

## AI-BASED PHARMACEUTICAL PRICING AND ALGORITHMIC CARTELS: REGULATORY CHALLENGES UNDER INDIAN COMPETITION LAW

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### ABSTRACT

Artificial Intelligence (AI) has substantially transformed India's pharmaceutical sector, with AI-driven drug delivery, algorithmic pricing, predictive analytics and digital healthcare platforms now woven into the industry fabric. E-pharmacies and AI-enabled supply chains increasingly use machine learning to optimize inventory, forecast demand and streamline distribution, thereby boosting efficiency and accessibility.<sup>1</sup> Yet with these advances comes a complex legal puzzle. AI-driven pricing systems can sometimes result in similar prices across companies even when there's no explicit agreement. This is a genuine challenge for the regulatory body that is trying to ensure fair competition, since traditional competition law tends to focus on human-driven collusion or communication.<sup>2</sup>

The Competition Act 2002 prohibits anti-competitive agreements and abuse of dominance, but it was written for a world where people, not algorithms, set the rules. Today, regulators face new dilemmas about how to assign liability or spot collusion when decisions are made by autonomous systems.<sup>3</sup> This concern is especially urgent for the pharmaceutical sector, where pricing has real consequences for public health and affordability. This study explores how AI might facilitate tacit collusion and whether India's current competition law is up to the task. The analysis draws on statutes, policy documents, judicial precedents, and comparative examples from the United States and European Union, combining legal rigor with a practical focus on the new realities of AI.

**KEYWORDS:** Artificial Intelligence, Competition law, Pharmaceutical Markets, Drug Delivery Technologies, Anti-trust law, Tacit Collusion, Algorithmic Pricing,

### 1. INTRODUCTION

Artificial Intelligence (AI) has emerged as a powerful force in the global pharmaceutical industry sometimes in ways that surprise even longtime industry observers. It's now common to see intelligent drug-delivery systems, predictive healthcare analytics, automated logistics and algorithmic pricing as part of day-to-day operations. In India, these changes are also occurring, as the pharmaceutical industry is embracing AI-driven tools to improve manufacturing, streamline medicine and make healthcare more accessible.<sup>4</sup> E-pharmacies, digital platforms and AI-powered market place distribution have shaken up traditional market structures by embedding automated decision-making at every level. A shift that is as much a talking point in academic circles as it is in boardrooms.

India now ranks among the world's biggest pharmaceutical producers and is a global leader in generics and vaccines.<sup>5</sup> Over the last ten years advances in both healthcare policy and commerce have accelerated the adoption of AI especially in areas such as production, procurement, inventory, and pricing. Government programs such as the National Digital Health Mission have only accelerated this trend.<sup>6</sup> These days it's common to hear from private-sector executives about how machine-learning tools are helping them analyze demand, forecast prescription trends, automate logistics and fine-tune pricing in ways that would have seemed futuristic not so long ago.

There's no denying that integrating AI into pharma has brought clear economic and practical benefits. Intelligent drug delivery now means more reliable demand forecasts, smarter stock management and better patient access especially

<sup>1</sup> World Health Organization, *Global Strategy on Digital Health 2020–2025* (WHO 2021) 18–25.

• Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30.

<sup>2</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 56–70.

<sup>3</sup> Competition Commission of India, *Competition Act, 2002*.

<sup>4</sup> World Health Organization, *Global Strategy on Digital Health 2020–2025* (WHO 2021) 18–25.

<sup>5</sup> Indian Brand Equity Foundation, *Indian Pharmaceuticals Industry Report* (2024) 3–8.

<sup>6</sup> Ministry of Health and Family Welfare, Government of India, *National Digital Health Mission Strategy Overview* (2020) 6–12.

important in a country as vast as India. Automated systems help companies cut waste and respond quickly to market changes, all thanks to predictive analytics and data-driven decision-making.<sup>7</sup> E-pharmacies and digital healthcare platforms have even made it possible for medicines to reach remote areas, a win that sometimes goes underappreciated. It's fair to say that AI-assisted pharma is genuinely modernizing healthcare distribution nationwide.

With these advances also come with a new set of headaches especially for those interested in competition law. Algorithmic coordination, tacit collusion, market concentration and anti-competitive pricing are all on the radar now. Modern self-learning algorithms can quietly monitor competitors, process market data in real time and adjust prices on their own.<sup>8</sup> As a result, we sometimes see parallel pricing and coordinated business moves even when no company has picked up the phone. Distinguishing between smart optimization and anti-competitive behavior has become a genuine puzzle for regulators and a growing topic in both policy and academic debates.

The stakes are high in pharma, since the price of medicine isn't just a business matter it's about public health and everyday access for millions. Algorithmic pricing is now common in digital pharma markets, directly influencing who gets the medicine they need. Big digital healthcare players armed with massive data and advanced AI can use these tools to get ahead and sometimes make it tough for smaller competitors to keep up.<sup>9</sup> The result? Competitive conditions shift, and regulators have to keep a close watch to ensure that market power doesn't get too concentrated or that access to essential medicines isn't compromised.

Against this backdrop, the Competition Act 2002 remains India's main tool for regulating anti-competitive conduct.<sup>10</sup> Sections 3 and 4 ban anti-competitive agreements and abuse of dominance but the law was drafted with human actors in mind focusing on things like clear agreements or coordinated communication. The rise of autonomous AI systems brings new doctrinal headaches algorithms can coordinate or set prices on their own with no direct human input.<sup>11</sup> That means enforcement gets tricky proving liability, intent, or even the existence of collusion is now much less straightforward than it used to be.

International regulatory institutions increasingly acknowledge the competition law implications of AI-enabled coordination. The Organization for Economic Co-operation and Development (OECD), European Commission, and United States antitrust authorities have examined algorithmic collusion as a growing challenge within digital markets.<sup>12</sup> Academic scholarship similarly recognizes that machine-learning systems may facilitate tacit coordination through predictive adaptation and strategic pricing optimization.<sup>13</sup> These developments demonstrate the need to evaluate India's regulatory preparedness for AI-driven pharmaceutical markets and autonomous coordination mechanisms.

In this study, the researcher is examining how AI-driven drug delivery and pricing might clash with competition law in India's fast-changing pharmaceutical sector. I'm especially interested in the rise of algorithmic pricing, automated drug distribution and the risk that companies might 'collude' without ever speaking thanks to similar algorithms. The heart of the study is to ask whether India's current laws are sufficient to address these new problems. This legal analysis examines statutes, policy reports, court cases, and expert commentary to get a full picture of the legal and practical challenges.

With AI now deeply woven into pharmaceutical commerce, it's clear that India needs updated legal tools—not just to protect fair competition, but also to make sure innovation and access to healthcare aren't left behind. Getting the balance right means asking tough questions about who's accountable when algorithms go rogue, how transparent these systems really are, and whether our current antitrust tools are up to the job. India's healthcare economy is changing fast, and the law needs to keep pace.

## 1. Background of the Study

India's pharmaceutical industry has undergone a remarkable technological transformation, largely driven by the integration of Artificial Intelligence into drug development, manufacturing, logistics, and medical delivery. These AI-driven pharmaceutical technologies are now widely used to support predictive diagnostics, robotic dispensing systems, automated prescription analysis, and personalized medicine distribution, as well as to enhance intelligent healthcare logistics.<sup>14</sup> In practice, pharmaceutical enterprises rely on machine-learning algorithms to streamline operations, optimize production schedules, and minimize distribution delays across complex healthcare supply chains.

The fast-paced growth of AI-enabled pharmaceutical systems is part of a broader trend of digitalization in India's healthcare sector. Over the past few years, government-led digital health initiatives have played a key role in encouraging innovation, specifically to make healthcare more accessible, strengthen pharmaceutical governance, and modernize

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<sup>7</sup> Ajay Agrawal, Joshua Gans and Avi Goldfarb, *Prediction Machines: The Simple Economics of Artificial Intelligence* (Harvard Business Review Press 2018) 77–85.

<sup>8</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30.

<sup>9</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 56–70.

<sup>10</sup> Competition Commission of India, *Competition Act, 2002*.

<sup>11</sup> Maurice E Stucke and Ariel Ezrachi, 'Artificial Intelligence and Collusion: When Computers Inhibit Competition' (2017) 2017 University of Illinois Law Review 1775, 1782–1788.

<sup>12</sup> OECD (n 5) 33–41.

<sup>13</sup> Ariel Ezrachi and Maurice E Stucke (n 6) 83–95.

<sup>14</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 24–28.

medical infrastructure.<sup>15</sup> The National Digital Health Mission, for instance, has helped to connect digital health records, telemedicine services, pharmaceutical distribution and analytics platforms. Because of these changes, the adoption of AI-assisted systems has accelerated across a broad range of healthcare ecosystems, from hospitals and care providers to online pharmacies and diagnostic services.

AI-driven drug delivery technologies now offer a wide range of both commercial and clinical benefits in the pharmaceutical market. For example, predictive analytics systems help healthcare providers pinpoint patient-specific treatment needs and forecast demand for medicines more accurately.<sup>16</sup> On the logistical side, smart platforms are optimizing transportation routes, reducing medication waste, and making inventory management far more efficient through real-time data analysis. Automated dispensing technologies also play a significant role by improving the accuracy of pharmaceutical distribution and reducing the inefficiencies associated with manual systems. In short, AI-enabled healthcare ecosystems are making pharmaceutical supply chains and medicine delivery frameworks more efficient than ever before.

The rise of personalized medicine highlights just how important AI has become in pharmaceutical delivery systems. These days, AI-assisted technologies can analyze everything from genetic data to prescription histories and patient-specific healthcare information, ultimately helping doctors recommend individualized treatments and optimize drug administration.<sup>17</sup> More and more, pharmaceutical companies are turning to computational models that predict how patients will respond to medicines and identify the most suitable therapeutic options. Such advances are making precision medicine a reality and are gradually improving healthcare outcomes within India's increasingly digital pharmaceutical ecosystem.

Indian pharmaceutical companies are also collaborating more closely with technology firms, healthcare startups, and digital platforms in their push to bring AI-based solutions into everyday business. For example, e-pharmacies and online healthcare marketplaces are using machine-learning algorithms for everything from targeting consumers and managing prescriptions to automating customer support and offering dynamic product recommendations.<sup>18</sup> These platforms now gather large amounts of consumer and healthcare data, which supports predictive business strategies and enables more personalized pharmaceutical services. In this way, data-driven pharmaceutical governance is becoming a major force in shaping India's digital healthcare landscape.

The spread of AI-driven pharmaceutical systems in India also mirrors global advances in healthcare regulation and medical innovation. International pharmaceutical corporations are now using AI for everything from drug discovery and clinical trial management to supply chain optimization.<sup>19</sup> As India becomes more integrated with global pharmaceutical markets, there's been a noticeable shift toward adopting similar technological frameworks domestically. It's clear that AI-assisted pharmaceutical systems in India are part of a worldwide trend toward digital healthcare modernization and the rise of data-driven medical governance.

Taken together, these developments show how AI-driven drug delivery technologies are now playing a central role in shaping India's pharmaceutical infrastructure. From automation and predictive analytics to smarter supply-chain management, the impact is far-reaching. The rapid growth of AI-assisted healthcare ecosystems is opening up new opportunities to make medicines more accessible and operations more efficient. However, as these systems expand, they also bring complex regulatory and competition law challenges that demand thorough legal analysis.

Algorithmic pricing systems are now a major force in how commercial decisions are made in pharmaceutical markets. These systems use automated analysis of factors such as competitor actions, consumer demand, inventory levels, and market changes. Thanks to AI-enabled pricing technology, large datasets can be processed and medicine prices can be adjusted in real time, all based on predictive commercial models.<sup>20</sup> As a result, pharmaceutical companies and e-pharmacy platforms are increasingly relying on these algorithmic systems to fine-tune pricing strategies, boost profits, and stay competitive in an ever-evolving digital healthcare landscape.

Dynamic pricing mechanisms are now at the heart of AI-driven pharmaceutical commerce. Machine-learning systems monitor market conditions and competitor pricing, continually seeking the most commercially beneficial pricing outcomes.<sup>21</sup> These technologies enable price adjustments to be made instantly as supply-chain conditions, consumer habits, prescribing patterns, or inventory levels change. In turn, automated pricing systems help distribution networks respond faster and reduce the need for manual intervention in commercial decision-making.

The rapid growth of e-pharmacies in India has given a strong push to the adoption of algorithmic pricing. These online pharmaceutical marketplaces rely on complex, data-heavy models that use predictive analytics, consumer profiling, and real-time inventory checks to guide their operations.<sup>22</sup> With AI-enabled systems, e-pharmacies can better understand customer needs, make smarter product recommendations, forecast demand, and fine-tune their promotions. All of this

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<sup>15</sup> Ministry of Health and Family Welfare (n 3) 10–15.

<sup>16</sup> World Health Organization (n 1) 30–34.

<sup>17</sup> Eric Topol, *Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again* (Basic Books 2019) 112–118.

<sup>18</sup> NITI Aayog (n 11) 35–38.

<sup>19</sup> Deloitte, *AI-enabled Drug Discovery and Clinical Trials Report* (2023) 9–14.

<sup>20</sup> OECD (n 5) 25–29.

<sup>21</sup> Ajay Agrawal, Joshua Gans and Avi Goldfarb (n 4) 91–96.

<sup>22</sup> Federation of Indian Chambers of Commerce and Industry, *Digital Healthcare in India Report* (2022) 18–22.

enables digital healthcare platforms to navigate the fast-changing, competitive world of pharmaceutical markets more efficiently.

Automated pharmaceutical distribution systems are playing a key role in modernizing India's healthcare supply chains. These days, intelligent logistics platforms use AI to handle warehousing, optimize the transport of medicines, and coordinate deliveries to even the most remote parts of the country.<sup>23</sup> Predictive supply-chain systems can analyze past purchasing patterns and healthcare demand trends, which helps improve inventory allocation and minimize shortages. Thanks to these automated distribution technologies, pharmaceutical accessibility is improving, and operational coordination across digital healthcare ecosystems is improving.

Beyond logistics, algorithmic pricing and automated distribution systems are also shaping how competition plays out in the pharmaceutical sector. Large platforms with advanced technology and vast consumer datasets can gain significant competitive advantages through predictive analytics and automated commercial optimization.<sup>24</sup> When data gets concentrated in the hands of a few technologically advanced players, it can make it harder for others to enter the market and can change the way competition unfolds in India's pharmaceutical ecosystem.

Naturally, as algorithmic pricing systems become more common, they are raising important legal and regulatory questions about transparency, accountability and the governance of competition. Self-learning algorithms that can adjust prices on their own in response to competitors' actions may end up producing similar prices and coordinated market behavior even without any explicit agreement.<sup>25</sup> Because of this, competition authorities are finding it increasingly challenging to maintain effective oversight of AI-enabled pharmaceutical markets and to detect anti-competitive behavior arising from these new technologies.

Digital healthcare platforms and e-pharmacies have seen swift expansion in India, thanks in large part to greater internet penetration, widespread smartphone use, ongoing technological advances, and changing healthcare consumer expectations. Online pharmaceutical marketplaces now routinely offer integrated healthcare services like digital prescriptions, telemedicine consultations, pharmaceutical delivery, and even AI-powered consumer support.<sup>26</sup> These platforms are built on sophisticated infrastructures that blend data analytics, automated logistics, and algorithmic pricing to make healthcare distribution networks more efficient than ever before.

The COVID-19 pandemic played a major role in accelerating the adoption of digital healthcare across India, boosting the commercial growth of e-pharmacies and telemedicine platforms.<sup>27</sup> During this period, more and more consumers turned to digital healthcare systems to order medicines, receive remote consultations, and use contactless delivery services. As a result, AI-enabled healthcare platforms saw significant growth, as people demanded more efficient and accessible healthcare solutions. This also pushed pharmaceutical companies to invest heavily in digital infrastructure to strengthen automated healthcare delivery and expand their online operations.

AI-enabled supply chains are now a crucial part of India's digital pharmaceutical landscape. Today's intelligent logistics systems use predictive analytics, machine learning, and real-time monitoring to make sure pharmaceutical distribution processes run smoothly and efficiently.<sup>28</sup> Automated warehousing helps keep a better track of inventory and reduces logistical hiccups in medicine distribution. Meanwhile, AI-assisted transportation makes delivery schedules more reliable and improves coordination across even the most geographically dispersed healthcare markets.

On top of this, digital healthcare platforms are generating huge amounts of consumer and healthcare data that can significantly influence pharmaceutical market behavior. E-pharmacies are routinely gathering data on how consumers buy medicines, their prescription histories, personal preferences, and broader healthcare usage patterns.<sup>29</sup> AI systems sift through all this information to create personalized product recommendations, target advertising, and manage dynamic pricing. Increasingly, it's this data-driven approach that is shaping how commercial decisions are made in India's pharmaceutical markets.

The continued growth of digital pharmaceutical platforms is making healthcare more accessible across a wide range of regions, including semi-urban and even remote areas. These days, more consumers outside major cities can get the medicines they need through online pharmaceutical marketplaces, many of which rely on AI-powered logistics to deliver them.<sup>30</sup> Telemedicine has further expanded access to healthcare by connecting patients and providers through digital channels. All together, these AI-driven healthcare ecosystems are pushing India closer to its goals of modernizing healthcare and making medicines widely accessible.

