

Patent Eligibility And Diagnostic Testing

By Charles Duan

For clinical diagnostics, the most important driver of innovation does not come from investment-backed firms aiming to sell products to laboratories, but from the laboratories themselves as they seek to expand their service offerings.

Introduction

Medical diagnostics have been squarely in the eye of the hurricane in debates over patent eligibility law. After the Supreme Court's decision in *Mayo Collaborative Service v. Prometheus Laboratories, Inc.* applied patent eligibility doctrine under 35 U.S.C. section 101 to hold that a diagnostic correlation between a blood test outcome and a treatment regimen was unpatentable, critics have especially harshly described the doctrine as "unsound," "problematic" and devastating [to] the biotechnology, personalized medicine, and medical diagnostics industries in the United States."¹ These criticisms have led to potentially fast-moving legislative proposals directed specifically at overturning the Supreme Court's recent decisions and rendering diagnostic methods eligible for patenting.²

1. *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66 (2014); *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 809 F.3d 1282, 1287 (Fed. Cir. 2015); Christopher M. Holman, "Mayo, Myriad, and the Future of Innovation in Molecular Diagnostics and Personalized Medicine," *North Carolina Journal of Law & Technology* 15:4 (2014), pp. 639-642. <https://scholarship.law.unc.edu/ncjolt/vol15/iss4/4>; Shahrokh Falati, "Patent Eligibility of Disease Diagnosis," *North Carolina Journal of Law and Technology* 21:3 (March 2020), pp. 63-140. https://digitalcommons.nyls.edu/fac_articles_chapters/1448.

2. Patent Eligibility Restoration Act of 2022, S. 4734, 117th Congress (Aug. 2, 2022). <https://www.congress.gov/bill/117th-congress/senate-bill/4734>; Blake Brittain, "U.S. Senate bill would reform patent-eligibility standards," *Reuters*, Aug. 3, 2022. <https://www.reuters.com/legal/government/us-senate-bill-would-reform-patent-eligibility-standards-2022-08-03>.

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To support claims that the *Mayo* decision and the patent eligibility doctrine have undermined innovation in clinical diagnostics, scholars and policy experts have turned to empirical research on investment in the diagnostics industry. For example, a widely cited survey of venture capital investors found decreases in willingness to invest, particularly in “pharmaceutical, biotechnology, and medical device industries.”³ Another study analyzed data on venture funding and concluded that, following *Mayo*, investment in disease diagnostics technologies increased at a slower rate compared to other industries.⁴ Additionally, the recent report by the U.S. Patent and Trademark Office on patent eligibility jurisprudence demonstrated interest in investment consequences, noting that stakeholders “explicitly or implicitly acknowledged a link between innovation and investment” and dedicated a section to reporting views about how patent eligibility and investment were tied.⁵ However, even in the diagnostics industry, views on the impact of *Mayo* and the patent eligibility doctrine are not uniform; other researchers have found more tenuous or no links between section 101 and investment.⁶ Importantly, all of these studies have focused on venture capital and investment.

For clinical diagnostics, this constant focus on investment as the driver of innovation ignores another important driver—arguably the most important: Diagnostic tests are developed not just by investment-backed firms looking to sell products to laboratories that perform tests, but also by the laboratories themselves in order to expand their service offerings.⁷ The clinical diagnostics industry is thus bifurcated between commercially sold tests and laboratory-developed tests (LDTs), the latter of which are unlikely to be venture-funded by virtue of surrounding regulatory law.

Based on publicly available data from a federally hosted database of testing services, this study finds substantial growth in one important sector of LDTs following *Mayo* in 2012: genetic testing and molecular diagnostics. The number of genetic tests developed has increased at least sevenfold between 2013 and 2022, as has the number of unique genes with developed tests. The vast majority of these, at a ratio of over 500 to 1, are LDTs rather than commercial tests. Although it is not easy to assess the economic benefits of this tremendous growth and further research is required, our preliminary findings show that an important dimension of innovation in the diagnostics industry, LDT development, is largely ignored in the policy discussion of patent eligibility law, and needs to be incorporated into that discussion.

In addition to challenging a dominant line of argument on the doctrine of patent eligibility, this study contributes a broader insight. The failure of patent policy experts to consider the role of LDTs in the diagnostics industry exemplifies a more general failure of patent law to consider the role of “user-innovators,” namely those individuals and firms that innovate not so much to profit off of the sale of proprietary technology as to use that technology to enhance their own businesses and practices. This study thus adds another data point to the burgeoning literature on user-driven innovation and its relationship with intellectual property law.⁸



For clinical diagnostics, this constant focus on investment as the driver of innovation ignores another important driver—arguably the most important: Diagnostic tests are developed not just by investment-backed firms but also by the laboratories themselves in order to expand their service offerings.

