration of competing interest

The authors claim no conflicts of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.fsisyn.2020.08.005.

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