Taken together, these trends make it clear that digital healthcare platforms, e-pharmacies, and AI-powered supply chains are reshaping how pharmaceutical markets are governed and how competition unfolds in India. While these technologies are making healthcare more efficient and accessible, they're also raising fresh regulatory concerns—especially around data concentration, algorithmic pricing, and the risk of anti-competitive practices

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<sup>23</sup> World Economic Forum, *AI in Healthcare Supply Chains* (2021) 11–16.

<sup>24</sup> OECD (n 5) 37–39.

<sup>25</sup> Maurice E Stucke and Ariel Ezrachi (n 8) 1791–1798.

<sup>26</sup> FICCI (n 19) 24–30.

<sup>27</sup> World Health Organization, *Global Pulse Survey on Continuity of Essential Health Services During the COVID-19 Pandemic* (2021) 15–18.

<sup>28</sup> World Economic Forum (n 20) 18–23.

<sup>29</sup> NITI Aayog (n 11) 40–42.

<sup>30</sup> Ministry of Health and Family Welfare (n 3) 16–19.

The growing integration of AI technologies into pharmaceutical markets is raising some big questions for competition law—especially regarding algorithmic collusion, market concentration, pricing coordination, and digital platform dominance. Nowadays, AI-enabled systems can autonomously monitor competitors and adjust strategies, enabling coordinated market outcomes to emerge even without explicit agreements among pharmaceutical companies.<sup>31</sup> This situation poses a real regulatory challenge, since traditional competition law tends to focus on human-driven collusion that's based on clear communication or proof of a conspiracy.

Algorithmic pricing systems also make tacit collusion a real possibility by adapting to the market and synchronizing commercial responses. Self-learning algorithms can continuously monitor competitor pricing and adjust their own prices to maximize profits in digital pharmaceutical markets.<sup>32</sup> Over time, repeated interactions between these algorithms can lead to stable, parallel pricing sometimes weakening genuine competition. This makes it much harder for competition authorities to distinguish between fair algorithmic optimization and unlawful coordinated behavior.

Because pharmaceutical pricing has a direct impact on healthcare affordability and public welfare, the pharmaceutical sector needs even closer scrutiny under competition law. When algorithmic coordination pushes prices up or narrows price diversity, it can hurt consumers' access to essential medicines.<sup>33</sup> Plus, digital healthcare markets with lots of data concentration and platform dependency often help technologically advanced companies become even more dominant while smaller firms that can't match these AI capabilities may face real challenges just to compete.

India's Competition Act, 2002, is set up to prohibit anti-competitive agreements (section 3) and abuse of dominant position (section 4).<sup>34</sup> Still, the law mainly addresses traditional cartelization involving clear agreements or coordinated communication. The arrival of autonomous AI systems is stretching these traditional legal ideas, since algorithms can independently generate collusive outcomes through their own learning processes.<sup>35</sup> That makes it much trickier to assign liability, as it's hard to prove intent, agreement, or even direct human involvement.

International competition regulators are waking up to these risks, too. Both the OECD and the European Commission have recognized that AI technologies can enable tacit collusion by continuously monitoring markets and adapting strategies in real time.<sup>36</sup> When you look at how regulation is changing globally, it's clear there's a growing need to modernize competition law frameworks to handle algorithmic governance and autonomous coordination.

As AI-regulated pharmaceutical markets become the norm, there's a greater need than ever for thorough legal analysis covering everything from algorithmic accountability and market transparency to antitrust liability and digital competition governance. To keep these increasingly automated markets fair and accessible, competition law needs to adapt and ensure that consumer welfare and healthcare access are protected.

## 1.2 Statement of the Problem

Artificial Intelligence (AI) is now a driving force in how commercial decisions are made across pharmaceutical markets. With the rise of automated pricing systems, predictive analytics, digital healthcare platforms, and smart supply-chain management, the industry looks very different from what it did even a few years ago. In India both pharmaceutical companies and e-pharmacies are increasingly turning to machine-learning algorithms to fine-tune pricing, monitor consumer behavior, forecast demand, and streamline distribution.<sup>37</sup> Thanks to these technological leaps, healthcare delivery and pharmaceutical commerce have been fundamentally reshaped, with AI-enabled systems now affecting everything from market competition and pricing to inventory management and how easily consumers can access medicines in this rapidly digitalizing environment.

The adoption of algorithmic pricing systems in pharmaceutical markets has raised major competition law concerns, particularly regarding tacit collusion and autonomous coordination. Typically, cartelization involves clear agreements among competitors to fix prices, impose production limits, allocate markets, or engage in other coordinated actions.<sup>38</sup> Traditionally regulators have relied on evidence like communications, conspiracies, or coordinated agreements to enforce competition law. But AI-driven pharmaceutical markets are a new ballgame self-learning algorithms can now monitor market conditions, analyze competitors' moves and adjust commercial strategies all on their own, without any direct human involvement.<sup>39</sup>

Machine-learning algorithms running across different pharmaceutical platforms are constantly crunching huge amounts of data everything from competitor prices and prescription patterns to demand shifts, consumer preferences and supply-chain changes. The goal is to Maximize profits and maintain sharp market performance through predictive analysis and

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<sup>31</sup> OECD (n 5) 33–41.

<sup>32</sup> Ariel Ezrachi and Maurice E Stucke (n 6) 95–103.

<sup>33</sup> World Health Organization (n 1) 41–45.

<sup>34</sup> Competition Commission of India, *Competition Act, 2002*.

<sup>35</sup> Maurice E Stucke and Ariel Ezrachi (n 8) 1801–1807.

<sup>36</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–52.

<sup>37</sup> World Health Organization, *Global Strategy on Digital Health 2020–2025* (WHO 2021) 18–25.

<sup>38</sup> Richard Whish and David Bailey, *Competition Law* (10th edn, Oxford University Press 2021) 530–538.

<sup>39</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30

automated adaptation.<sup>40</sup> But there's a catch: as algorithms keep interacting in these digital markets, it's possible for parallel pricing and synchronized behavior to emerge, quietly weakening competition. This means that autonomous systems might end up facilitating tacit collusion simply through computational learning, with no explicit human coordination required.

Tacit collusion is a real worry in AI-regulated pharmaceutical markets, precisely because algorithms can coordinate without any obvious agreements or direct communication between competitors. Self-learning algorithms by observing the market and adapting can develop pricing strategies that benefit all players.<sup>41</sup> When multiple firms use similar pricing software or AI systems they might unintentionally arrive at stable higher than competitive prices without ever conspiring. This scenario puts pressure on older competition law doctrines that rely heavily on finding actual agreements or obvious parallel conduct.

This issue is especially sensitive in the pharmaceutical sector where the price of medicine isn't just a business matter it has direct consequences for public health, affordability and access to vital drugs. When algorithmic pricing leads to higher prices or less price variety it can seriously hurt consumer welfare and make healthcare less accessible in India.<sup>42</sup> Digital healthcare markets dominated by a few powerful platforms with advanced AI and massive data resources can end up crowding out smaller firms making it even harder to maintain a level playing field.

India's pharmaceutical sector is part of one of the world's fastest growing digital healthcare environments. Government efforts such as the National Digital Health Mission have significantly accelerated the adoption of new technologies across distribution networks, telemedicine and e-pharmacies.<sup>43</sup> Online healthcare marketplaces are now using AI to automate everything from procurement and logistics to real time price adjustments. While these shifts have made operations more efficient and medicines more accessible they have also raised new worries about algorithmic coordination and the risk of market concentration.

India's Competition Act 2002 is the country's main law for tackling anti-competitive behavior.<sup>44</sup> Section 3 addresses agreements that negatively affect competition and section 4 focuses on abuse of dominance. The thing is, these rules were mostly designed with traditional business practices in mind where there is a paper trail or clear human involvement. Autonomous AI systems complicate things algorithms can now produce anti-competitive outcomes on their own without any explicit human intent or direct conspiracy.<sup>45</sup>

One of the toughest legal puzzles with AI facilitated cartelization is proving intent. Traditional competition law relies on finding evidence of deliberate anti-competitive aims or coordinated strategies among companies.<sup>46</sup> But with AI based pricing things get tricky these algorithms adapt on their own based on market data and predictive analytics. Companies might use them just to get more efficient, not to collude. Still as these autonomous systems keep interacting they can end up setting similar prices and limiting competition without anyone actually intending it. This makes it hard to tell where intentional collusion ends and technology-driven market adaptation begins.

The whole idea of what counts as an agreement under competition law gets blurry in AI regulated pharmaceutical markets. Traditionally cartel investigations look for evidence like conversations, meetings, or decisions that show companies working together.<sup>47</sup> But now autonomous algorithms can create coordinated pricing even if the companies never actually talk to each other or make any formal arrangements. So when firms use similar algorithms they might end up with synchronized prices and market behavior without any clear agreement. That a tough challenge for existing legal standards which weren't built to handle this sort of computational coordination.

Assigning liability is another huge challenge in AI-driven pharmaceutical markets. These autonomous pricing systems involve a web of contributors software developers, pharma companies, data providers, digital platforms and those who manage the algorithms.<sup>48</sup> When self-learning algorithms end up causing anti-competitive outcomes, it's hard to say who's really responsible since so many different players are indirectly involved in how decisions get made. Regulators are left wondering Should liability fall on the company using the AI the tech company that built it or the platforms that run the infrastructure.

The way evidence is collected in competition law makes it even more complicated to regulate algorithmic collusion. Traditional cartel cases depend on finding documents, emails, meeting records or witness statements that show businesses were working together.<sup>49</sup> But with algorithmic coordination most of the action happens via automated data exchanges and

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<sup>40</sup> Ajay Agrawal, Joshua Gans and Avi Goldfarb, *Prediction Machines: The Simple Economics of Artificial Intelligence* (Harvard Business Review Press 2018) 77–90.

<sup>41</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 83–95.

<sup>42</sup> World Health Organization, *Access to Medicines and Health Products Programme* (WHO 2022) 10–15.

<sup>43</sup> Ministry of Health and Family Welfare, Government of India, *National Digital Health Mission Strategy Overview* (2020) 6–15.

<sup>44</sup> Competition Commission of India, *Competition Act, 2002*.

<sup>45</sup> Maurice E Stucke and Ariel Ezrachi, 'Artificial Intelligence and Collusion: When Computers Inhibit Competition' (2017) 2017 University of Illinois Law Review 1775, 1788–1801.

<sup>46</sup> Richard Posner, *Antitrust Law* (2nd edn, University of Chicago Press 2001) 63–69.

<sup>47</sup> Maher M Dabbah, *Competition Law and Policy* (Cambridge University Press 2010) 214–220.

<sup>48</sup> OECD (n 3) 33–41.

<sup>49</sup> Richard Whish and David Bailey (n 2) 540–546.

computational learning so there is often no clear evidence of communication or conspiracy. Since self-learning systems are always tweaking prices based on calculations not direct instructions its very tough for regulators to spot investigate and prove anti-competitive conduct caused by algorithms.

These problems are exacerbated by regulatory gaps in India's competition law. There aren't any sector specific laws that target algorithmic collusion, autonomous computational coordination or AI-driven market conduct.<sup>50</sup> The Competition Act, 2002 for example doesn't spell out what counts as algorithmic coordination, digital collusion or AI-assisted tacit cartelization. As a result regulators are still using older doctrines that may not be enough for dealing with the new tech complexities of AI and machine learning in pricing.

Another issue is the lack of requirements for algorithmic transparency which makes regulatory oversight even tougher in pharma markets. Many AI pricing systems work as black boxes their inner workings are hard to explain or review from the outside.<sup>51</sup> This means competition authorities may struggle to understand how these systems make decisions or to spot anti-competitive outcomes that come from machine-learning interactions. The limited transparency not only complicates holding the right parties accountable but also makes legal enforcement that much harder in digital healthcare systems.

Looking at developments around the world, it's clear that regulators are waking up to the risks of algorithmic collusion. The Organization for Economic Co-operation and Development (OECD), for instance has pointed out that AI systems can help drive tacit coordination by adapting to the market and constantly tracking competitors.<sup>52</sup> Both the European Commission and US antitrust authorities have begun investigating how autonomous pricing technology can affect competition in digital markets.<sup>53</sup> Scholars are also noting that machine learning algorithms might end up mimicking cartel behavior even without any explicit human deals.<sup>54</sup> All of this shows that there is growing concern internationally about whether current competition laws are really up to the task of managing AI-driven business practices.

This is especially urgent in the pharmaceutical world, where anti-competitive practices can directly affect the affordability access and public welfare of medicine. If AI driven pricing keeps pushing up the cost of medicines it could harm people who rely on affordable drugs and digital healthcare services especially those who are economically vulnerable.<sup>55</sup> On top of that if algorithmic market concentration continues to grow a few dominant platforms could end up controlling most of the healthcare data and AI infrastructure. That's why smart regulation of AI in pharma really matter for fair competition consumer protection and healthcare equity in India.

Because of these issues the current legal framework in India struggles to address autonomous coordination tacit algorithmic collusion and liability determination in AI regulated pharmaceutical ecosystems. Most competition law doctrines were built for the old-school world of clear human agreements and direct communication. But now AI-driven pharma systems can coordinate outcomes on their own, just by crunching data and adapting to the market. That's why there is a real need for legal analysis around algorithmic accountability, antitrust liability, evidentiary rules and modernizing regulations for India's fastchanging pharma sector.

In short this study examines the widening gap between India's fast evolving AI-powered pharmaceutical market and the more traditional legal frameworks designed to ensure fair competition. With autonomous pricing and digital healthcare platforms now shaping how pharma markets operate sometimes allowing tacit collusion to slip through the cracks existing laws struggle to keep up. Without clear rules for algorithmic accountability, computational coordination, or AI focused antitrust liability, there is a significant uncertainty about how best to regulate India's digital pharmaceutical ecosystem.

### 1.3 Objectives of the Study

The rapid integration of Artificial Intelligence (AI) into India's pharmaceutical markets has brought about sweeping changes. Drug delivery systems, pricing, digital healthcare platforms and supply-chain governance are all being transformed by these technologies. AI-enabled pharmaceutical ecosystems now routinely use machine learning to automate pricing improve medicine distribution, forecast consumer demand, and make healthcare more accessible.<sup>56</sup> These shifts, while boosting efficiency have also triggered new legal and regulatory debates especially around algorithmic coordination, market concentration, tacit collusion and antitrust liability. This study explores how AI driven pharmaceutical technologies interact with India's competition law framework in the digital healthcare era.

A main objective of this study is to look at how AI is changing drug delivery and pricing in the pharmaceutical sector. Today's AI driven technologies are influencing everything from inventory management and procurement to automated logistics and dynamic pricing for e-pharmacies and digital healthcare platforms.<sup>57</sup> By running large datasets on consumer behavior, prescription trends, supply shifts, and competitor pricing, machine-learning algorithms generate predictive commercial outcomes. This study evaluates how such AI technologies are reshaping market structures and decision-making in healthcare. Special focus is placed on automated pricing, smarter logistic and the role of AI in pharmaceutical distribution within India's growing digital health landscape.

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<sup>50</sup> Competition Act 2002.

<sup>51</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 40–45.

<sup>52</sup> OECD (n 3) 45–52.

<sup>53</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–56.

<sup>54</sup> riel Ezrachi and Maurice E Stucke (n 5) 95–108.

<sup>55</sup> World Health Organization (n 6) 16–21.

<sup>56</sup> World Health Organization, *Global Strategy on Digital Health 2020–2025* (WHO 2021) 18–25.

<sup>57</sup> Ministry of Health and Family Welfare, Government of India, *National Digital Health Mission Strategy Overview* (2020) 10–15.

Another key aim is to break down the idea of algorithmic cartelization and tacit collusion in the pharmaceutical market. Today's algorithmic pricing systems can independently monitor competitors' actions, process real-time market data and adjust prices on the fly using predictive models.<sup>58</sup> When these self-learning algorithms interact repeatedly they can create parallel pricing and coordinated behavior sometimes reducing competition without any explicit agreement between companies. This study examines how far autonomous algorithms might enable tacit collusion simply through ongoing adaptation and observation. It also delves into the theoretical and legal issues that arise in digital pharmaceutical ecosystems where data-driven strategies and platform based governance dominate.

This research also aims to evaluate the complicated question of antitrust liability when coordination happens through autonomous algorithms. Traditional competition laws usually deal with clear cut cases obvious agreements, coordinated communications, or decisions made directly by people.<sup>59</sup> But now, AI systems can coordinate autonomously through computational learning, without the need for direct instructions or conspiracies. The study examines the thorny issues of proving liability, intent, agreement, and accountability in markets governed by AI. It pays special attention to who might be legally responsible—whether it's pharmaceutical companies, digital healthcare platforms, software developers, or those managing algorithms for pricing and distribution.

Another objective is to assess whether current Indian competition law is up to the task of regulating algorithmic collusion and autonomous coordination. While the Competition Act 2002 is the main law on anti-competitive behavior<sup>60</sup>, its rules were written mostly with traditional human-driven business in mind. This study evaluates if those old doctrines really address the new complexities of AI-enabled pharmaceutical markets. To help with this it also compares how the European Union and the United States are handling similar issues in their own digital markets.<sup>61</sup>

A final goal of this study is to recommend legal and regulatory reforms for AI-driven pharmaceutical markets. Regulating autonomous pricing systems effectively means having flexible modern legal frameworks ones that can address issues such as algorithmic transparency, accountability, investigative processes, and digital competition governance.<sup>62</sup> The study examines potential reforms, including requiring algorithmic audits, creating sector-specific competition guidelines, establishing AI accountability standards, and strengthening regulatory oversight. It also highlights the need for coordination between competition authorities, healthcare regulators, digital governance bodies, and data protection agencies to keep up with AI in pharma.