3. David O. Taylor, “Patent Eligibility and Investment,” *Cardozo Law Review* 41:5 (2019), pp. 2019-2116. <http://cardozolawreview.com/patent-eligibility-and-investment>.

4. A. Sasha Hoyt, “The Impact of Uncertainty Regarding Patent Eligible Subject Matter for Investment in U.S. Medical Diagnostic Technologies,” *Washington and Lee Law Review* 79:1 (2022), pp. 397-452. <https://scholarlycommons.law.wlu.edu/wluir/vol79/iss1/8>.

5. “Patent eligible subject matter: Public views on the current jurisprudence in the United States,” United States Patent and Trademark Office, June 2022. <https://www.uspto.gov/sites/default/files/documents/USPTO-SubjectMatterEligibility-PublicViews.pdf>.

6. See, e.g., Arti K. Rai and Colleen Chien, “Intellectual Property in Precision Medicine,” Duke University Warppire, Feb. 15, 2018. <https://warppire.duke.edu/w/QP0BAA>; Colleen V. Chien and Arti K. Rai, “Dx Innovation in Decline? An Empirical Analysis post-*Mayo*,” United States Patent and Trademark Office, Dec. 5, 2016. <https://www.uspto.gov/sites/default/files/documents/RT2%206-2%20Colleen%20Chien.pdf>; Turna Ray, “Supreme Court Patent Cases Haven’t Hindered Diagnostics Innovation, Preliminary Data Suggest,” *GenomeWeb*, Dec. 5, 2016. <https://www.genomeweb.com/molecular-diagnostics/supreme-court-patent-cases-havent-hindered-diagnostics-innovation-preliminary>.

7. See, e.g., Amanda K. Sarata, “FDA Regulation of Laboratory-Developed Tests (LDTs),” Congressional Research Service, Dec. 16, 2019. <https://crsreports.congress.gov/product/pdf/IF/IF11389>.

8. See, e.g., Eric von Hippel, *Democratizing Innovation* (MIT Press, 2005). <https://web.mit.edu/evhippel/www/books/DI/DemocInn.pdf>.

Background

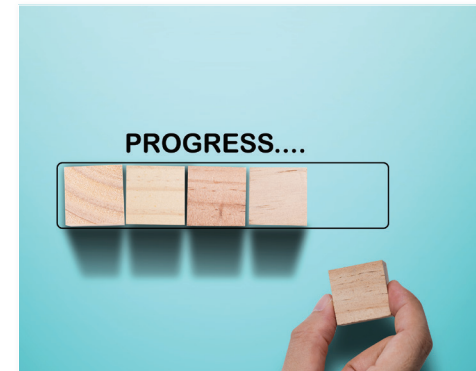
This section provides brief background on the two primary subjects of this study: the patent eligibility doctrine and clinical diagnostic testing.

Patent Eligibility

A patent is a government-backed exclusivity granted to inventors, permitting them to prevent others from making, using, selling or taking other actions with respect to an invention.⁹ Being a potentially substantial limitation on other individuals' and firms' ability to engage in free-market activity, patents must be granted judiciously with "regard to the innovation, advancement or social benefit gained thereby."¹⁰ The limitations on what inventions may be patented are thus central to fulfilling the constitutional requirement that the grant of patents "promote the progress of science and useful arts."¹¹

Three primary legal doctrines restrict the patentability of inventions. Two of them deal purely with the relationship between the invention to be patented and prior knowledge: The invention must be new, or "novel," compared to what was known previously, and it must have been nonobvious to a person with ordinary skill in the relevant technical field at the time the patent is sought.¹² The third doctrine (or the first, in the order that the Patent Act places them) is patent eligibility under section 101. The text of section 101 broadly encompasses "any new and useful process, machine, manufacture, or composition of matter," but in case law, the Supreme Court has identified three categories of exceptions not eligible for patenting: abstract ideas, laws of nature and natural phenomena.¹³

Over at least a century and a half, the Supreme Court and other courts have wrestled with the scope of these three exceptions to patent eligibility, particularly in view of patent applicants' efforts to skirt those exceptions through clever patent document drafting. In *Gottschalk v. Benson*, the Court reached the unremarkable proposition that a mathematical computation was not patentable.¹⁴ Six years later, the Court was faced again with a patent on a mathematical computation, except the patent applicant had tacked on an extra step of "updating the value of an alarm limit" based on the result of the computation.¹⁵ To avoid interpreting patent law in a way that "exalts form over substance," the Supreme Court concluded that "post-solution activity," particularly when "conventional or obvious," cannot transform an otherwise ineligible computation into a patent-eligible invention.¹⁶ More recently, in *Alice Corp. Pty. Ltd. v. CLS Bank International*, the Court held that an otherwise ineligible abstract idea did not become eligible when performed on a general-purpose computer, as the "ubiquity of computers" meant that the patent was no more than "a drafting effort designed to monopolize the abstract idea itself."¹⁷



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9. 35 U.S.C. § 271. <https://www.law.cornell.edu/uscode/text/35/271>.