Altogether, these objectives set the framework for this study and shape how it examines AI-driven pharmaceutical markets through the lens of competition law. The research aims to add to current legal scholarship by exploring algorithmic cartelization, antitrust liability, and the governance of digital healthcare in India's fast evolving pharma sector.

#### 1.4 Research Proposition

AI-enabled systems are now running the show across pricing, inventory, consumer targeting, and pharma logistics. They use predictive analytics and machine learning for these tasks.<sup>63</sup> Digital healthcare platforms and e-pharmacies are especially reliant on autonomous pricing algorithms that can track market trends and tweak business strategies on the fly. While these technologies have made operations more efficient and healthcare more accessible, they've also raised big concerns about tacit collusion and algorithmic coordination from a competition law perspective.

This study argues that AI-driven pricing and distribution technology in pharma could indirectly facilitate tacit algorithmic collusion in digital healthcare markets. Self-learning algorithms that work across different pharma platforms can monitor competitors' pricing, analyze market data and develop their own pricing strategies.<sup>64</sup> Over time these algorithms may begin to exhibit parallel pricing and coordinated market outcomes even without explicit communication or agreement between companies. This kind of coordination brings up tough legal questions, since most competition law is designed to catch human-driven cartels based on clear agreements or conspiracies.<sup>65</sup>

The study also argues that India's current competition law framework isn't quite ready to regulate this new world of autonomous algorithmic coordination or to determine who's liable when AI causes market issues. The Competition Act, 2002 does ban anti-competitive agreements and abuse of dominance but it was written for a world where people not machines were calling the shots.<sup>66</sup> AI systems challenge basic legal ideas about agreement, intent, communication and responsibility because they can coordinate pricing or market behavior solely through machine learning. That's why figuring out antitrust liability gets really complicated when pricing outcomes result from AI adaptation rather than old fashioned collusion.

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<sup>58</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30.

<sup>59</sup> Richard Whish and David Bailey, *Competition Law* (10th edn, Oxford University Press 2021) 530–546.

<sup>60</sup> Competition Commission of India, *Competition Act 2002*.

<sup>61</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–56.

<sup>62</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 40–45.

<sup>63</sup> World Health Organization, *Global Strategy on Digital Health 2020–2025* (WHO 2021) 18–25.

<sup>64</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30.

<sup>65</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 83–95.

<sup>66</sup> Competition Commission of India, *Competition Act, 2002*.

## 1.5 Scope and Limitations

This study centers on India's pharmaceutical industry and its digital healthcare ecosystem especially as they intersect with Artificial Intelligence, algorithmic pricing, automated drug distribution and competition law. The analysis examines AI-powered pharmaceutical markets operating through e-pharmacies, digital healthcare platforms, smart supply-chain systems and predictive pricing models in India.<sup>67</sup> There is a strong focus on issues such as algorithmic cartelization, tacit collusion, autonomous coordination and the antitrust liability arising from AI-driven business practices.

The research uses a doctrinal legal approach, drawing on statutory interpretation, case law, policy documents, regulatory reports, and academic literature on competition law, pharmaceutical governance, digital healthcare regulation and Artificial Intelligence.<sup>68</sup> It examines the Competition Act, 2002 and other regulations governing anti-competitive behavior in India. The study's analysis is also supported by academic research, government publications, OECD materials, and international policy documents.

For context, the study includes some comparative references to the United States and the European Union, especially when discussing algorithmic collusion, digital market regulation and AI governance frameworks.<sup>69</sup> These comparisons help evaluate international trends and highlight broader competition law challenges associated with autonomous algorithmic coordination. Still, the analysis focuses primarily on Indian competition law and the country's pharmaceutical sector.

This research does not include empirical work like field investigations, interviews, surveys or quantitative analysis. That's a limitation since many algorithmic pricing practices in pharma are locked behind proprietary systems with little public access or transparency.<sup>70</sup> At present, there just isn't much reliable data about autonomous pricing coordination in India's pharmaceutical sector. As a result, the study relies mostly on doctrinal analysis and secondary legal sources.

The scope of the study is also limited to competition law issues specifically linked to AI-driven pharmaceutical markets. Broader topics such as data protection, cybersecurity, intellectual property, consumer law, and healthcare ethics are discussed only when they directly relate to algorithmic collusion or antitrust liability. This focus helps keep the analysis clear and focused on AI-facilitated cartelization in India's pharma and digital healthcare sectors.

## 2. RESEARCH METHODOLOGY

### 2.1 Doctrinal Research Method

This study uses a doctrinal and analytical legal research method to explore how AI, pharmaceutical pricing, algorithmic cartelization, and competition law interact in India's digital healthcare ecosystem. The rapid growth of AI-powered pharma tech, automated pricing, and digital health platforms has raised tough legal questions about tacit collusion, autonomous coordination and antitrust risk.<sup>71</sup> These developments call for a detailed doctrinal examination of existing competition law and regulatory mechanisms for digital pharma markets. So, the methodology centers on systematic legal analysis digging into statutes, court decisions, policy documents, and academic research relating to AI in pharma and competition law.

This doctrinal approach enables a close examination of the legal principles governing anti-competitive conduct under Indian competition law. The study primarily examines whether the Competition Act, 2002 is up to the task of addressing algorithmic coordination and AI-driven cartelization in pharmaceutical markets.<sup>72</sup> Doctrinal research allows for a deep dive into statutes, court rulings, and regulatory frameworks connected to autonomous pricing and digital healthcare. The analytical side also helps evaluate the conceptual and regulatory hurdles that come with machine learning and computational market behavior.

### 2.2 Sources of Data

The study draws on both primary and secondary data sources for a thorough legal analysis. Primary sources form the backbone of the research these include the Competition Act 2002 (which covers anti-competitive agreements, abuse of dominance and market practices affecting competition in India), as well as related legal and regulatory materials.<sup>73</sup> The research critically examines relevant provisions of the Act to determine whether the current framework is sufficient to address issues such as autonomous algorithmic coordination and tacit collusion in AI powered pharma markets.

The research also examines decisions and regulatory guidance issued by the Competition Commission of India on anti-competitive conduct, digital markets, cartelization and market regulation. It draws on court precedents about competition law interpretation, standards of evidence and cartel liability to build the analysis.<sup>74</sup> Other primary materials include government policies, regulatory and AI reports, and official documents on digital healthcare and pharmaceutical regulation. To round things out, international competition law tools, OECD and European Commission policy documents,

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<sup>67</sup> Ministry of Health and Family Welfare, Government of India, *National Digital Health Mission Strategy Overview* (2020) 10–18

<sup>68</sup> Richard Whish and David Bailey, *Competition Law* (10th edn, Oxford University Press 2021) 530–546

<sup>69</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–56.

<sup>70</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 40–45.

<sup>71</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30.

<sup>72</sup> Competition Commission of India, *Competition Act, 2002*.

<sup>73</sup> Competition Act 2002, ss 3–4.

<sup>74</sup> Richard Whish and David Bailey, *Competition Law* (10th edn, Oxford University Press 2021) 530–546.

and comparative regulatory frameworks help put global approaches to algorithmic collusion and digital market regulation in context.<sup>75</sup>

Secondary sources also play a big role in shaping the conceptual and theoretical side of the study. The research draws from peer-reviewed articles, key books, research papers, policy analysis and expert commentaries on competition law, AI, pharmaceutical governance, digital health and algorithmic collusion.<sup>76</sup> Academic work on tacit coordination, autonomous pricing, algorithmic accountability and antitrust risk helps provide important insights into new legal challenges in AI-regulated markets. Reports from international bodies, research institutes and policy think tanks further support the examination of tech developments and regulatory concerns tied to AI in pharma.

### 2.3 Methods of Analysis

The method of analysis used in this study draws on several legal research tools i.e. conceptual analysis, comparative legal analysis, case law analysis and a close examination of statutory frameworks. Conceptual analysis helps break down key legal and technical concepts such as algorithmic cartelization, tacit collusion, autonomous coordination, AI-driven pricing and antitrust liability.<sup>77</sup> The study takes a critical look at how these concepts play out in pharmaceutical markets that now rely heavily on predictive analytics and machine learning. Comparative legal analysis is used to see how the United States and European Union tackle algorithmic collusion and digital market regulation giving a broader view of international developments that matter for India's competition law.

Analyzing case law is another big part of the research. The study examines court decisions and competition law precedents on cartelization, abuse of dominance, digital markets and coordinated commercial conduct to determine what existing legal standards say about anti-competitive behavior.<sup>78</sup> There's also a critical review of the statutes that shape competition law and AI regulation in India. This kind of analysis helps spot doctrinal limits, gaps in evidence and regulatory challenges arising from autonomous algorithmic coordination in pharma markets.

Altogether, this research methodology provides a clear framework for examining AI-driven pharma systems and algorithmic cartelization from a competition law perspective. The doctrinal and analytical approach provides a thorough legal analysis of regulatory challenges, liability issues and governance concerns arising from autonomous pricing technologies in India's fast-changing digital healthcare ecosystem.

## 3. AI-Driven Drug Delivery Technologies and Pharmaceutical Markets

The rapid growth of Artificial Intelligence (AI) has transformed global healthcare systems and pharmaceutical markets in major ways i.e. think automation, predictive analytics, digital supply chain management, and smarter business decisions. Pharma companies now lean on AI to boost efficiency, streamline medicine distribution, strengthen inventory and make healthcare more accessible.<sup>79</sup> In India the rise of e-pharmacies, telemedicine, automated logistics and AI-assisted pharma systems has driven a digital transformation. These changes have shaken up traditional pharmaceutical markets by bringing in algorithmic pricing, data-driven strategies and predictive healthcare infrastructure.

AI-driven pharma ecosystems have brought big economic and healthcare benefits: better access to medicines, smoother logistics and smarter resource use. But as more algorithmic systems are used for pricing and distributing medicines, new competition law concerns are emerging such as market concentration, data dominance, algorithmic coordination and the governance of digital platforms.<sup>80</sup> Autonomous pricing systems that watch the market and adjust strategies in real time are now shaping competition and pricing in digital healthcare. This part of the discussion examines how AI works in pharma that how algorithmic pricing fits into this and how India's pharma sector is being digitally transformed all through a legal and regulatory lens.

### 3.1 Concept of AI in Pharmaceutical Systems

Artificial Intelligence, in simple terms, means computer systems that can handle tasks such as data analysis, pattern recognition, prediction and even automated decision-making using machine learning and advanced algorithms.<sup>81</sup> In pharma AI is now used for drug development, clinical diagnostics, logistics, inventory, personalized medicine and healthcare delivery. Pharma companies use AI tools to sift through big health datasets, predict demand, optimize delivery and automate business decisions across digital health platforms.

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<sup>75</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–56.

<sup>76</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 83–108.

<sup>77</sup> Maurice E Stucke and Ariel Ezrachi, 'Artificial Intelligence and Collusion: When Computers Inhibit Competition' (2017) 2017 University of Illinois Law Review 1775, 1782–1807.

<sup>78</sup> Maher M Dabbah, *Competition Law and Policy* (Cambridge University Press 2010) 214–220.

<sup>79</sup> World Health Organization, *Global Strategy on Digital Health 2020–2025* (WHO 2021) 18–25.

<sup>80</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30.

<sup>81</sup> Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach* (4th edn, Pearson 2021) 1–15

AI-enabled drug delivery is now a key part of modern pharma. Smart pharma systems use machine learning and robotics to make medicine dispensing more accurate, reduce logistics problems and get medicines to more people.<sup>82</sup> Automated drug delivery systems help efficiently distribute medicines to hospitals, pharmacies, and online platforms by leveraging predictive analytics and real-time inventory tracking. Supply chains in pharma are now relying on AI to spot shortages, forecast demand and coordinate the transport of medicines more smoothly.

The rise of smart healthcare logistics has strengthened India's pharmaceutical distribution systems. AI-powered logistics use predictive algorithms to optimize warehousing, plan transport and manage inventory.<sup>83</sup> These intelligent supply chains monitor demand, prescribing patterns, buying habit and local needs to keep things running smoothly. For pharma companies, this means less waste, fewer delivery delays and better access to medicines even in far-flung regions.

Predictive analytics is another game-changer for pharma supply chains. With machine learning, systems can comb through historical data and forecast what healthcare will need in the future. AI-powered predictive models analyze prescription records, illness trends, inventory swings and even seasonal patterns to help improve distribution plans.<sup>84</sup> This helps hospitals and pharmaceutical companies keep the right amount of medicine in stock and reduce inefficiencies. Plus, predictive tools make it easier to spot shortages early and prepare for emergencies.

AI-based personalized medicine is another major leap in pharma. These technologies use AI to analyze a patient's unique health info, genetic data, prescription history and clinical records to create tailored treatment plans.<sup>85</sup> More pharma companies are using machine learning to predict how patients will respond to different treatments. As a result, AI-powered healthcare is paving the way for precision medicine making treatments more effective and accurate.

In India, pharma companies are increasingly teaming up with tech firms and digital platforms to weave AI-driven healthcare solutions into their operations.<sup>86</sup> E-pharmacies and telemedicine providers now use AI to check prescriptions, automate customer support, predict which medicines people might need and manage digital healthcare. All these changes show how data-driven approaches are becoming central to how pharma commerce and health regulations work.

On the whole bringing AI into pharma has changed how medicines are delivered how logistics are managed, how healthcare is predicted and how treatment is tailored to individuals. These AI-powered systems are making India's pharma markets more efficient and are changing how commercial decisions get made. At the same time these tech advances are raising tricky legal and competition law issues about algorithmic governance, market power and digital health regulation.

### 3.2 Algorithmic Pricing in Pharmaceutical Markets

Algorithmic pricing systems are playing a larger role in the pharmaceutical industry using automated computational models to monitor market conditions, analyze competitors' moves and adjust drug prices on the fly.<sup>87</sup> These AI powered pricing technologies are built on machine-learning systems to boost efficiency and maximize profits in digital healthcare. Both pharmaceutical companies and e-pharmacies now depend on these systems to quickly respond to changes in market demand, inventory, prescription trends and customer buying behavior.

Dynamic pricing is now at the core of AI-driven pharma markets. These systems are always scanning real-time data competitor prices, available medicine levels, regional demand, and broader healthcare consumption trends.<sup>88</sup> As a result AI pricing algorithms can automatically adjust prices based on predictive analysis and strategic goals. This kind of tech makes it easier for companies to respond quickly to changing demands and keeps pharmaceutical distribution running efficiently even as healthcare needs shift.

Automated pricing algorithms also significantly influence how pharmaceutical companies compete. These AI systems can monitor competitors' activities and adjust pricing strategies as needed.<sup>89</sup> Since machine-learning algorithms are designed to continuously observe the market and predict optimal pricing moves companies using similar tools can end up with parallel prices and synchronized behavior. This raises serious competition law questions because when pricing coordination is left to autonomous systems it can sometimes lead to less real competition in digital healthcare.

Another crucial part of algorithmic pricing is real-time market monitoring. AI-powered pharma platforms constantly collect and analyze data on consumer behavior, competitors' pricing, prescription records, inventory levels, and general healthcare usage trends.<sup>90</sup> This kind of data-driven surveillance helps companies adapt quickly to shifts in demand and the competitive landscape. E-pharmacies and online healthcare marketplaces are especially reliant on these automated systems to keep track of customer activity and fine-tune medicine pricing using predictive models.

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<sup>82</sup> Eric Topol, *Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again* (Basic Books 2019) 112–120.

<sup>83</sup> World Economic Forum, *AI in Healthcare Supply Chains* (2021) 11–18

<sup>84</sup> Ajay Agrawal, Joshua Gans and Avi Goldfarb, *Prediction Machines: The Simple Economics of Artificial Intelligence* (Harvard Business Review Press 2018) 77–91.

<sup>85</sup> Eric Topol (n 4) 140–148.

<sup>86</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 24–38

<sup>87</sup> OECD (n 2) 25–32.

<sup>88</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 56–70.

<sup>89</sup> Maurice E Stucke and Ariel Ezrachi, 'Artificial Intelligence and Collusion: When Computers Inhibit Competition' (2017) 2017 University of Illinois Law Review 1775, 1782–1798.

<sup>90</sup> OECD (n 2) 33–41.

Data-driven pricing models add even more weight to AI's influence in digital healthcare. When pharmaceutical platforms have large consumer datasets and robust computational infrastructure they can leverage predictive analytics and automated pricing to gain a real edge over competitors.<sup>91</sup> These AI-powered systems tap into all sorts of healthcare data what people buy their demographics, their prescription histories to create targeted pricing and personalized recommendations. This not only leads to more concentrated data in digital healthcare but also boosts the power of companies that are ahead in technology.

But algorithmic pricing also raises serious legal concerns especially about tacit collusion and coordination that happens all on its own. Self-learning algorithms that monitor competitors and adjust their strategies independently can lead to similar prices across firms, reducing competition.<sup>92</sup> Over time these AI-driven systems might start to settle on stable, higher-than-competitive prices even if companies never actually talk to each other. This makes it much harder for regulators to keep tabs on algorithmic coordination in the digital healthcare world.

Because medicine prices have such a direct impact on healthcare access and public welfare the pharmaceutical sector needs extra careful oversight when it comes to algorithmic pricing. If automated pricing systems push up prices or limit price variation, that can hit vulnerable consumers hard especially those who rely on affordable healthcare.<sup>93</sup> And when digital health platforms with advanced AI and lots of consumer data use these predictive pricing tools they can further cement their dominance in the market.

Algorithmic pricing systems are changing the way pharma companies do business such as using dynamic pricing, predictive analytics, and automated coordination to expand digital markets and boost efficiency. But as these AI-driven tools become more central they also raise tricky competition law questions about tacit collusion, data dominance and who is really in charge of algorithmic decisions.

### 3.3 Digitalization of India's Pharmaceutical Sector

India's pharmaceutical sector has undergone rapid digital transformation, driven by the expansion of e-pharmacies, telemedicine platforms, AI-enabled healthcare systems and digital pharmaceutical distribution networks.<sup>94</sup> Increased internet penetration, smartphone adoption, technological innovation and digital healthcare initiatives have significantly altered pharmaceutical commerce and healthcare delivery in India. Digital healthcare platforms increasingly offer integrated pharmaceutical services including online consultations, digital prescriptions, medication delivery, automated healthcare support and AI-assisted consumer engagement systems.

The growth of e-pharmacies represents one of the most significant developments within India's digital healthcare ecosystem. Online pharmaceutical marketplaces facilitate convenient access to medicines, healthcare consultations and digital prescription services through technologically advanced platforms.<sup>95</sup> E-pharmacies increasingly operate through AI-enabled infrastructure that automates inventory management, optimizes delivery logistics and personalizes consumer recommendations. Digital pharmaceutical commerce therefore contributes to expanding healthcare accessibility, particularly within urban and semi-urban regions characterized by increasing digital connectivity.

The COVID-19 pandemic substantially accelerated digital healthcare adoption within India and strengthened the commercial expansion of e-pharmacies and telemedicine services.<sup>96</sup> Consumers increasingly relied upon online pharmaceutical platforms for medicine procurement and remote healthcare consultations during periods of restricted physical mobility. Pharmaceutical enterprises consequently expanded investments in digital infrastructure, AI-enabled logistics systems and automated healthcare technologies to support increasing demand for digital healthcare services.

AI integration within pharmaceutical commerce has significantly transformed healthcare distribution systems and commercial decision-making processes. E-pharmacies and digital healthcare platforms increasingly deploy machine-learning technologies for prescription verification, inventory optimization, customer analytics, and automated pricing systems.<sup>97</sup> AI-enabled pharmaceutical platforms analyze consumer behavior, healthcare demand patterns and prescription trends to improve operational coordination and strengthen commercial competitiveness. Intelligent logistics systems further support rapid medicine delivery and efficient pharmaceutical distribution across geographically diverse healthcare markets.

Digital pharmaceutical ecosystems also generate substantial amounts of healthcare and consumer data that can influence market competition and commercial governance. Pharmaceutical platforms collect data relating to purchasing behavior, prescription histories, demographic characteristics, and healthcare utilization trends.<sup>98</sup> AI systems process this information to facilitate predictive pricing, personalized recommendations, targeted advertising and automated healthcare services. Data-driven healthcare governance is consequently a major component of digital pharmaceutical commerce in India.

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<sup>91</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–52.

<sup>92</sup> Ariel Ezrachi and Maurice E Stucke (n 10) 83–95.

<sup>93</sup> World Health Organization, *Access to Medicines and Health Products Programme* (WHO 2022) 10–18.

<sup>94</sup> Ministry of Health and Family Welfare, Government of India, *National Digital Health Mission Strategy Overview* (2020) 6–18.

<sup>95</sup> Federation of Indian Chambers of Commerce and Industry, *Digital Healthcare in India Report* (2022) 18–3

<sup>96</sup> World Health Organization, *Global Pulse Survey on Continuity of Essential Health Services During the COVID-19 Pandemic* (2021) 15–18.

<sup>97</sup> NITI Aayog (n 8) 35–42.

<sup>98</sup> FICCI (n 17) 24–30.

The digitalization of pharmaceutical markets simultaneously generates significant competition law concerns. Platform-based medicine distribution systems may strengthen market concentration and increase the commercial dominance of technologically advanced pharmaceutical enterprises possessing extensive data resources and sophisticated AI capabilities.<sup>99</sup> Smaller pharmaceutical firms lacking comparable technological infrastructure may encounter barriers to effective market participation within increasingly digitized healthcare ecosystems. Dominant e-pharmacy platforms may additionally influence market competition through algorithmic pricing strategies, preferential product placement and control over consumer healthcare data.

Competition concerns within platform-based pharmaceutical markets further arise from the increasing use of autonomous pricing systems and predictive analytics technologies. AI-enabled pharmaceutical platforms capable of monitoring competitor behavior and dynamically adjusting commercial strategies may facilitate tacit algorithmic coordination within digital healthcare ecosystems.<sup>100</sup> Self-learning pricing algorithms may independently generate synchronized pricing outcomes thereby weakening competitive pressures and limiting pricing diversity in pharmaceutical markets. Such developments create substantial regulatory challenges for competition authorities responsible for preserving market fairness and consumer welfare.

India's regulatory framework continues to evolve in response to the expansion of digital healthcare and technological innovation in pharmaceutical markets. Government initiatives promoting digital healthcare integration and AI adoption increasingly influence pharmaceutical governance and healthcare policy development.<sup>101</sup> Simultaneously regulatory institutions face growing pressure to address algorithmic accountability, data concentration, digital platform dominance and competition law concerns arising from AI-driven pharmaceutical commerce.

The digitalization of India's pharmaceutical sector has therefore transformed healthcare delivery systems, pharmaceutical commerce and market competition through e-pharmacies, AI-enabled logistics, automated pricing technologies and digital healthcare platforms. These technological developments strengthen healthcare accessibility and operational efficiency while also raising important legal and regulatory concerns regarding algorithmic governance, market concentration, and digital competition within pharmaceutical ecosystems.

#### **4 Algorithmic Cartelization and Tacit Collusion**

The fast adoption of Artificial Intelligence (AI) across digital markets has changed the way businesses make decisions especially in the pharmaceutical sector. Now AI-driven systems are leading the way in pricing, inventory management, demand forecasting and automated distribution in digital healthcare settings.<sup>102</sup> Pharma companies and e-pharmacies using advanced platforms are relying more than ever on machine-learning algorithms that track market conditions, analyze consumer behavior and adjust business strategies autonomously in real time. All these changes have raised serious concerns in competition law especially regarding algorithmic cartelization, tacit collusion and market coordination without direct human input.

Traditionally competition law was set up to target anti-competitive agreements and cartels by looking for clear coordination between people.<sup>103</sup> But AI-driven commercial systems have changed the game now algorithms can independently create coordinated pricing even if companies never speak or make formal deals. This kind of algorithmic coordination challenges the usual legal ideas about collusion, intent, liability and anti-competitive behavior. Pharma especially needs careful oversight since drug pricing directly impacts how affordable healthcare is and public welfare overall. So this section takes a closer look at what algorithmic cartelization is how AI can enable tacit collusion in pharma, and what this means for consumers and public health.

##### **4.1 Understanding Algorithmic Cartelization**

Cartelization in the traditional sense means competitors making agreements or coordinating to limit competition by fixing prices, controlling production, dividing up markets, or rigging bids.<sup>104</sup> These classic cartels usually involve direct communication, meetings or coordinated decisions between the players. Regulators look for things like documents, emails, witness statements or patterns of parallel behavior to prove that anti-competitive intent was present.

Algorithmic cartelization is the modern tech-driven version where AI-powered pricing and automated business decisions create anti-competitive coordination.<sup>105</sup> More and more AI systems are taking over strategic roles that used to be handled by people. These machine-learning algorithms keep a constant eye on competitor prices, customer behavior, inventory changes and market trends to find the most profitable options. As a result you can get synchronized pricing and coordinated market moves even if no human actually gives instructions or signs a deal.

There are some big differences between traditional and algorithmic cartels especially in how they work and how you can prove they exist. In a classic cartel, companies deliberately coordinate by talking with each other or setting up secret

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<sup>99</sup> European Commission (n 13) 52–56.

<sup>100</sup> OECD (n 2) 45–52.

<sup>101</sup> Ministry of Health and Family Welfare (n 16) 16–20.

<sup>102</sup> World Health Organization, *Global Strategy on Digital Health 2020–2025* (WHO 2021) 18–25.

<sup>103</sup> Richard Whish and David Bailey, *Competition Law* (10th edn, Oxford University Press 2021) 530–546.

<sup>104</sup> Alison Jones, Brenda Sufrin and Niamh Dunne, *EU Competition Law* (7th edn, Oxford University Press 2019) 687–695.

<sup>105</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30.

meetings.<sup>106</sup> Regulators usually look for documents, witness confessions or evidence of these meetings to catch explicit collusion. But with algorithmic cartels it's all about autonomous systems interacting i.e. self-learning AIs independently optimize business moves using predictions and constant market observation. That means anti-competitive outcomes can emerge simply from how algorithms adapt, not because anyone planned them.

Competition law typically distinguishes between two types of cartel behavior i.e. explicit and tacit collusion. Explicit collusion is when there's a clear agreement between competitors to act together or limit competition.<sup>107</sup> Tacit collusion, on the other hand is when companies just end up acting in parallel by watching each other and adapting without ever making a formal deal. AI-powered pricing makes tacit collusion much more likely, since algorithms can continuously monitor the market and independently set profitable prices. Over time, these autonomous pricing systems can keep prices above competitive levels simply by learning and adapting to one another.

Getting a handle on how algorithms coordinate on their own is one of the trickiest parts of regulating AI-driven markets. These machine-learning tools are designed to adapt changing business strategies based on market feedback and predictions.<sup>108</sup> Pharma companies often use them to be more efficient and make more money. But when different companies' algorithms keep interacting they may start coordinating prices in ways that weaken competition even if that was never the goal. This kind of autonomous coordination makes it tough to apply old legal ideas about what counts as an agreement, intent or conspiracy.

This is a big deal for pharma, since AI-driven coordination can directly affect how much medicines cost and who can get them. Digital pharmaceutical platforms now use connected pricing systems and predictive health analytics enabling synchronized market actions.<sup>109</sup> E-pharmacies and AI health marketplaces are always crunching huge amounts of data prescription trends, customer buys, competitor prices. That kind of tech setup makes the market more predictable and increases the likelihood of tacit algorithmic coordination in pharma.

Researchers are paying closer attention to the anti-competitive risks associated with algorithmic coordination. For example, Ariel Ezrachi and Maurice Stucke point out that autonomous algorithms can learn to favor higher prices just by interacting and adapting over time.<sup>110</sup> The OECD also notes that algorithmic pricing can make tacit collusion easier by boosting market transparency and letting companies always keep an eye on each other.<sup>111</sup> All of this shows that there's a growing global concern about how AI could weaken fair competition in markets.

So, algorithmic cartelization is a big shift in how anti-competitive behavior can happen because now it's autonomous computer systems driving pricing, coordination and market strategy. This puts real pressure on traditional competition law which struggles to handle cases where it's hard to prove an agreement, intent or clear liability in AI-governed markets.

#### 4.2 AI and Tacit Collusion in Pharmaceutical Markets

As AI use in pharmaceutical markets increases concerns about tacit collusion and autonomous pricing coordination have grown. Many pharmaceutical platforms today lean heavily on predictive analytics, automated pricing systems, and real-time market monitoring to boost their commercial performance.<sup>112</sup> Machine-learning algorithms constantly process huge amounts of healthcare and commercial data everything from consumer demand and prescription patterns to inventory and competitor prices. These AI capabilities make the market much more predictable and foster environments where algorithms coordinate strategies more easily.

One of the most noticeable signs of algorithmic coordination in pharma is parallel pricing where prices move together across companies. AI-powered pricing systems constantly monitor competitors' prices and adjust their own to stay profitable.<sup>113</sup> When different companies use similar technologies, they might end up with synchronized prices even if they never communicate or make any agreements. This kind of parallel pricing can reduce healthy competition and keep medicine prices higher than they would be in a more competitive market.

Machine-learning systems make it even more likely that this kind of coordination will happen. These algorithms continually adjust their strategies based on market feedback.<sup>114</sup> Smart pricing tools monitor market responses, observe competitors' moves and adjust prices to maximize profit. As these autonomous systems interact repeatedly they can start to coordinate their moves helping keep the market stable but also making it less competitive. In pharma markets with lots of digital integration and constant data sharing, the conditions are just right for this kind of tacit algorithmic coordination to take hold.

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<sup>106</sup> Richard Posner, *Antitrust Law* (2nd edn, University of Chicago Press 2001) 63–69.

<sup>107</sup> Maher M Dabbah, *Competition Law and Policy* (Cambridge University Press 2010) 214–220.

<sup>108</sup> Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach* (4th edn, Pearson 2021) 18–30.

<sup>109</sup> Ministry of Health and Family Welfare, Government of India, *National Digital Health Mission Strategy Overview* (2020) 10–18.

<sup>110</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 83–108.

<sup>111</sup> OECD (n 4) 33–45.

<sup>112</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 24–42.

<sup>113</sup> Maurice E Stucke and Ariel Ezrachi, 'Artificial Intelligence and Collusion: When Computers Inhibit Competition' (2017) 2017 *University of Illinois Law Review* 1775, 1782–1807.

<sup>114</sup> Ajay Agrawal, Joshua Gans and Avi Goldfarb, *Prediction Machines: The Simple Economics of Artificial Intelligence* (Harvard Business Review Press 2018) 77–96.

Algorithmic signaling and information exchange add another layer to this issue. AI pricing systems often use public commercial data, consumer information and competitor pricing information to make predictions and set prices.<sup>115</sup> With continuous market surveillance these algorithms can detect pricing signals from other companies and adjust their own strategies. Even though there's no direct communication this kind of interaction can still lead to companies moving in sync making prices more predictable and strengthening subtle strategic coordination in the market.

Digital pharmaceutical platforms and e-pharmacies make algorithmic information exchange far more efficient because online healthcare marketplaces generate vast amounts of real-time commercial data.<sup>116</sup> In these environments AI systems can process competitor prices, inventory status, consumer buying habits and regional demand simultaneously. This high-speed data processing and automated market adaptation make it much more likely that we'll see synchronized pricing behavior in the pharma sector.

Self-learning algorithms also make the market more predictable. These machine-learning systems are continually refining their strategies through predictive models and learning from past data.<sup>117</sup> AI-driven pharmaceutical platforms tap into massive datasets like prescription histories, healthcare trends, demographics and buying behavior to forecast how the market will move. The result? Less pricing uncertainty and stronger algorithmic coordination, as autonomous systems get better at anticipating what competitors will do next.

There are special concerns about algorithmic tacit collusion in pharma because medicines are essential for public welfare not just everyday goods. When AI-driven systems lead to parallel pricing it can directly affect how affordable and accessible medicines are.<sup>118</sup> Consumers who rely on these essential drugs could face financial strain if autonomous pricing keeps prices artificially high. That's why digital healthcare markets with concentrated platforms and predictive coordination require additional regulatory oversight.

Competition authorities have a tough job spotting and regulating algorithmic tacit collusion mainly because this kind of coordination can happen without any explicit agreement or human involvement.<sup>119</sup> Traditionally investigators look for proof of communication or secret meetings but self-learning algorithms might create anti-competitive outcomes just by adapting leaving little evidence of actual collusion. This makes it hard to assign liability and enforce the law in AI-driven pharma markets.

Regulators around the world are catching on to the risks of algorithmic tacit collusion. Both the European Commission and the OECD have noted that algorithmic pricing can achieve coordinated market outcomes by continuously monitoring markets and adapting strategies.<sup>120</sup> As these international discussions continue, there's clear and growing concern about whether current competition laws are sufficient to address autonomous coordination by AI.

In short, AI-driven tacit collusion is a major headache for competition law. Autonomous systems are playing a bigger role than ever in coordinating business moves and pricing in pharma thanks to machine learning, predictive analytics and non-stop market surveillance.

### 4.3 Consumer and Public Health Concerns

Algorithmic cartelization in pharmaceutical markets raises serious concerns for consumer welfare and public health because the price of medicine directly impacts how easily people can get the care they need. Medicines are not just ordinary products they are essential for treating diseases, managing chronic conditions, and protecting public health.<sup>121</sup> When AI-powered pricing coordination keeps medicine prices high it can have major economic consequences for consumers who rely on affordable drugs and healthcare services.

One of the biggest worries with algorithmic coordination in pharma is the artificial inflation of medicine prices. Self-learning pricing systems focused on maximizing profits can set price points much higher than those a competitive market would set.<sup>122</sup> When these algorithms cause prices to move in parallel across companies it can weaken price competition and keep medicine costs high. This puts extra financial pressure on people who need prescription drugs on a regular basis. Consumer exploitation can occur when AI-driven pharmaceutical systems prioritize profit over patients' needs.<sup>123</sup> Digital healthcare platforms collect a lot of personal data like prescription history, buying habits, demographics and how people use healthcare. AI uses this information to set personalized prices, target marketing and make commercial recommendations. In markets where a few digital platforms dominate consumers may find it harder to see how prices are set or to find better deals elsewhere.

Limited market competition makes these public welfare concerns even more serious. When big e-pharmacies and tech-savvy pharma firms have more data and advanced AI they can gain huge competitive advantages in digital healthcare.<sup>124</sup> Smaller companies without the same resources may struggle to compete. This leads to less market diversity and gives more power to already dominant digital healthcare platforms.