10. *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 6 (1966).

11. U.S. Constitution, art. I § 8, cl. 8.

12. 35 U.S.C. § 102; § 103.

13. *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 573 U.S. 208, 215 (2014).

14. *Gottschalk v. Benson*, 409 U.S. 63, 71-72 (1972).

15. *Parker v. Flook*, 437 U.S. 584, 586 (1978).

16. *Ibid.*, p. 590.

17. See, e.g., *Alice Corp. Pty. Ltd. v. CLS Bank Int'l*, 573 U.S. pp. 223-24; *Mayo Collaborative Servs. v. Prometheus Labs., Inc.*, 566 U.S. 66, 77 (2014).

This concern about patent eligibility and clever patent drafting explains the trajectory of the Supreme Court’s decisions on patent eligibility of diagnostic testing. In *Ass’n for Molecular Pathology v. Myriad Genetics, Inc.*, the Court reached an again unremarkable decision, holding that a gene sequence found in humans was a natural phenomenon and was therefore ineligible for patenting.¹⁸ The patent holder argued that the act of chemically “isolating” DNA from the human body overcame the eligibility bar, but the Court disagreed, evincing a concern that such a minor distinction would end-run the eligibility doctrine on a technicality.¹⁹

Similarly, in *Mayo*, the Court considered a patent on a method for adjusting the dosage of an autoimmune disease treatment based on measured levels of a chemical in the patient’s bloodstream.²⁰ After noting that the correlation between the chemical level and the dosage was a natural law ineligible for patenting, the Court turned to the question of whether applying that natural law to adjust a patient’s dosage regimen overcame that ineligibility.²¹ Again, worried about mere “drafting effort[s] designed to monopolize the law of nature itself,” the Court concluded that the dosage adjustment aspects of the patent were “well-understood, routine, conventional activity” that were “not sufficient to transform unpatentable natural correlations” into patent-eligible subject matter.²²

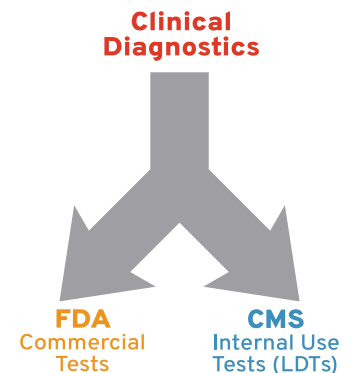
Although *Mayo*’s reasoning is straightforward in the context of section 101 jurisprudence, its implications for patents in diagnostic testing are profound. Most diagnostic testing involves adjusting a treatment in view of a correlation with a measurement, so by *Mayo*’s logic, all such testing is ineligible for patenting.²³ The decision’s broad sweep is what has given rise to the ongoing debate over the patent eligibility doctrine’s effects on the diagnostics industry over the last few years.

The Diagnostics Industry

However, to understand the impact patent eligibility has had on the diagnostics industry, it is first necessary to understand the nature of the industry—which is bifurcated between commercially produced tests and LDTs.

Regulation is the initial driver of this bifurcation. Two federal agencies and regulatory bodies govern clinical diagnostics. First, the U.S. Food and Drug Administration (FDA) regulates the clearance of medical devices under section 510 of the Federal Food, Drug and Cosmetics Act. Second, the Centers for Medicare and Medicaid Services (CMS) provide oversight for clinical laboratories under section 353 of the Clinical Laboratory Improvement Amendments of 1988. If a test is intended to be sold commercially to clinical laboratories or to individual patients, then the FDA oversight applies, and the developer of the test must demonstrate the safety and effectiveness of the test as a medical device. However, if a laboratory develops a test for its own operations and does not sell or distribute the test components, then the test is considered an LDT that the FDA does not regulate. Instead, the lighter-touch section 353 framework applies, in which the CMS sets standards for the quality of laboratory facilities and the expertise of employed scientists but does not investigate individual tests.

Regulation: The Initial Driver of Clinical Diagnostics Bifurcation



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18. *Ass’n for Molecular Pathology v. Myriad Genetics, Inc.*, 569 U.S. 576, 591 (2013).

19. *Ibid.*, p. 593.

20. *Mayo*, 566 U.S., pp. 73-75.

21. *Ibid.*, p. 77.

22. *Ibid.*, pp. 77, 79-80.

23. Rebecca S. Eisenberg, “Diagnostics Need Not Apply,” *University of Michigan Law Review* 21:2 (2015), p. 256. <https://repository.law.umich.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=2718&context=articles>.

The misaligned regulatory approaches for commercial tests and LDTs have generated numerous major controversies over the years, and it is not the purpose of this study to weigh in on that debate.²⁴ The disparate approaches are highlighted as important here because they affect the role of investment in diagnostic tests. The medical device clearance process incurs FDA fees in addition to other costs that may include clinical trials, legal representation and scientific analysis. A 2010 survey estimated that the lower-cost 510(k) pathway for device clearance cost on average \$24 million in “FDA dependent and/or related activities” and 10 months of time.²⁵ For developers of commercial diagnostic tests that must undertake this process, venture capital is important.²⁶ In contrast, clinical laboratories engaged in developing LDTs do not incur per-test regulatory costs under section 353. Furthermore, the constraint that LDTs can only be used in-house (lest they become commercial tests if sold outside) means that the potential returns on investment in LDTs are inherently limited by the laboratory’s size and testing capacity. As a result, venture capital investment in clinical laboratories and LDTs has been much rarer—even prior to *Mayo*.²⁷

Given that venture capital and investment in the diagnostics industry are applicable primarily to commercial tests, it is unsurprising that the literature on investment largely overlooks LDTs. Neither of the major empirical studies of investment in the diagnostics industry mentions LDTs.²⁸ A survey purportedly of “molecular-test companies” considered only commercial test kit developers, characterizing LDTs only in passing as a second-best option to commercial kits.²⁹ Indeed, there is very little literature mentioning both patent eligibility and LDTs, most of which considers the possible interaction between diagnostic test patents and the FDA’s later-withdrawn proposal to tighten regulation of LDTs.³⁰ Only one article, indeed one largely written prior to the Supreme Court’s *Mayo* decision, appears to consider the effects of patent eligibility on the current deregulated environment for LDTs, and that article concluded that “[t]he harms to follow-on innovation from these diagnostic method patents are real and potentially significant.”³¹

Data and Methods

To investigate the role of LDTs in clinical diagnostics, this study uses publicly available data from the Genetic Testing Registry (GTR). Operated by the National Institutes of Health (NIH) since 2012, the GTR is a repository of voluntary submissions by



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24. See, e.g., Kenneth Offit et al., “Regulation of Laboratory-Developed Tests in Preventive Oncology: Emerging Needs and Opportunities,” *Journal of Clinical Oncology* (Aug. 9, 2022), pp. 1-12. <https://ascopubs.org/doi/full/10.1200/JCO.22.00995>; Jonathan R. Genzen et al., “Laboratory-Developed Tests: A Legislative and Regulatory Review,” *Clinical Chemistry* 63:10 (Oct. 1, 2017), pp. 1575-1584. <https://academic.oup.com/clinchem/article/63/10/1575/5612690>; Joshua Sharfstein, “FDA Regulation of Laboratory-Developed Diagnostic Tests: Protect the Public, Advance the Science,” *JAMA* (Jan. 5, 2015). <https://www.law.uh.edu/assignments/spring2015/19040/jvp140180-sharfstein.pdf>.

25. Josh Makower et al., “FDA Impact on U.S. Medical Technology Innovation: A Survey of Over 200 Medical Technology Companies,” MedTech Europe, November 2010. https://www.medtecheurope.org/wp-content/uploads/2015/09/01112010_FDA-impact-on-US-medical-technology-innovation_Backgrounder.pdf.

26. *Ibid.*, p. 17.

27. Gary Kurtzman, “A Business Model for Diagnostic Startups—A Business Model for a New Generation of Diagnostics Companies,” *Biotechnology Healthcare* 2:5 (October 2005), pp. 50-55. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3570996>.

28. Taylor. <http://cardozolawreview.com/patent-eligibility-and-investment>; Hoyt. <https://scholarlycommons.law.wlu.edu/wlur/vol79/iss1/8>.