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<sup>115</sup> OECD (n 4) 45–52.

<sup>116</sup> Federation of Indian Chambers of Commerce and Industry, *Digital Healthcare in India Report* (2022) 18–30.

<sup>117</sup> Ariel Ezrachi and Maurice E Stucke (n 9) 95–103.

<sup>118</sup> World Health Organization, *Access to Medicines and Health Products Programme* (WHO 2022) 10–18.

<sup>119</sup> Richard Whish and David Bailey (n 2) 540–546.

<sup>120</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–56.

<sup>121</sup> World Health Organization (n 17) 16–21

<sup>122</sup> OECD (n 4) 37–45.

<sup>123</sup> NITI Aayog (n 11) 40–45.

<sup>124</sup> Indian Brand Equity Foundation, *Indian Pharmaceuticals Industry Report* (2024) 3–9

This issue is even more important in developing healthcare systems like India's where many people depend on affordable generic medicines and accessible health services.<sup>125</sup> If tacit algorithmic coordination pushes prices up it hits economically vulnerable groups the hardest especially those needing long-term treatment and essential medicines. When medicines become less affordable it can widen health inequalities and make it even harder for marginalized communities to get the care they need.

Digital healthcare platforms play a bigger role in making medicines accessible thanks to automated distribution, predictive logistics and AI-powered supply chain coordination.<sup>126</sup> But when pricing is coordinated autonomously, it can affect not only competition but also how the entire healthcare system is run. For public health policies that aim to keep medicines affordable and ensure fair distribution, strong regulatory oversight of AI-powered markets is essential.

That's why competition law plays such an important role in ensuring consumers are protected and markets remain fair in pharma. If algorithmic cartelization restricts competition and raises drug prices it can undermine both healthcare access and the public interest.<sup>127</sup> Regulators need to continually update legal frameworks to handle AI-driven coordination ensure algorithmic accountability and manage digital markets in the pharmaceutical sector.

In short, the effects of algorithmic cartelization go far beyond simple business concerns they touch on healthcare equity, social welfare and whether people can get the medicines they need. This is why strong and effective regulation of AI-driven pharmaceutical markets is necessary to keep healthcare systems competitive and protect public welfare in India's digital healthcare landscape.

## 5 Indian Competition Law Framework and Algorithmic Collusion

The rapid integration of Artificial Intelligence (AI) into digital commerce and pharmaceutical markets is posing new challenges for today's competition law. More and more AI-powered systems are taking the lead in pharmaceutical pricing, market forecasting, healthcare logistics and automated distribution all thanks to advances in machine learning and predictive analytics.<sup>128</sup> In India, digital healthcare platforms and e-pharmacies now rely on algorithmic pricing systems that monitor competitors, process real-time market data and adjust business strategies autonomously. While these changes have transformed the way the pharmaceutical business is done, they've also raised serious concerns about algorithmic cartelization, tacit collusion and coordination that occur without direct human input.

Indian competition law was primarily designed to address old-school anti-competitive behavior such as human-controlled business deals, explicit agreements and obvious conspiracies.<sup>129</sup> But AI-driven markets are different i.e. self-learning algorithms can coordinate market behavior all on their own, with no direct communication or formal agreement between companies. This makes it much harder to apply the usual legal ideas about agreement, intent, liability and evidence. Since medicine pricing affects both affordability and access to essential medicines the pharma sector needs extra close attention. That's why this discussion examines how Indian competition law addresses anti-competitive conduct the role of the Competition Commission of India in the digital market era the challenges of applying traditional legal principles to AI-driven systems and the new competition issues emerging in India's pharmaceutical sector.

### 5.1 Overview of the Competition Act, 2002

The Competition Act, 2002 is the primary law that shapes competition regulation in India.<sup>130</sup> It replaced the older Monopolies and Restrictive Trade Practices Act 1969 and created a more modern approach designed to keep markets competitive, protect consumers and stop anti-competitive behavior as the Indian economy has changed. The Act establishes a broad system to address anti-competitive agreements, abuse of dominant position and anti-competitive mergers or combinations.<sup>131</sup>

The main goals of Indian competition law are to promote fair competition, protect consumers, keep trade open and prevent practices that could harm competition.<sup>132</sup> The law reflects India's shift toward a more open global economy following liberalization. In this way, competition law acts as a safeguard for efficient markets helps foster innovation, and prevents the build-up of excessive market power that could harm consumers.

Section 3 of the Competition Act, 2002 makes it illegal to have agreements that could significantly harm competition in India.<sup>133</sup> This rule covers deals involving the production, supply, storage or control of goods and services. Horizontal agreements such as price fixing, market division, bid rigging, production limitation or other collusive practices are presumed to harm competition.<sup>134</sup> In this way the law directly targets cartelization and coordinated actions among competitors.

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<sup>125</sup> Indian Brand Equity Foundation, *Indian Pharmaceuticals Industry Report* (2024) 3–9

<sup>126</sup> World Economic Forum, *AI in Healthcare Supply Chains* (2021) 11–23.

<sup>127</sup> Competition Commission of India, *Competition Act, 2002*.

<sup>128</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30 <https://www.oecd.org/en/publications/algorithms-and-collusion-competition-policy-in-the-digital-age>

<sup>129</sup> Richard Whish and David Bailey, *Competition Law* (10th edn, Oxford University Press 2021) 530–546.

<sup>130</sup> Competition Act 2002. [https://en.wikipedia.org/wiki/Competition\\_Act](https://en.wikipedia.org/wiki/Competition_Act)

<sup>131</sup> Maher M Dabbah, *Competition Law and Policy* (Cambridge University Press 2010) 214–220.

<sup>132</sup> Competition Act 2002, preamble. [https://en.wikipedia.org/wiki/Competition\\_Act](https://en.wikipedia.org/wiki/Competition_Act).

<sup>133</sup> Competition Act 2002, s 3.

<sup>134</sup> Alison Jones, Brenda Sufrin and Niamh Dunne, *EU Competition Law* (7th edn, Oxford University Press 2019)

Cartelization is a key concern in Indian competition law. Section 2(c) of the Act defines a cartel as a group of producers, sellers, distributors, traders or service providers who work together to control production, supply, distribution or pricing through agreements.<sup>135</sup> Cartels are considered among the worst forms of anti-competitive behavior as coordinated pricing and market manipulation can directly harm consumers and undermine the functioning of markets.

Section 3 also covers concerted practices and coordinated behavior, not just formal agreements. Regulators can infer anti-competitive coordination from patterns in the market like parallel behavior or other signs that companies are working together even without direct proof.<sup>136</sup> But it's important to note that these laws were created for markets where people talked and made agreements. In today's AI-driven markets, coordination can occur automatically through algorithms rather than through deliberate deals, creating new legal challenges.

Algorithmic pricing systems make things even trickier for section 3. AI can cause companies to set similar prices all on its own without any direct communication between firms.<sup>137</sup> If several pharma companies use similar algorithms or predictive analytics they might end up with synchronized prices simply because their systems interact over time. The law's traditional ideas about agreements and concerted practices can fall short when dealing with self-learning autonomously coordinating systems.

The Act also deals with abuse of dominant position under section 4.<sup>138</sup> When digital pharmaceutical platforms have large amounts of data, strong AI capabilities, and control a significant market share, they might use algorithms in ways that lead to unfair pricing, the exclusion of competitors, or other anti-competitive practices. That's why these platform-based pharma markets need close regulatory attention—not just for agreements, but also for digital market power and the risks it entails.

In summary, Indian competition law provides a strong legal framework for tackling anti-competitive conduct in the pharma market. But as AI-driven systems become more common in healthcare, important gaps are emerging especially around autonomous coordination, tacit collusion and determining who is liable for what algorithms do.

## 5.2 Role of the Competition Commission of India

The Competition Commission of India (CCI) is the principal regulatory authority responsible for enforcing the Competition Act, 2002.<sup>139</sup> The CCI has the power to investigate, adjudicate and regulate business practices to prevent any practices that could harm competition in India. It also plays a big role in promoting awareness, protecting consumers and ensuring markets remain fair often through policy work and ongoing oversight.

The CCI's powers are pretty broad it can look into anti-competitive agreements, abuse of dominance and problematic mergers or combinations.<sup>140</sup> Under section 26 the CCI can ask the Director General to investigate if there's initial evidence of anti-competitive behavior. The Commission can demand documents, question witnesses, conduct market studies and impose serious penalties for breaches of competition law. These tools are key to maintaining fair and competitive markets in India.

Digital markets and AI-powered business models are now a big focus for the CCI. The Commission has conducted studies on e-commerce, telecom and especially Artificial Intelligence to get a handle on new competition issues tied to algorithms and digital platforms.<sup>141</sup> In its latest market study on AI and competition law the CCI specifically flags risks such as algorithmic collusion, autonomous coordination and anti-competitive pricing enabled by AI. The report points out that AI-driven pricing can make markets more transparent but it can also make it easier for companies to coordinate prices even without talking to each other.<sup>142</sup>

The CCI also recognizes that AI-based pricing can lead to collusion even in the absence of direct human contact or a formal agreement.<sup>143</sup> Self-learning algorithms that constantly track competitors and adjust strategies can keep prices higher than they would be in a truly competitive market. Because of this, the CCI sees algorithmic coordination as a new challenge that needs fresh enforcement strategies and more specialized oversight.

Still, the CCI faces significant hurdles in regulating AI-driven markets. Older competition law investigations usually rely on documents, emails, meetings or witness testimony to show that companies were working together.<sup>144</sup> But with algorithmic coordination its often just machines adapting and learning on their own leaving very little traditional evidence behind. AI systems can end up setting similar prices through predictive analytics without any clear record of collusion.

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<sup>135</sup> Competition Act 2002, s 2(c). [https://en.wikipedia.org/wiki/Competition\\_Act%2C\\_2002](https://en.wikipedia.org/wiki/Competition_Act%2C_2002)

<sup>136</sup> Richard Posner, *Antitrust Law* (2nd edn, University of Chicago Press 2001) 63–69

<sup>137</sup> Maurice E Stucke and Ariel Ezrachi, 'Artificial Intelligence and Collusion: When Computers Inhibit Competition' (2017) 2017 University of Illinois Law Review 1775, 1782–1807.

<sup>138</sup> Competition Act 2002, s 4.

<sup>139</sup> Competition Commission of India. [https://en.wikipedia.org/wiki/Competition\\_Commission\\_of\\_India](https://en.wikipedia.org/wiki/Competition_Commission_of_India)

<sup>140</sup> Competition Act 2002, ss 26–27.

<sup>141</sup> <https://www.cci.gov.in/images/marketstudie/en/market-study-on-artificial-intelligence-and-competition1759752172.pdf>

<sup>142</sup> *Ibid.*

<sup>143</sup> Mondaq, 'Artificial Intelligence and the Competition Act, 2002: CCI's Market Study and the Architecture of Digital Competition' (2025). <https://www.mondaq.com/india/antitrust-cu-competition/1689902/artificial-intelligence-and-the-competition-act-2002-ccis-market-study-and-the-architecture-of-digital-competition>

<sup>144</sup> Richard Whish and David Bailey (n 2) 540–546.

It gets even harder because AI systems are so complex. Machine-learning algorithms often work in ‘black boxes’ meaning it’s tough to explain or see how they make decisions since they crunch huge amounts of data in the background.<sup>145</sup> This lack of transparency makes it hard for regulators to really understand what’s going on or to spot anti-competitive outcomes arising from these self-learning systems. These evidentiary gaps are a big barrier for enforcement in digital pharma markets.

There’s also the issue of expertise. Regulating AI in pharma means dealing with complicated systems algorithms, digital platforms, big data, healthcare infrastructure and predictive models all working together.<sup>146</sup> To do this well the CCI needs teams with know-how in law, economics, data science, machine learning and digital regulation. Since AI keeps evolving, regulators need to keep building their skills and adapting their approach.

All this means that the CCI’s job now goes far beyond just catching cartels. The Commission is increasingly responsible for overseeing digital markets and algorithmic business systems. As pharma becomes more AI-driven there is a stronger need for specialized competition oversight that can handle the technical complexity, autonomous coordination and the risks posed by too much market power in the hands of a few data-rich players.

### 5.3 Challenges in Applying Existing Competition Law to AI Systems

Applying traditional competition law principles to AI-driven systems brings a host of new challenges both in legal theory and in the evidence needed for enforcement. Most of our current competition law frameworks are built around stopping anti-competitive conduct involving explicit agreements, clear communication or intentional coordination.<sup>147</sup> But with autonomous AI now in the mix we see a whole new kind of market behavior self-learning algorithms can independently generate coordinated commercial strategies simply through computational adaptation and predictive analytics.

One of the toughest problems is that tacit algorithmic collusion rarely involves explicit agreements. Section 3 of the Competition Act mainly targets agreements and concerted practices between businesses.<sup>148</sup> This means that traditional cartel investigations look for proof of communication, meetings or other arrangements between competitors. But with AI-driven pharmaceutical systems synchronized pricing can happen simply because algorithms adapt to the market no direct human contact or formal agreement is needed. This makes it really hard for regulators to legally prove collusion when it’s all happening through algorithms.

Another big challenge is proving intent and coordination. Traditional competition law often looks for evidence of anti-competitive intent or conscious parallelism meaning businesses deliberately moving in sync.<sup>149</sup> But self-learning algorithms adjust prices on their own optimizing for profit based on market conditions. Pharmacies might just want to be efficient not to collude. Still as these algorithms keep interacting they can end up coordinating prices anyway. Figuring out whether this is illegal coordination or just a side effect of smart technology is a tricky legal question.

Black-box algorithms add even more complexity. Many AI tools operate in ways that are hard to explain even for their creators so investigators can’t always access or interpret the decision making process.<sup>150</sup> This makes it tough for competition authorities to figure out how a particular price was set or whether anti-competitive outcomes were programmed, learned or just happened naturally in the market. The lack of transparency in AI really weakens the traditional methods used to prove cartel behavior.

Another major issue is figuring out who’s responsible when things go wrong. In an AI-driven pharmaceutical market there can be a whole chain of actors i.e. pharma companies, software developers, digital platforms, data providers, algorithm designers and more.<sup>151</sup> Sorting out legal responsibility for anti-competitive outcomes from self-learning systems is no easy task. Traditional competition law usually blames the company that did something wrong but with autonomous AI prices can change and collusion can happen without any single manager making the call. This makes liability a real legal puzzle.

Experts around the world are starting to see these legal limits. The OECD, for example, notes that algorithms can facilitate tacit collusion by continuously monitoring markets, sending signals and predicting what others will do.<sup>152</sup> Scholars like Ariel Ezrachi and Maurice Stucke point out that AI systems can keep cartel-like conditions going simply by adapting their strategies. All of this shows that the old competition law ideas are falling short in regulating algorithmic coordination. So, Indian competition law faces significant hurdles in regulating AI-powered pharma systems, since the law is still tied to older ideas about collusion that assume clear human involvement. But now, autonomous algorithms are acting like independent players in the market, shaping prices and coordinating competition in ways the law wasn’t built to handle.

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<sup>145</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 40–45.

<sup>146</sup> OECD (n 1) 45–52.

<sup>147</sup> Alison Jones, Brenda Sufrin and Niamh Dunne (n 7) 695–703.

<sup>148</sup> Competition Act 2002, s 3.

<sup>149</sup> Richard Posner (n 9) 70–74.

<sup>150</sup> NITI Aayog (n 17) 42–46.

<sup>151</sup> OECD (n 1) 33–45.

<sup>152</sup> OECD (n 1) 45–52. [https://www.oecd.org/en/publications/algorithms-and-collusion-competition-policy-in-the-digital-age\\_258dcb14-en.html](https://www.oecd.org/en/publications/algorithms-and-collusion-competition-policy-in-the-digital-age_258dcb14-en.html)

## 5.4 Indian Pharmaceutical Sector and Competition Concerns

India's pharmaceutical sector is one of the biggest in the world and is a major source of generic medicines and healthcare products.<sup>153</sup> The rapid digital shift in pharma markets has driven the rise of e-pharmacies, AI-powered logistics, predictive healthcare analytics and automated pricing technology. These advances have made healthcare more accessible and strengthened distribution, but they've also raised serious competition law issues.

Competition problems in digital pharma markets are increasingly about platform concentration, algorithmic pricing, and data-driven business models.<sup>154</sup> Big digital healthcare platforms with advanced AI and extensive consumer data can gain major competitive advantages. This can hurt market diversity and let the most tech-savvy companies become even more dominant especially when they use predictive strategies to steer the market.

AI-driven pricing systems in pharma also bring up the risk of price manipulation and subtle unspoken coordination. These self-learning algorithms are always watching competitor prices what people are buying and shifts in healthcare demand to get the best commercial results.<sup>155</sup> When different companies use similar pricing algorithms they can end up with synchronized prices and parallel outcomes even without making explicit deals. This can push medicine prices higher than they should be and reduce healthy market competition.

That's why the pharma sector needs close competition oversight because medicine pricing has a direct impact on public health and whether people can afford their treatment. If algorithmic coordination drives prices up it can put a real financial strain on people who already rely on affordable medicines for long-term care.<sup>156</sup> So AI-driven price manipulation isn't just a business issue its a public welfare concern that goes far beyond normal business regulation.