29. Johnathon Liddicoat et al., “The Effects of Myriad and Mayo on Molecular-Test Development in the United States and Europe: Interviews from the Frontline,” *Vanderbilt Journal of Entertainment and Technology Law* 22:4 (2020), pp. 804, 821-822. <https://scholarship.law.vanderbilt.edu/jetlaw/vol22/iss4/5/>

30. See, e.g., Eisenberg, pp. 285-286. <https://repository.law.umich.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=2718&context=articles>; Arti K. Rai, “Legal Issues in Genomic and Precision Medicine: Intellectual Property and Beyond,” in *Genomic and Precision Medicine*, third edition (Academic Press, 2017), pp. 357-366. <https://www.elsevier.com/books/genomic-and-precision-medicine/ginsburg/978-0-12-800681-8>; Christi J. Guerrini et al., “Constraints on gene patent protection fuel secrecy concerns: a qualitative study,” *Journal of Law and the Biosciences* 4:3 (December 2017), pp. 542-564. <https://academic.oup.com/jlb/article/4/3/542/4636770>; Roger D. Klein, “Intellectual property and regulation of molecular pathology tests,” *Cancer Journal* 20:1 (Jan-Feb 2014), pp. 85-90. <https://pubmed.ncbi.nlm.nih.gov/24445770>.

31. Rachel Sachs, “Diagnostic Method Patents and Harms to Follow-On Innovation,” *Harvard Law Review* 126:5 (Oct. 10, 2013), pp. 1370-1391. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2505766.

clinical testing laboratories of genetic and other diagnostic tests that they offer.³² A laboratory submission of a test may include information such as the genes and conditions (phenotypes) tested for, certifications for the test and the nature of the test’s development (whether it is an LDT or an FDA-approved commercial test).³³

Voluntary submissions of tests to the GTR means that the database is not guaranteed to be comprehensive, especially in its first few years of operation. Nevertheless, it is possible to estimate completeness in view of another database of genetic testing services: GeneTests.org. In 2011, the NIH found that GeneTests included about 7,800 genetic tests and estimated that the database was about 83 percent comprehensive, such that there were potentially 9,360 tests that could be added to the GTR.³⁴ These estimates can be useful for assessing the relative comprehensiveness of the GTR in its early years.

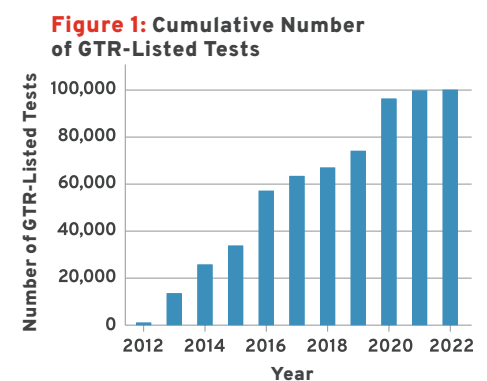
The particular data file used for this study was the GTR’s “test version history” file, which includes records for each version of every test currently or previously listed in the GTR.³⁵ Of note, there may be multiple versions of a test because a laboratory may update its testing protocol or other attributes of a test over time and is required to update its GTR listings accordingly.³⁶

Genetic Testing Registry Analysis

As of September 2022, there were 200,895 test versions and 100,134 tests listed in the GTR. The GTR website itself reported about 74,000 tests as of that same date; the discrepancy is because some tests are subsequently removed from the database when the laboratories that originally listed them no longer offer them. For the purpose of assessing the rate of genetic test development, the full count is more relevant, as even a test subsequently removed from the market still represents test development activity.

Figure 1 shows the cumulative number of distinct tests listed each year. The low number of tests in 2012 (1,081) suggests that laboratories did not submit to the GTR immediately upon the database’s inception. However, by 2013, 13,565 tests were listed, exceeding the number of tests that the NIH anticipated based on the 2011 estimate by almost 45 percent. In comparison to that estimate, the 2013 test count suggests that the GTR was likely relatively comprehensive by that year.

Between 2013 and 2021—the last year for which complete data is currently available—the number of individual genetic tests increased sevenfold, representing growth of about 28 percent each year. These figures are consistent with other research finding substantial increases in available genetic tests during this time period.³⁷ Of note, the bulk of that growth occurred in the first few years: The number of tests almost doubled between 2013 and 2014 and increased by almost 70 percent



32. Wendy S. Rubinstein, “The NIH genetic testing registry: a new, centralized database of genetic tests to enable access to comprehensive information and improve transparency,” *Nucleic Acids Research* 41:D1 (January 2013), pp. D925-D935. <https://academic.oup.com/nar/article/41/D1/D925/1066832>.

33. “Genetic Testing Registry: GTR Field Definitions, Version 2.1,” National Center for Biotechnology Information, Dec. 22, 2015, pp. 1-78. <https://ftp.ncbi.nlm.nih.gov/pub/GTR/documentation/GTRFieldDefinitions.pdf>.