Because of these challenges India's digital healthcare system needs competition oversight that's tailored to AI able to tackle algorithmic collusion, autonomous pricing and the concentration of market power on big platforms.<sup>157</sup> The current laws need to be updated to include transparency rules, better investigative tools greater technical know-how, and digital competition guidelines for the sector. Governing AI-driven pharma markets well also means regulators, health authorities and digital governance bodies must work together.

India's pharma sector is a clear example of how AI tech, digital market governance and competition law now overlap. While AI systems make operations more efficient and expand access to healthcare they also raise big questions about algorithmic coordination, market power and safeguarding public welfare.

## 6 Comparative International Perspective

The explosion of AI in digital markets has sparked global concern about algorithmic pricing, autonomous coordination and tacit collusion. Regulators in many countries now recognize that AI-powered pricing systems can shape market behavior through predictive analytics, real-time data, and automated business processes.<sup>158</sup> Digital platforms powered by self-learning algorithms can set prices in ways that reduce competition and harm consumers. This is even more serious in pharma, where medicine prices affect not just profits, but public health and access to care.

The United States and European Union have become leaders in the debate over how to regulate algorithmic collusion and AI-powered markets. Both are now questioning whether old competition laws can really deal with autonomous algorithms and concentrated digital markets. Their new rules and approaches offer useful lessons on antitrust enforcement, algorithmic accountability, digital competition policy and AI regulation.<sup>159</sup> India's fast-changing pharma sector can learn a lot from these international experiences. The sections ahead dig into US and EU perspectives on algorithmic pricing and tacit collusion and what they mean for India's own competition law.

### 6.1 United States Perspective

The U.S. competition law framework is built on key federal statutes like the Sherman Antitrust Act, the Clayton Act and the Federal Trade Commission Act.<sup>160</sup> Section 1 of the Sherman Act bans contracts, combinations, or conspiracies that restrain trade while Section 2 addresses monopolization and the misuse of market power. Traditionally American antitrust law has focused on clear agreements and coordinated actions among competitors that could hurt competition and consumers.<sup>161</sup>

The rise of algorithmic pricing systems is getting a lot of attention from U.S. antitrust regulators because these AI-powered systems can lead to tacit coordination or parallel pricing even when companies never speak to each other. Digital platforms

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<sup>153</sup> Indian Brand Equity Foundation, *Indian Pharmaceuticals Industry Report* (2024) 3–9

<sup>154</sup> Federation of Indian Chambers of Commerce and Industry, *Digital Healthcare in India Report* (2022) 18–30.

<sup>155</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 83–108

<sup>156</sup> World Health Organization, *Access to Medicines and Health Products Programme* (WHO 2022) 10–18.

<sup>157</sup> Algorithmic Collusion and the Limits of Agreement under Indian Competition Law' (Indian Review of Corporate and Commercial Laws, 2026). <https://www.irccl.in/post/algorithmic-collusion-and-the-limits-of-agreement-under-indian-competition-law>

<sup>158</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30. <https://one.oecd.org/document/DAF/COMP/WD%282023%2917/en/pdf>

<sup>159</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–56. [https://competition-policy.ec.europa.eu/antitrust-and-cartels/legislation/competition-law-treaty-articles\\_en?](https://competition-policy.ec.europa.eu/antitrust-and-cartels/legislation/competition-law-treaty-articles_en?)

<sup>160</sup> Sherman Antitrust Act 1890.

<sup>161</sup> Richard Posner, *Antitrust Law* (2nd edn, University of Chicago Press 2001) 63–74.

and businesses are increasingly relying on pricing algorithms that process real-time market data, monitor competitors' moves and adjust strategies automatically.<sup>162</sup> This technology has regulators worried that algorithms can create cartel-like outcomes through predictive adaptation and computational coordination.

U.S. enforcement agencies like the Department of Justice (DOJ) and Federal Trade Commission (FTC) are now looking closely at AI-based pricing under current antitrust laws. Recent cases show they are willing to treat algorithmic coordination as a possible violation of Section 1 of the Sherman Act especially if competitors use the same pricing software or systems to coordinate prices.<sup>163</sup> The DOJ and FTC have made it clear that companies could still face antitrust liability even if they never talk to each other, as long as their algorithms end up coordinating prices.

A key development in the U.S. has been litigation over algorithmic pricing software and digital platforms. The RealPage case which involved AI-driven rental pricing software is a notable example of regulators taking algorithmic coordination seriously.<sup>164</sup> The DOJ argued that landlords using the same pricing system could coordinate rental prices via shared data and automated recommendations. The main claim was that competitors could break antitrust law simply by letting common algorithms set prices in ways that lead to coordinated results even without a direct agreement.

The Yardi litigation shows similar worries about AI-enabled price coordination and algorithmic control over markets.<sup>165</sup> Both the DOJ and the FTC argued that using common pricing algorithms that synchronize prices might constitute illegal collusion under the Sherman Act. This trend suggests U.S. regulators are starting to treat algorithmic pricing like traditional antitrust issues such as price fixing and coordinated actions.

Legal scholars in the U.S. are also recognizing the risk of tacit algorithmic collusion. Ariel Ezrachi and Maurice Stucke, for example, have argued that AI systems might learn to collude all on their own, simply by repeatedly interacting and adapting based on predictions.<sup>166</sup> These machine-learning algorithms, built to maximize profits could keep prices higher than normal simply by watching the market and tweaking their strategies. This possibility is shaping much of today's antitrust debate in the U.S.

The FTC is also looking at issues such as surveillance pricing and personalized pricing systems that dynamically set prices based on consumer data.<sup>167</sup> Investigators are digging into whether these AI-powered pricing practices which rely on personal data and predictive analytics might undercut market fairness or consumer rights. Some states such as New York and California have even started pushing for new transparency rules and disclosure requirements for prices set by algorithms or AI systems.

Even with stepped-up enforcement the U.S. still faces significant legal hurdles regarding tacit collusion and AI coordination. Traditionally American law draws a line between clear agreements and more subtle forms of parallel or tacit coordination.<sup>168</sup> Courts usually require evidence of an agreement or shared intent before holding companies liable under Section 1 of the Sherman Act. But with AI coordinated market outcomes can happen on their own through machine learning and adaptation without any real conspiracy or communication between people.

Overall the U.S. approach shows a shift toward tougher scrutiny of algorithmic pricing while still relying on existing antitrust laws. Regulators increasingly accept that AI-powered pricing can lead to anti-competitive coordination even in the absence of traditional agreements among people. This evolving enforcement strategy offers useful lessons for other countries facing similar issues in digital healthcare and pharma markets.

## 6.2 European Union Perspective

The European Union's competition law framework is mainly built around Articles 101 and 102 of the Treaty on the Functioning of the European Union (TFEU).<sup>169</sup> Article 101 bans agreements concerted practices and decisions that could restrict or distort competition within the EU's internal market. Article 102 deals with abuse of dominant position and anti-competitive use of market power. Compared to U.S. competition law European competition law takes a broader view especially when it comes to regulating coordinated practices and market behavior.

The EU is increasingly aware that algorithmic collusion is a real challenge for digital competition law and AI regulation. Institutions within the EU acknowledge that AI-powered pricing systems can make markets more transparent facilitate

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<sup>162</sup> Maurice E Stucke and Ariel Ezrachi, 'Artificial Intelligence and Collusion: When Computers Inhibit Competition' (2017) 2017 University of Illinois Law Review 1775, 1782–1807.

<sup>163</sup> DOJ and FTC enforcement developments concerning algorithmic pricing. <https://natlawreview.com/article/ai-antitrust-landscape-2025-federal-policy-algorithm-cases-and-regulatory-scrutiny?>

<sup>164</sup> United States v RealPage litigation developments. <https://www.morganlewis.com/pubs/2025/02/ai-and-algorithmic-pricing-2025-antitrust-outlook-and-compliance-considerations?>

<sup>165</sup> DOJ and FTC submissions regarding Yardi algorithmic pricing litigation. <https://www.mintz.com/insights-center/viewpoints/2191/2024-03-07-doj-and-ftc-weigh-alleged-algorithmic-price-fixing-ai?>

<sup>166</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 83–108.

<sup>167</sup> FTC and state regulatory scrutiny concerning surveillance pricing. <https://www.reuters.com/legal/legalindustry/amidst-uncertainty-ftc-states-zero-dynamic-algorithmic-pricing--pracin-2026-03-04/?>

<sup>168</sup> Alison Jones, Brenda Sufrin and Niamh Dunne, *EU Competition Law* (7th edn, Oxford University Press 2019) 687–703.

<sup>169</sup> Treaty on the Functioning of the European Union, arts 101–102. [https://competition-policy.ec.europa.eu/antitrust-and-cartels/legislation/competition-law-treaty-articles\\_en?](https://competition-policy.ec.europa.eu/antitrust-and-cartels/legislation/competition-law-treaty-articles_en?)

strategic signaling and even enable companies to coordinate automatically.<sup>170</sup> For this reason, European regulators are examining whether these pricing systems, which operate through machine learning, could break Article 101 TFEU even if there's no clear human agreement at play.

The European Commission has rolled out several policy initiatives focused on digital competition and AI regulation. The report, *Competition Policy for the Digital Era*, shines a spotlight on worries about algorithmic coordination, the concentration of digital platforms and autonomous pricing in online markets.<sup>171</sup> Policymakers in Europe are aware that algorithms that monitor competitors and adapt in real time can make tacit collusion much easier and hurt real competition. One unique aspect of EU competition law is its strong focus on concerted practices which extends beyond explicit agreements.<sup>172</sup> The European Court of Justice has said that concerted practices are any form of coordination in which competitors replace genuine competition with practical cooperation. This means Article 101 TFEU can be applied more widely including to algorithmic coordination and adaptations based on market predictions in digital markets.

Legal scholars in Europe are now debating whether autonomous algorithms might end up creating concerted practices just by interacting and adapting over time.<sup>173</sup> AI systems that can analyze competitors' private data, interpret market signals and adjust their prices autonomously may well fall under Article 101 TFEU. This is why European regulators are deeply concerned about the anti-competitive risks posed by AI-based pricing and predictive business systems.

The EU also takes a broader approach to AI regulation than the U.S. does. The EU AI Act sets out detailed rules on transparency, accountability, data governance and risk management for AI systems operating in the European market.<sup>174</sup> Although the Act's main goal is to address safety, ethics and accountability it also supports competition regulation by promoting transparency and stronger oversight of algorithms.

The Digital Markets Act (DMA) takes things a step further by targeting the largest digital platforms and issues related to data concentration.<sup>175</sup> Policymakers in the EU see that markets dominated by massive platforms with vast amounts of data and AI-driven business models can undermine competition. That's why competition regulation in Europe is becoming more intertwined with digital governance covering issues like data protection, interoperability, transparency and holding platforms accountable.

When it comes to enforcement the EU is placing greater emphasis on algorithmic audits and compliance requirements for companies that use AI-powered pricing systems. Businesses are increasingly being told to monitor their digital pricing tools, regularly review algorithm outputs and guard against anti-competitive data sharing.<sup>176</sup> The overall EU approach is to combine competition law with digital governance and strong AI accountability measures ensuring they work together. Even so European regulators still face tough challenges like deciding who's responsible what counts as proof, and how to handle self-learning algorithms. These AI systems often work as black boxes that are hard to explain and use very complex predictive models.<sup>177</sup> So proving that there was intentional coordination or spotting anti-competitive computer-driven behavior remains difficult, even with the EU's broader legal approach.

Still, the EU's approach is seen as more proactive than most in AI governance and digital competition. The EU framework keeps evolving and there's a growing focus on integrated regulatory tools to tackle algorithmic collusion, curb platform dominance, and address AI-driven coordination in digital markets.

### 6.3 Relevance for India

The experiences of the United States and the European Union are highly relevant for India as it shapes its own competition law and digital pharmaceutical landscape. India's pharma sector now relies more on AI-powered pricing, predictive healthcare analytics, automated distribution and digital platform-based medicine delivery.<sup>178</sup> These changes bring up many of the same regulatory concerns that U.S. and EU authorities face especially around algorithmic coordination and autonomous pricing.

One big lesson India can take from the U.S. is the value of proactive antitrust enforcement for algorithmic pricing and shared AI-powered business platforms. American regulators point out that letting algorithms set prices for multiple

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<sup>170</sup> European Commission concerns regarding algorithmic coordination.

<https://www.loyensloeff.com/insights/news--events/news/europe-steps-up-antitrust-enforcement-against-algorithmic-pricing/>

<sup>171</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–56.

<sup>172</sup> Article 101 TFEU and concerted practices doctrine. <https://www.corporatelawacademy.net/post/pricing-algorithms-and-antitrust-issues?>

<sup>173</sup> European legal scholarship concerning algorithmic collusion.

<https://www.europeanpapers.eu/europeanforum/algorithmic-collusion-corporate-accountability-application-art-101-tfeu>

<sup>174</sup> EU AI Act governance obligations. <https://arxiv.org/abs/2410.14501?>

<sup>175</sup> European Union Digital Markets Act regulatory framework.

<sup>176</sup> European algorithmic pricing compliance guidance. <https://www.hoganlovells.com/en/publications/update-softwarebased-pricing-and-its-eu-competition-law-boundaries>.

<sup>177</sup> Algorithmic opacity and evidentiary barriers within EU competition law.

[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=6135548&utm](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=6135548&utm)

<sup>178</sup> Ministry of Health and Family Welfare, Government of India, *National Digital Health Mission Strategy Overview* (2020) 10–18.

competitors can create anti-competitive risks even if the companies never actually communicate.<sup>179</sup> India's competition authorities could consider interpreting algorithmic coordination more broadly using the concept of concerted practices and general anti-competitive behavior under the Competition Act, 2002.

The EU offers more guidance on algorithmic transparency, AI governance and the regulation of digital platforms. The European approach shows that it's crucial to integrate competition regulation with wider digital governance, focusing on AI accountability, data concentration and platform dominance.<sup>180</sup> Since India's pharma sector is increasingly relying on data-driven digital healthcare and e-pharmacies rules on transparency audits and accountability could help India regulate its AI-driven pharmaceutical markets more effectively.

India also needs to modernize its regulatory institutions and develop more technical expertise. AI-powered pharmaceutical markets are complex involving advanced machine learning, predictive analytics, digital platforms, health infrastructure and big data.<sup>181</sup> This means competition authorities need teams with skills in AI, data science, law and digital market analysis to keep up.

Looking at the global picture it's clear that harmonized competition regulation is becoming more important for AI-driven markets. Digital healthcare and AI-powered pharma systems often work across borders, using interconnected commercial and tech networks.<sup>182</sup> That's why issues like algorithmic coordination and digital platform dominance now have international aspects, making cross-border regulatory cooperation and common standards much more important.

In summary, India's competition law will benefit from learning from the evolving approaches of the U.S. and EU on algorithmic collusion and AI regulation. Updating laws to include algorithmic accountability, digital market oversight and AI-specific compliance tools is key to keeping India's rapidly digitalizing pharmaceutical market fair and protecting consumers.

## 7. Antitrust Liability in AI-Facilitated Pharmaceutical Markets

The rapid growth of Artificial Intelligence (AI) in pharmaceutical markets has dramatically changed how decisions are made about medicine pricing, healthcare logistics, supply chains and digital distribution. AI-powered pricing systems and predictive analytics now play a key role in pharmaceutical commerce, using autonomous computational tools to process huge amounts of commercial and healthcare data in real time.<sup>183</sup> Pharma companies, e-pharmacies and digital health platforms all rely more on machine-learning algorithms to manage inventory, forecast demand, personalize healthcare, and automate pricing. While these new technologies make operations more efficient and healthcare more accessible, they also bring serious competition law concerns especially around algorithmic collusion, autonomous coordination, and antitrust liability.

Traditional competition law was primarily designed to address anti-competitive behavior driven by people such as explicit agreements, direct communication, or intentional conspiracies.<sup>184</sup> But AI-driven pharmaceutical markets are a whole new challenge: self-learning algorithms can independently create synchronized pricing and coordinated market actions, without any direct human involvement or formal arrangement. These autonomous systems make it much harder to apply old legal rules about liability, intent, agreement or what counts as proof. Since medicine pricing is so closely tied to public health and consumer welfare the pharma sector needs extra scrutiny. This section examines how liability is assigned in AI-powered pharma markets the tricky question of intent (*mens rea*) with autonomous algorithms and the broader enforcement challenges of algorithmic coordination in digital healthcare.

### 7.1 Attribution of Liability

Attributing antitrust liability is one of the most difficult legal issues in AI-driven pharmaceutical markets. These autonomous pricing systems operate in a web of technology that includes pharmaceutical companies, software developers, digital health platforms, data providers, and AI vendors.<sup>185</sup> Self-learning algorithms constantly analyze the market, track competitors' prices and adjust their strategies autonomously. Determining who is legally responsible for anti-competitive outcomes arising from these autonomous systems is extremely complex under competition law.

Pharmaceutical companies that use AI-powered pricing systems are often at the center of liability questions since they are the ones putting these autonomous tools to work in real business decisions.<sup>186</sup> Many pharma firms are turning to algorithmic pricing to boost profits, streamline supply chains, and respond faster in digital healthcare. If these systems

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<sup>179</sup> DOJ and FTC approach toward common pricing algorithms. <https://www.mintz.com/insights-center/viewpoints/2191/2024-03-07-doj-and-ftc-weigh-alleged-algorithmic-price-fixing-ai?>

<sup>180</sup> European AI governance and competition regulation frameworks. <https://www.loyensloeff.com/insights/news-events/news/europe-steps-up-antitrust-enforcement-against-algorithmic-pricing/>

<sup>181</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 40–45.