34. “Request for Comments Under the Paperwork Reduction Act, Section 3506,” 76 Fed. Reg. 44397, 44937 National Institute of Health, July 27, 2011. <https://www.federalregister.gov/documents/2011/07/27/2011-18970/request-for-comments-under-the-paperwork-reduction-act-section-3506>.

35. See, e.g., National Library of Medicine, “GTR Data Documents,” National Center for Biotechnology, last accessed Sept. 28, 2022. https://ftp.ncbi.nlm.nih.gov/pub/GTR/data/_README.html.

36. National Library of Medicine, “Code of Conduct,” National Center for Biotechnology Information, last accessed Sept. 8, 2022. <https://www.ncbi.nlm.nih.gov/gtr/docs/code>.

37. Kathryn A. Phillips et al., “Genetic Test Availability And Spending: Where Are We Now? Where Are We Going?,” *Health Affairs* 37:5 (2018), pp. 710-716. <https://www.healthaffairs.org/doi/pdf/10.1377/hlthaff.2017.1427>.

between 2015 and 2016. Indeed, growth was so rapid during this period that one study incorrectly suggested that the growth in test counts between 2014 and 2018 was a data reporting error.³⁸ After the steep growth in those years, the rate of growth slowed to about 12 percent each year between 2016 and 2021.

Although the GTR includes tests from laboratories worldwide, the vast majority of tests, almost 49 percent, come from U.S. facilities. **Figure 2** shows that the United States has generally led the world in new tests added to the GTR in most years. The notable exception in 2020 was largely due to a Turkish laboratory entering records for about 10,000 tests that year.

As seen in **Figure 3**, the vast majority of U.S. tests listed in the GTR were identified as LDTs, which outnumbered tests identified as FDA-approved 559 to 1. This is again consistent with the general perception that most genetic tests are not FDA-approved.³⁹ A fair number of tests omit any information about their development, and a small number of tests identify multiple development types (for example, saying that they are both FDA approved and LDTs depending on the version of the test). It is unclear why a laboratory would omit test-development information, but one possibility is that the FDA’s vacillating positions on what constitutes an LDT led some laboratories to avoid making the determination.

Although the data so far shows that the number of genetic tests available has been rapidly growing, that information alone is insufficient to determine whether laboratories are developing new tests as opposed to copying existing tests of other laboratories. One way to assess the rate of development of new tests is to consider the date of the addition of tests for genes previously not tested. **Figure 4** plots, for each year, the number of genes for which a test was first added in that year. The figure suggests consistent increases in new gene tests, at about 2,100 genes per year. However, the distribution of these new tests is sporadic, with especially large increases in 2016 and 2019. The reasons for these increases are unclear. However, if those spikes are discounted, the rate of new genes tested appears to decrease starting around 2017.

Discussion

Our findings suggest that there has been continuing growth in at least one key area of clinical diagnostics: genetic testing. Both the number of tests available and the number of distinct genes tested for continued to increase substantially well after *Mayo* went into effect. While these numbers increased more slowly in recent years, that change is likely explained by the field moving away from individual gene testing toward newer technologies such as whole-exome sequencing. In any event, a change in LDT development beginning around 2017 is likely not explained by the *Mayo* decision from 2012.

That the vast majority of these tests were LDTs confirms that the ongoing focus on venture capital and investment in diagnostics is potentially misplaced.⁴⁰ To the extent that investment in commercial diagnostics declined following *Mayo*, one might

Figure 2: Number of Tests Added to the GTR Per Year, By Laboratory Nationality

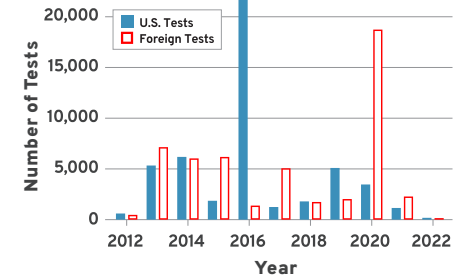


Figure 3: Number of Tests By Development Type

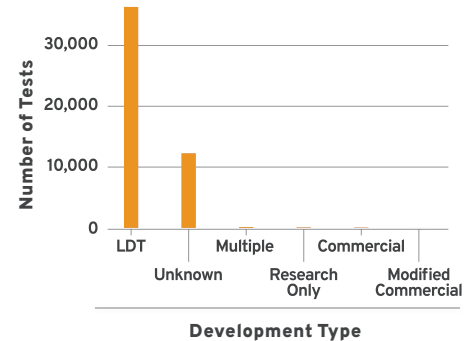
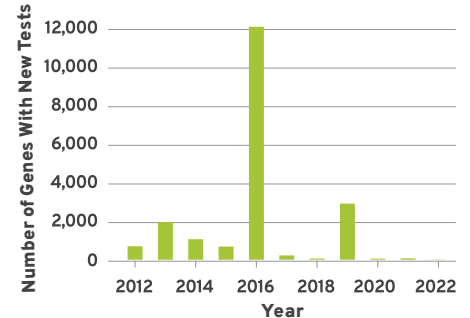


Figure 4: Number of Genes With New Tests Added, Per Year



38. “The Role of Lab-Developed Tests in the In Vitro Diagnostics Market,” The Pew Charitable Trusts, October 2021. <https://www.pewtrusts.org/-/media/assets/2021/10/understanding-the-role-of-lab-developed-tests-in-vitro-diagnostics.pdf>.

39. See, e.g., Amanda K. Sarata and Judith A. Johnson, “Regulation of Clinical Tests: In Vitro Diagnostic (IVD) Devices, Laboratory Developed Tests (LDTs), and Genetic Tests,” Congressional Research Service, Dec. 17, 2014. <https://sgp.fas.org/crs/misc/R43438.pdf>.

40. Mattias Karlsson Dinnetz and Michael S. Mireles, “The Promise of Patent-Backed Finance for SMEs and Universities, and Shifting Patent Eligible Subject Matter,” *Lewis & Clark Law Review* 26:1 (2022), pp. 56-111. <https://law.lclark.edu/live/files/33136-261-dinnetz-mireles>.

hypothesize that laboratories' ability to develop their own genetic tests free of patent concerns made up for the decline. To be sure, the lack of data on LDT development prior to *Mayo* means that this study cannot evaluate this hypothesis, and, moreover, it is not immediately clear how to compare the economic and welfare benefits of LDTs versus commercial tests. Nevertheless, growth in LDTs after 2012 challenges the ongoing assumption that less investment in diagnostics is tantamount to a loss of potential innovation, particularly a loss resulting from patent eligibility jurisprudence.

The data on the countries from which the diagnostic tests were submitted further challenges the supposed impact of eligibility jurisprudence on diagnostic testing: The United States has consistently been the source of most tests listed in the GTR.⁴¹ To be sure, as a U.S.-run database, the GTR likely underincludes non-U.S. tests and laboratories. Nevertheless, the data does not indicate that diagnostics innovators are leaving the United States to develop new tests in countries with supposedly stronger patent protection.

Beyond these observations, the growth in LDTs in the diagnostics industry contributes to a broader consideration that typically has not figured into patent policy discussions. LDTs exemplify a phenomenon known in the economics literature as “user-innovation”: the practice of firms or individuals developing new technologies for their own use rather than to profit off of the sale or exploitation of those technologies.⁴² To be sure, clinical laboratories that develop their own tests do so to profit from new services to patients, so those laboratories are perhaps not “pure” user-innovators akin to the open-source software developers that scholars of user innovation have previously studied.⁴³ Nevertheless, clinical laboratories are in the business of selling test *results to patients*, not the tests themselves, and those laboratories choosing between acquiring a commercial test or developing an LDT in-house face the same innovate-or-buy decision that other user-innovators face.⁴⁴

Prior research has found that user-innovators in other technological fields, such as open-source software developers and sports enthusiasts, exhibit innovation patterns and characteristics distinct from their investment-driven counterparts. Rather than racing to develop technologies in secret in order to outdo their competitors, user-innovators tend to form communities and share their innovations freely, engaging in an open, cumulative process of technological improvement.⁴⁵ These and other features of user innovation are in conflict with patent theory, which has “for the most part remained rooted in the paradigm of commercial sale as motivation.”⁴⁶ Indeed, user-innovators often “do not judge patents to be very effective” and can find their work stymied by webs of overlapping patents.⁴⁷



LDTs exemplify a phenomenon known in the economics literature as “user innovation”: the practice of firms or individuals developing new technologies for their own use rather than to profit off of the sale or exploitation of those technologies.

41. “Patent eligible subject matter: Public views on the current jurisprudence in the United States.” <https://www.uspto.gov/sites/default/files/documents/USPTO-SubjectMatterEligibility-PublicViews.pdf>.

42. Von Hippel, pp. 45-46. <https://web.mit.edu/evhippel/www/books/DI/DemocInn.pdf>.

43. Ibid., p. 20; William W. Fisher III, “The Implications for Law of User Innovation,” *Minnesota Law Review* 94:5 (Jan. 5, 2010), pp. 1417-1477. <https://m.heinonline.org/HOL/LandingPage?handle=hein.journals/mnlr94&div=41&id=&page=>.