<sup>182</sup> Algorithmic pricing and transnational digital market regulation. <https://www.theregreview.org/2025/07/12/seminar-antitrust-and-algorithmic-pricing/>

<sup>183</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30. <https://www.law.ox.ac.uk/centre-for-competition-law-and-policy/ai-database?>

<sup>184</sup> Richard Whish and David Bailey, *Competition Law* (10th edn, Oxford University Press 2021) 530–546.

<sup>185</sup> Maurice E Stucke and Ariel Ezrachi, 'Artificial Intelligence and Collusion: When Computers Inhibit Competition' (2017) 2017 University of Illinois Law Review 1775, 1782–1807.

<sup>186</sup> Robin Feldman and Caroline A Yuen, 'AI and Antitrust: "The Algorithm Made Me Do It"' (2025) UC Law SF Research Paper. <https://papers.ssrn.com/sol3/Delivery.cfm/4935199.pdf?abstractid=4935199&mirid=1&utm>

lead to anti-competitive results like higher prices, coordinated conduct or even market manipulation competition authorities may hold the pharma companies responsible.

Corporate liability in AI-powered pharma markets can also come into play if companies knowingly use pricing systems that can coordinate competitors' behavior.<sup>187</sup> Pharmas often use the same pricing software, share data systems and rely on predictive analytics. Regulators now point out that if businesses let common algorithms make pricing decisions, they could end up with coordinated market results even if no one actually talks. Recent U.S. cases show there is an increasing willingness to hold companies liable if their shared pricing tools keep prices in sync.

Software developers and AI providers are another important piece of the liability puzzle in digital pharma markets. These tech firms design, build and maintain the algorithmic pricing systems that pharma businesses and digital health platforms use.<sup>188</sup> They create the models and automation that can shape how markets work. Regulators are starting to see that these software companies might also be responsible at least in part if their algorithms help enable collusion or anti-competitive results.

Recent antitrust cases in the U.S. involving algorithmic pricing vendors underscore the growing importance of software provider liability in AI-driven markets.<sup>189</sup> Regulators now argue that tech companies that supply shared pricing algorithms can act as facilitators of coordinated market behavior especially when competitors all rely on the same tools. This is where the hub-and-spoke theory comes in software providers can serve as the central hub, enabling different pharma companies (the spokes) to achieve synchronized pricing, even without direct contact.

But making software developers liable is not straightforward. Most AI providers build these systems to make businesses more efficient or accurate not to encourage collusion.<sup>190</sup> Machine-learning systems might create coordinated outcomes just by learning and adapting, beyond what any programmer planned. So figuring out whether a software provider intended their tech to facilitate collusion or if they just built a neutral tool is a tough legal question.

Because of these complexities, legal scholars are now discussing shared accountability for algorithmic collusion and AI governance. The idea is that liability in AI-driven markets may need to be distributed, given the many different players involved.<sup>191</sup> Pharmas using AI, software developers building the tech, platforms running the infrastructure and data providers all play a part in market outcomes. Shared accountability means regulators might need to look at everyone's role, not just try to pin blame on a single actor.

The Organization for Economic Co-operation and Development (OECD) also notes that algorithmic collusion typically involves many different tech and business players working together in digital networks.<sup>192</sup> This means that pharma markets powered by AI need flexible liability rules that account for collective responsibility. Adopting these broader frameworks could strengthen antitrust enforcement while still recognizing the real-world complexity of how these systems operate.

In short figuring out who is liable in AI-powered pharma markets is a major challenge for today's competition law. Because these autonomous pricing systems operate through networks of diverse actors and complex algorithms, traditional liability models based on direct human action are becoming less effective in digital healthcare.

## 7.2 Mens Rea and Autonomous Algorithms

The question of intent (*mens-rea*) and its application to autonomous algorithms is one of the trickiest areas in AI-driven pharmaceutical markets. Traditionally competition law has focused on concepts such as intention, knowledge, agreement and conscious coordination among people.<sup>193</sup> Regulators usually look for signs of deliberate anti-competitive conduct such as documents, communications or organized schemes. But with AI, machine-learning algorithms can end up coordinating prices and market outcomes on their own, with no explicit human guidance or anti-competitive intent. This complicates the legal principles that have been used for decades.

Intent has always been crucial in antitrust law helping authorities decide whether companies were merely moving in parallel or actually colluding.<sup>194</sup> AI-driven pharma systems change the picture by continuously adapting prices based on

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<sup>187</sup> DOJ and FTC enforcement developments concerning algorithmic pricing systems.

<https://www.reuters.com/legal/legalindustry/collusion-by-code-understanding-algorithmic-pricing-antitrust-enforcement--pracin-2026-03-20/?utm>

<sup>188</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 83–108.

<sup>189</sup> United States algorithmic pricing litigation involving RealPage and Yardi systems.

<https://www.reuters.com/legal/legalindustry/collusion-by-code-understanding-algorithmic-pricing-antitrust-enforcement--pracin-2026-03-20/?utm>

<sup>190</sup> Stefan Thomas, 'Autonomization and Antitrust' in *The Cambridge Handbook of Responsible Artificial Intelligence* (Cambridge University Press 2022) 347–358. <https://www.cambridge.org/core/books/cambridge-handbook-of-responsible-artificial-intelligence/autonomization-and-antitrust/6B026CF3CF0EC7092493D8E32AF3F782?utm>

<sup>191</sup> Algorithmic liability scholarship concerning distributed accountability models.

<https://recordoflaw.in/algorithmic-collusion-and-liability-reassessing-antitrust-enforcement-in-autonomous-markets/>

<sup>192</sup> OECD (n 1) 33–45.

<sup>193</sup> Richard Posner, *Antitrust Law* (2nd edn, University of Chicago Press 2001) 63–74.

<sup>194</sup> Alison Jones, Brenda Sufrin and Niamh Dunne, *EU Competition Law* (7th edn, Oxford University Press 2019)

analytics and market signals. Pharma companies might just be aiming for efficiency, better demand forecasting, or more accurate pricing not collusion. Still when these algorithms interact repeatedly they can end up setting prices in sync and harming competition even if that wasn't anyone's goal.

This creates significant legal uncertainty about the role of intent in algorithmic collusion. AI systems are built to maximize profits and respond to the market and they might independently settle on high price strategies through their own learning without any secret deals between companies.<sup>195</sup> Since this kind of coordination can occur naturally its much harder for regulators to determine whether anti-competitive outcomes from AI systems meet the old standards for intent and agreement.

Its also hard to show there is an agreement in the traditional legal sense. Both U.S. and Indian competition law mainly target agreements or concerted practices between competitors.<sup>196</sup> But with autonomous algorithms, coordinated pricing can happen even when companies never communicate or make any deal. Self-learning systems that monitor the market and adapt over time can sustain collusion all outside the usual legal definition of an agreement.

Legal scholars now recognize that algorithmic coordination is a real problem for old antitrust ideas like the meeting of mind which has always been a key part of cartel liability.<sup>197</sup> Experts likeriel Ezrachi and Maurice Stucke point out that autonomous pricing systems can reach collusive outcomes simply by interacting and learning from the market. This means anti-competitive outcomes can occur even in the absence of a human plan or an actual agreement, making enforcement much more difficult.

This intent problem is especially important in pharma where algorithmic pricing can affect whether medicines are affordable or even available. These autonomous systems might keep prices high and limit healthcare access even though no human meant to coordinate or harm consumers.<sup>198</sup> Thats why competition law is under pressure to move beyond old doctrines based on intent and start focusing more on the real-world outcomes of algorithmic behavior.

Some legal researchers are now saying the law should focus less on intent and more on what actually happens a so-called effects-based approach.<sup>199</sup> Instead of asking if someone meant to collude, regulators would look at whether the algorithmic system led to less competition or hurt consumers. This kind of outcomes-based liability could strengthen antitrust enforcement in AI driven pharma markets by focusing on the real economic impact of algorithmic coordination.

But there are also risks to this approach. If liability is based solely on outcomes without considering intent, it could lead to over enforcement or create uncertainty for businesses. Pharma companies often use AI for good reasons like improving supply chains, optimizing logistics or analyzing markets more accurately.<sup>200</sup> If the law punishes any coordinated outcome it might deter companies from adopting helpful technology. So regulators need balanced rules that can distinguish between innovation that helps competition and algorithmic coordination that harms it.

In summary, the question of intent and AI is a major legal challenge in competition law today. Pharma systems powered by AI are now producing coordinated market outcomes through machine learning and data analysis often with no human intent or explicit agreement involved.

### 7.3 Regulatory and Enforcement Challenges

The regulatory and enforcement challenges in AI-driven pharmaceutical markets go way beyond the usual cartel enforcement strategies. Thats because algorithmic coordination often occurs within black-box computer systems and across borders via digital networks. More and more, competition authorities recognize that AI-powered pharma markets need specialized investigative tools greater technical expertise and flexible rules that can keep pace with complex tech and independent algorithmic behavior.<sup>201</sup>

Spotting tacit algorithmic collusion is one of the toughest enforcement problems for regulators. Usually cartel cases depend on finding emails, meeting notes or witness statements showing companies agreed to break the rules.<sup>202</sup> But with autonomous pricing systems synchronized behavior can emerge simply from how algorithms adapt and predict no obvious evidence left behind. These self-learning systems use market data and machine learning so their decisions might leave no normal paper trail at all.

The 'black box' nature of AI systems makes antitrust investigations even harder. These algorithms often run in ways that are tough to explain or even see from the outside.<sup>203</sup> When regulators look into pharma pricing they may have no clear

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687–703.

<sup>195</sup> Ajay Agrawal, Joshua Gans and Avi Goldfarb, *Prediction Machines: The Simple Economics of Artificial Intelligence* (Harvard Business Review Press 2018) 77–96.

<sup>196</sup> Competition Act 2002, s 3; Sherman Antitrust Act 1890, s 1.

<sup>197</sup> Stefan Thomas (n 8). <https://www.cambridge.org/core/books/cambridge-handbook-of-responsible-artificial-intelligence/autonomization-and-antitrust/6B026CF3CF0EC7092493D8E32AF3F782?>

<sup>198</sup> World Health Organization, *Access to Medicines and Health Products Programme* (WHO 2022) 10–18.

<sup>199</sup> Algorithmic Collusion and Liability: Reassessing Antitrust Enforcement in Autonomous Markets' (2026). <https://recordoflaw.in/algorithmic-collusion-and-liability-reassessing-antitrust-enforcement-in-autonomous-markets/?>

<sup>200</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 24–45.

<sup>201</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–56.

<sup>202</sup> Richard Whish and David Bailey (n 2) 540–546.

<sup>203</sup> NITI Aayog (n 18) 40–45.

way to tell whether an algorithm sets prices deliberately by accident or as a side effect of normal market forces. The technical complexity of these systems means enforcement agencies face big hurdles just to get the evidence they need. Because of the complex tech landscape, competition authorities need specialized teams. AI-powered pharma markets use machine learning, predictive analytics, logistics tech, algorithmic pricing and loads of digital data.<sup>204</sup> To really investigate collusion, regulators need experts in law, economics, data science, engineering and digital market governance. Without these skills its much harder to spot the signs of algorithmic coordination or understand AI-driven business moves.

Global digital pharma markets make things even more complicated. AI-enabled healthcare platforms often operate across countries, leveraging international data networks and cloud computing.<sup>205</sup> Pharma companies, software firms and digital health platforms now form global business webs so algorithmic pricing can have international consequences sometimes outside the reach of any single regulator.

International platforms also make enforcement tricky because laws about algorithmic collusion and AI regulation vary from country to country.<sup>206</sup> The EU focuses on transparency and integrated digital rules, while the U.S. mostly sticks to traditional antitrust law adapted for digital business. India is still adapting its own approach. These differences can lead to fragmented enforcement when digital pharma markets cross borders.

That's why international cooperation is becoming so important for antitrust enforcement in AI markets. Regulators need ways to work together, share information and set common digital competition standards to handle cross border algorithmic coordination.<sup>207</sup> Groups like the OECD and the International Competition Network are pushing for greater global collaboration on AI governance and digital regulation.

Pharma needs special attention, since coordinated pricing can directly impact who gets medicine and at what price. If algorithmic pricing keeps medicine costs high or limits distribution it hits the most vulnerable consumers hardest those who rely on affordable healthcare.<sup>208</sup> So competition rules in AI driven pharma markets are not just about business they also relate to public health and making sure everyone has fair access to care.

All of these challenges show that old antitrust laws which were mostly built for human run businesses are struggling to keep up in the AI powered pharma world. Autonomous systems are now shaping prices, coordinating markets and handling healthcare delivery through complex connected digital networks. Thats why we need new adaptive competition law frameworks that address algorithmic accountability, tech complexity and international digital markets.

## 8 Regulatory Reforms and Policy Recommendations

The rapid growth of Artificial Intelligence (AI) in pharmaceutical markets has completely changed how healthcare distribution, pricing, digital platforms and supply chains operate. Today AI-powered pharmaceutical systems use predictive analytics, automated pricing, self-learning algorithms and data driven infrastructure to shape both competition and consumer behavior.<sup>209</sup> Digital healthcare platforms and e-pharmacies rely on machine learning to optimize medicine distribution, predict healthcare demand and automate pricing in real time. While these technologies boost operational efficiency and make healthcare more accessible they also raise significant concerns such as algorithmic cartelization, tacit collusion increased market concentration and unfair pharmaceutical pricing.

Current competition law was primarily designed to address old-fashioned anti-competitive behavior such as explicit agreements, coordinated communication and overt human involvement.<sup>210</sup> But as AI and autonomous pricing systems become more common these traditional legal ideas are being stretched. Self-learning algorithms can now set synchronized prices without any direct communication or formal agreement. Since medicine pricing affects affordability public welfare, and access to care the pharma sector needs even closer regulatory attention. Thats why effective governance of AI-driven pharma markets calls for new legal reforms focused on algorithmic accountability digital competition rules and managing the tech complexity in today's healthcare. This section explores the regulatory reforms and policy recommendations needed to implement AI specific competition la achieve greater algorithmic transparency strengthen institutions and improve consumer protections in India's pharmaceutical sector.

### 8.1 Need for AI-Specific Competition Law Reforms in India

India's current competition law the Competition Act, 2002 offers a broad legal framework to regulate anti-competitive agreements, cartelization, and abuse of dominance.<sup>211</sup> But this law was mainly designed to address old school collusion such as when companies communicate directly, coordinate actions or form obvious conspiracies. AI enabled

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<sup>204</sup> OECD (n 1) 45–52.

<sup>205</sup> World Health Organization, *Global Strategy on Digital Health 2020–2025* (WHO 2021) 18–25.

<sup>206</sup> European Union digital competition governance developments. <https://globalcompetitionreview.com/review/europe-middle-east-and-africa-antitrust-review/2026/article/european-union-pharma-regulators-heighten-scrutiny-new-theories-of-harm-and-increased-enforcement?>

<sup>207</sup> OECD (n 1) 52–58.

<sup>208</sup> World Health Organization (n 16) 16–21.

<sup>209</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30.

[https://www.oecd.org/content/dam/oecd/en/publications/reports/2017/05/algorithms-and-collusion-competition-policy-in-the-digital-age\\_02371a73/258dcb14-en.pdf?](https://www.oecd.org/content/dam/oecd/en/publications/reports/2017/05/algorithms-and-collusion-competition-policy-in-the-digital-age_02371a73/258dcb14-en.pdf)

<sup>210</sup> Richard Whish and David Bailey, *Competition Law* (10th edn, Oxford University Press 2021) 530–546.

<sup>211</sup> Competition Commission of India, *Competition Act, 2002*.

pharmaceutical systems are a whole new ballgame i.e. self-learning algorithms process market data, monitor competitors' prices and automatically adapt their own strategies. This makes market coordination possible without any direct human involvement.

One of the biggest reforms India needs is to officially recognize and define algorithmic collusion in its laws. Right now there are no clear rules about AI driven coordination, autonomous pricing or computational tacit collusion.<sup>212</sup> This lack of clear definitions creates significant uncertainty about who is liable, how to enforce the law and what constitutes anti-competitive behavior in digital pharma markets. That's why Indian competition law needs to be updated to specifically define algorithmic collusion in its statutes.

Such a definition should cover situations in which autonomous pricing systems, machine learning algorithms, predictive analytics or AI-driven market adaptation lead to coordinated commercial outcomes.<sup>213</sup> The law should address cases where self-learning systems result in parallel pricing, strategic market signals or synchronized business actions that restrict competition even if no one at the companies actually spoke or agreed to collude. Having this clarity in the law would give regulators greater certainty and enable stronger enforcement against AI facilitated collusion.

The OECD also points out that present competition law concepts of agreements and tacit collusion may need to be reconsidered for digital markets governed by autonomous algorithms.<sup>214</sup> Their report on Algorithms and Collusion explains how self-learning systems can keep prices high through repeated algorithmic interactions all without human planning. Competition law could benefit from using broader definitions that address this kind of autonomous coordination and computational market behavior.

Another needed reform is to broaden the interpretation of anti-competitive agreements under section 3 of the Competition Act, 2002.<sup>215</sup> Traditionally the law looks for evidence of communication, shared intent or clear conspiracies between businesses. But in AI driven pharma markets, anti-competitive outcomes can happen just from algorithms adapting on their own. So Indian regulators need to interpret the law more broadly recognizing that coordinated market outcomes can come from algorithmic interactions and predictive analytics, not just from human agreements.