44. Von Hippel, p. 3. <https://web.mit.edu/evhippel/www/books/DI/DemocInn.pdf>.

45. See, e.g., Kerstin Balka et al., “The Effect of Selective Openness on Value Creation in User Innovation Communities,” *Journal of Product Innovation Management* 31:2 (Oct. 8, 2013), pp. 392-407. <https://onlinelibrary.wiley.com/doi/10.1111/jpim.12102>.

46. Katherine J. Strandburg, “Users as Innovators: Implications for Patent Doctrine,” *University of Colorado Law Review* 79:2 (June 10, 2008), pp. 467-544. https://its.law.nyu.edu/faculty/profiles/representativeFiles/Strandburg%20-%2079UColoLRev467%20-%20Users%20as%20Innovators_3EA218F7-ADF6-11BB-082ACA7B687FB92F.pdf.

47. Von Hippel, pp. 112-115.

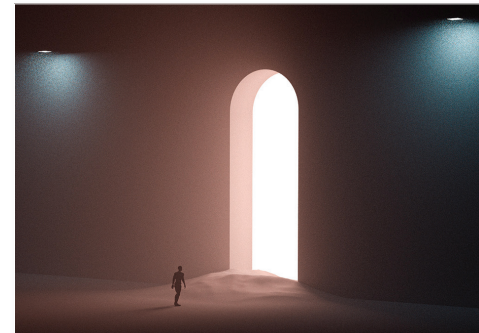
Clinical laboratories developing LDTs demonstrate the potentially tremendous economic and social value of user innovation. Among other things, these laboratories regularly share their discoveries of new genetic variants on the publicly accessible database ClinVar, in line with the general expectation that user-innovators tend to work openly and collaboratively.⁴⁸ To the extent that changes in patent eligibility law increase the protection of diagnostic testing, those changes could have the potentially widespread unintended consequence of diminishing this fast-paced class of user innovation in clinical diagnostics and the benefits of open access to that innovation.

Consider, for example, the leading proposal for reforming patent eligibility law, one of the purposes of which “is to ensure that diagnostics inventions can be patented.”⁴⁹ Before the *Mayo* decision, when human genes and diagnostic tests were treated as patent-eligible, a survey found that a majority of clinical laboratory directors had “decided not to develop or perform a test/service for clinical or research purposes because of a patent.”⁵⁰ Should the proposed legislation restore this pre-*Mayo* state of affairs, one might worry that newly permitted patents under a broader eligibility standard would again dissuade clinical laboratories from developing new and innovative LDTs.

Conclusion

This study has identified an underexplored dimension of the debate over the patent eligibility doctrine and diagnostic testing: the role of LDTs. Prior research into the economic consequences of that doctrine has assumed a model of investment-based innovation and largely ignored LDTs, which do not fit that model well by virtue of the relevant regulatory bodies surrounding them. To fill this gap, this study used data from the publicly available Genetic Testing Registry to trace the growth in LDT development over the last decade. It has shown that, following a substantial cutback in the patent eligibility of clinical diagnostics due to *Mayo* in 2012, development of LDTs continued to grow rapidly. The United States remained a leader in LDT development during that period, and laboratories continued to innovate by developing tests for new genes throughout the study period.

That growth in LDT development challenges the conventional view that investment in clinical diagnostics is the key marker for innovation in that technological space. It suggests a need for more holistic research on the relationship between patent policy and innovation, in particular accounting for user-driven innovation. Most importantly, it suggests a need to consider carefully any changes to patent eligibility law that may diminish ongoing rapid development in this technological space.



This study has identified an underexplored dimension of the debate over the patent eligibility doctrine and diagnostic testing: the role of LDTs.

48. See, e.g., Melissa J. Landrum and Brandi L. Kattman, “ClinVar at five years: Delivering on the promise,” *Human Mutation* 39:11 (Oct. 1, 2018), pp. 1623-1630. <https://onlinelibrary.wiley.com/doi/10.1002/humu.23641>.

49. Ryan Davis, “New Patent Bill Could Boost Diagnostics, But Needs Work,” *Law360*, Aug. 12, 2022. <https://www.law360.com/articles/1520615/new-patent-bill-could-boost-diagnostics-but-needs-work>.

50. Mildred K. Cho et al., “Effects of Patents and Licenses on the Provision of Clinical Genetic Testing Services,” *Journal of Molecular Diagnostics* 5:1 (February 2003), p. 5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1907368/pdf/0108.pdf>.

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