Enforcement of competition law may also need to move toward effects-based approaches focusing on whether the outcome reduces competition or raises prices, rather than merely on explicit agreements or intent.<sup>216</sup> This would let regulators ask if algorithms hurt competition, push up medicine prices or encourage coordinated pricing, even if nobody agreed to work together. By focusing on effects, enforcement becomes more flexible and better suited to complex, tech-driven pharmaceutical markets.

India should also develop sector specific digital competition guidelines for AI-powered pharma systems, e-pharmacies, predictive healthcare platforms and automated pricing.<sup>217</sup> The Competition Commission of India has already begun examining these issues in its Market Study on Artificial Intelligence and Competition which flagged algorithmic collusion, data concentration and digital market coordination as emerging concerns. This shows that institutions are beginning to recognize the need for AI focused competition rules.

India needs competition law reforms that are tailored to AI. Updating its laws and interpreting them to handle autonomous algorithmic coordination and tech driven market behavior is crucial for keeping competition fair and protecting consumers in India's digital pharmaceutical sector.

## 8.2 Algorithmic Transparency and Accountability

Algorithmic transparency and accountability are absolutely crucial in AI powered pharmaceutical markets. That's because autonomous pricing systems often run on complex black-box models that are hard for outsiders including regulators to understand or review.<sup>218</sup> When algorithms set prices and manage market coordination behind the scenes, competition law enforcement becomes much more difficult regulators may not have access to the inner workings or logic that drive these AI decisions.

Mandatory disclosure and audit requirements are essential when regulating AI driven pharma systems. Any company or digital healthcare platform using automated pricing should keep thorough records of how its algorithms work how it sets prices and the data and objectives it uses.<sup>219</sup> Regulators need this kind of access to decide if autonomous systems are making it easier to collude on prices or take advantage of the market.

Regular algorithmic audits can further strengthen oversight in digital pharma markets. Independent audits by certified experts can help regulators spot anti-competitive pricing, unfair practices or signs that algorithms are working too closely

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<sup>212</sup> Maurice E Stucke and Ariel Ezrachi, 'Artificial Intelligence and Collusion: When Computers Inhibit Competition' (2017) 2017 University of Illinois Law Review 1775, 1782–1807.

<sup>213</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 83–108.

<sup>214</sup> OECD (n 1) 33–45. [https://www.oecd.org/content/dam/oecd/en/publications/reports/2017/05/algorithms-and-collusion-competition-policy-in-the-digital-age\\_02371a73/258dcb14-en.pdf?](https://www.oecd.org/content/dam/oecd/en/publications/reports/2017/05/algorithms-and-collusion-competition-policy-in-the-digital-age_02371a73/258dcb14-en.pdf?)

<sup>215</sup> Competition Act 2002, s 3.

<sup>216</sup> Algorithmic Pricing and Algorithmic Collusion' (2025) arXiv Research Paper. <https://arxiv.org/abs/2504.16592?>

<sup>217</sup> CCI Market Study on Artificial Intelligence and Competition. <https://www.cci.gov.in/images/marketstudie/en/market-study-on-artificial-intelligence-and-competition1759752172.pdf?>

<sup>218</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 40–45

<sup>219</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–56.

together.<sup>220</sup> These reviews can show whether an AI system is set up in a way that could make tacit collusion, strategic signaling or synchronized pricing more likely, which could harm competition and consumers.

The European Union is placing significant emphasis on transparency in its AI laws especially with the EU AI Act and new digital competition rules.<sup>221</sup> The European approach emphasizes explainable AI, accountability and robust oversight. India could do something similar, adding transparency requirements to its own pharma pricing and competition rules.

Explainable AI is another key policy need for pharma pricing. This means building AI models that can explain their decisions in plain language, rather than just spitting out a result.<sup>222</sup> If pricing systems can give clear reasons for setting certain prices, regulators can do a much better job of keeping the market fair. Authorities need to see how these AI tools arrive at pricing and business strategies if they want to spot problems early.

The CCI's own Market Study on Artificial Intelligence and Competition notes that the lack of transparency and explainability in AI poses a real challenge for enforcement. If regulators can actually see and understand how algorithms make decisions it's much easier to hold companies accountable and spot anti-competitive behavior early.

It's also important to put compliance obligations on digital pharma platforms, since e-pharmacies and online health marketplaces are now major players in how medicines get distributed.<sup>223</sup> The rules should require these platforms to have real competition compliance programs including checks on their algorithmic pricing, consumer safeguards and anti collusion systems.

Pharma companies should also have their own internal safeguards such as regularly reviewing what their AI is doing, conducting risk assessments and establishing oversight committees focused on competition law.<sup>224</sup> These steps can help stop algorithms from drifting into coordinated pricing and make companies more accountable for how their AI acts.

All in all, having strict rules for algorithmic transparency and accountability is key to keeping India's AI-powered pharma markets fair. By combining transparency rules, explainable AI and robust compliance checks regulators will be much better equipped to oversee digital markets and ensure algorithms don't undermine competition.

### 8.3 Strengthening Institutional Capacity

To regulate AI driven pharmaceutical markets effectively competition law framework needs a big boost in institutional capacity. With autonomous pricing systems, machine learning algorithms, predictive healthcare analytics and digital pharma platforms all in play, regulators face a highly technical business environment that demands specialized expertise and flexible investigation methods.<sup>225</sup> The old competition law bodies were designed for simpler more traditional markets where you could spot deals or agreements between people. Now the rise of AI in pharma means those institutions need to modernize and build up their technical skills.

The Competition Commission of India needs to build deeper technical expertise in AI, machine learning, data science, computational economics and digital governance.<sup>226</sup> When competition authorities investigate algorithmic pricing they are up against complex systems that use predictive analytics, autonomous learning and real-time data crunching. To enforce the law effectively regulators need teams that combine skills across disciplines to spot anti-competitive algorithmic behavior and understand what is really happening under the hood.

The CCI could set up specialized divisions for AI and digital markets bringing together economists, data scientists, software engineers, digital governance experts and legal researchers trained in computational competition law.<sup>227</sup> These teams would boost the Commission's ability to assess AI driven pharma pricing systems, run algorithmic investigations and understand the complexities of new market behavior.

Another important policy move is to get technology regulators and competition authorities working together. AI driven pharma markets overlap with healthcare regulation, digital rules, data protection, cybersecurity and consumer rights.<sup>228</sup> So effective oversight means building coordinated frameworks that involve the CCI, healthcare regulators, data governance bodies and digital tech agencies.

When regulatory agencies work together, they can share information, coordinate investigations, and develop unified AI governance standards for the pharma market.<sup>229</sup> These collaborations also help keep policies consistent especially when it comes to digital healthcare regulation and holding algorithms accountable.

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<sup>220</sup> OECD Handbook on Competition Policy in the Digital Age (OECD 2022) 66–74.

[https://www.oecd.org/content/dam/oecd/en/publications/reports/2022/02/oecd-handbook-on-competition-policy-in-the-digital-age\\_50b6e951/c8c1841b-en.pdf](https://www.oecd.org/content/dam/oecd/en/publications/reports/2022/02/oecd-handbook-on-competition-policy-in-the-digital-age_50b6e951/c8c1841b-en.pdf)

<sup>221</sup> European Union AI governance framework and Digital Markets Act developments.

<sup>222</sup> Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach* (4th edn, Pearson 2021) 28–35.

<sup>223</sup> Federation of Indian Chambers of Commerce and Industry, *Digital Healthcare in India Report* (2022) 18–30.

<sup>224</sup> OECD (n 1) 45–52.

<sup>225</sup> World Economic Forum, *AI in Healthcare Supply Chains* (2021) 11–23.

<sup>226</sup> CCI Market Study on Artificial Intelligence and Competition. <https://www.cci.gov.in/economics-research/market-studies/details/47/0?>

<sup>227</sup> AI Markets and Competition in India, ICRIER Report (2024). <https://icrier.org/pdf/AI-Markets-and-Competition-in-India.pdf>

<sup>228</sup> Ministry of Health and Family Welfare, Government of India, *National Digital Health Mission Strategy Overview* (2020) 10–18.

<sup>229</sup> OECD Handbook on Competition Policy in the Digital Age (n 12).

Building better AI focused investigative tools is another essential reform. Competition authorities need advanced tech to spot algorithmic collusion, monitor pricing, analyze digital market trends and evaluate how businesses coordinate autonomously.<sup>230</sup> With AI powered regulatory tools authorities can more easily detect patterns such as unusual price movements or signs that digital healthcare platforms are moving in sync.

Global cooperation is crucial since AI powered pharma markets operate across national borders and through international digital networks.<sup>231</sup> The OECD and other groups are calling for more global teamwork on digital competition and AI regulation. Regulators can learn a lot and stay up to date by joining in on these international initiatives and policy discussions.

Boosting institutional capacity is the foundation for regulating AI driven pharma markets. Developing technical expertise, working across agencies and building AI-focused investigative skills will help India keep up with the challenges posed by algorithmic pricing and autonomous commercial coordination.

#### 8.4 Consumer and Public Interest Protection

Protecting consumers and the public interest is at the heart of regulating AI-powered pharmaceutical markets, since the price of medicine directly impacts healthcare access, consumer well-being, and public health outcomes.<sup>232</sup> When autonomous pricing systems keep pharmaceutical prices high or allow for tacit algorithmic coordination it can place a heavy financial burden on people who rely on affordable medicines and essential healthcare services.

Ensuring that medicines remain affordable means competition regulators need to keep a close watch on AI powered pharmaceutical pricing systems. Authorities should monitor digital pharma markets for pricing patterns that could inflate medicine costs or reduce price competition.<sup>233</sup> In this way competition law enforcement in the pharma sector goes beyond business it also helps protect public welfare.

Stopping exploitative pricing by algorithms is another key policy goal. AI driven pharma platforms often leverage extensive consumer health data and predictive analytics to set dynamic prices and offer tailored commercial recommendations.<sup>234</sup> Regulations should block unfair pricing that takes advantage of vulnerable consumers or manipulates healthcare demand through predictive systems.

Consumer protection rules could also require more transparency about how pharmaceutical prices and healthcare recommendations are set by algorithms.<sup>235</sup> People using digital health platforms deserve clear information about how AI driven pricing and decision making might affect the cost and accessibility of their medicines.

Fair competition in healthcare also means ensuring markets remain diverse and don't become dominated by a few powerful digital platforms.<sup>236</sup> When big e-pharmacies with vast amounts of data and advanced AI gain too much control they can push out smaller companies and limit consumer choices. That's why competition rules should stop exclusionary tactics, anti-competitive behavior and data driven dominance that hurts both business diversity and consumer choice.

The World Health Organization has made it clear that affordable access to medicines is a key part of public health and healthcare fairness.<sup>237</sup> When algorithmic coordination drives up prices or hurts competition it threatens these public goals. Strong regulation of AI in pharma is needed to ensure fair access to healthcare and protect consumers in Indian digital economy.

Regulatory reforms and policy for AI in pharma must strike a balance encouraging innovation, enforcing competition law, ensuring healthcare is accessible and protecting consumers. Flexible competition rules that address algorithmic collusion, digital market dominance and autonomous pricing are essential to keep Indian pharma sector fair and focused on the public good.

#### CONCLUSION

The rapid integration of Artificial Intelligence into pharmaceutical markets has completely changed how medicines are distributed, priced and delivered and has even reshaped the way healthcare platforms and supply chains are governed. AI-powered technologies now drive business decisions by using predictive analytics, autonomous pricing, machine learning and smarter pharma logistics.<sup>238</sup> In India, digital health platforms and e-pharmacies rely heavily on algorithms that track market trends, process commercial data and adjust pricing strategies autonomously. These advances have improved healthcare access, efficiency, and distribution but have also brought up major legal concerns about algorithmic cartelization, tacit collusion and autonomous market coordination.

This study shows that AI powered pharma pricing systems can actually help coordinate market behavior, thanks to their ability to adapt and predict business moves autonomously. These machine learning algorithms constantly monitor

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<sup>230</sup> 'Algorithmic Collusion by Large Language Models' (2024) arXiv Research Paper.  
<https://arxiv.org/abs/2404.00806?>

<sup>231</sup> OECD (n 1) 52–58.

<sup>232</sup> World Health Organization, *Access to Medicines and Health Products Programme* (WHO 2022) 10–18.

<sup>233</sup> Indian Brand Equity Foundation, *Indian Pharmaceuticals Industry Report* (2024) 3–9

<sup>234</sup> NITI Aayog (n 10) 42–45.

<sup>235</sup> European Commission (n 11) 52–56.

<sup>236</sup> Competition Commission of India market studies concerning digital markets and AI governance.  
<https://www.cci.gov.in/economics-research/market-studies/details/45/0?>

<sup>237</sup> World Health Organization (n 24) 16–21.

<sup>238</sup> World Health Organization, *Global Strategy on Digital Health 2020–2025* (WHO 2021) 18–25.

competitors' pricing, analyze demand patterns and optimize their commercial strategies through self-learning.<sup>239</sup> As these systems interact over time they can start to sync up prices and create market outcomes that reduce competition. That's why the risk of tacit algorithmic collusion is one of the biggest legal and regulatory challenges today.

The research also finds that digital healthcare platforms and e-pharmacies are having a greater influence on how pharma markets are structured largely because they collect vast amounts of data and use automated AI driven systems. These platforms make the market more predictable and increase the likelihood of coordinated pricing, since algorithms are constantly crunching data on prescriptions, consumer habits and competitors' prices.<sup>240</sup> This setup makes it much more likely for tacit coordination and parallel pricing to emerge in digital healthcare.

The study also points out that old competition law frameworks face big gaps when applied to AI powered pharma systems. Laws like the Competition Act 2002 were designed to address classic anti-competitive behavior such as collusive agreements, direct communication and coordinated conduct.<sup>241</sup> But AI changes the game as algorithms can create coordinated outcomes on their own without any direct communication or formal deal. The lack of explicit agreements in AI driven collusion makes it much harder to apply section 3 of the Competition Act to these new situations.

The research further shows that traditional competition law struggles with autonomous AI coordination as it typically relies on proof of intent, agreement or clear anti-competitive conduct.<sup>242</sup> Self-learning pricing systems change their behavior using data and repeated interactions not old-fashioned backroom deals. That makes it tough for regulators to prove intent and to figure out who is liable or show coordinated intent in markets run by AI. Basically the study confirms that our current legal interpretations are not enough to handle coordination and tacit collusion by algorithms.

Another big takeaway is the evidence problem with black-box AI. These pricing algorithms usually work in ways that are hard to explain and keep their decision-making process hidden.<sup>243</sup> That means when regulators look into pharma pricing, they often can not tell if a price was set intentionally learned by the machine or just happened. This opacity makes traditional investigative methods much less effective in cartel cases.

The study also finds that figuring out who is liable for antitrust violations in AI powered pharma markets is a legal maze. Currently pharmaceutical sector is a web of pharma companies, software developers, AI vendors, digital health platforms and data providers all working together.<sup>244</sup> Coordinated outcomes often result from how all these technologies interact not from any single person's actions. That's why old liability rules focused just on direct human action don't work as well in AI run markets.

Looking at the U.S. and Europe the study shows that regulators worldwide are increasingly recognizing the dangers of algorithmic collusion and market concentration. U.S. antitrust enforcers are looking harder at algorithmic pricing under the Sherman Act especially when companies use the same pricing infrastructure to coordinate outcomes.<sup>245</sup> The EU also sees algorithmic coordination as a major challenge and its rules emphasize transparency, explainability and oversight of digital platforms. These international approaches can help guide India as it updates its own competition law.

All these points point to an urgent need for new adaptive laws to regulate AI driven pharma markets in India. The old legal doctrines were made for a time when deals were done face to face and market structures were simpler.<sup>246</sup> Now that India's digital healthcare system is growing the country needs competition law reforms that specifically address AI-powered pricing, algorithmic accountability and predictive commercial technologies.

A key recommendation is to amend the Competition Act, 2002 to clearly define algorithmic collusion. Laws need to spell out what counts as autonomous pricing, AI driven coordination and computational tacit collusion so there is less legal gray area and stronger enforcement in digital pharma markets.<sup>247</sup> By also interpreting anti-competitive agreements in light of outcomes and coordinated tech behavior, India could give its regulators better tools to oversee algorithmic pricing.

The research also stresses the need for transparency and accountability in how pharma pricing algorithms are governed. Making companies disclose how their systems work, requiring regular algorithm audits and insisting on explainable AI and compliance checks for digital health platforms can all help regulators do their jobs.<sup>248</sup> Authorities need to be able to see how algorithmic decisions are made so they can spot anti-competitive behavior early in AI driven markets.

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<sup>239</sup> Organisation for Economic Co-operation and Development, *Algorithms and Collusion: Competition Policy in the Digital Age* (OECD 2017) 21–30.  
[https://www.oecd.org/content/dam/oecd/en/publications/reports/2017/05/algorithms-and-collusion-competition-policy-in-the-digital-age\\_02371a73/258dcb14-en.pdf](https://www.oecd.org/content/dam/oecd/en/publications/reports/2017/05/algorithms-and-collusion-competition-policy-in-the-digital-age_02371a73/258dcb14-en.pdf)

<sup>240</sup> Federation of Indian Chambers of Commerce and Industry, *Digital Healthcare in India Report* (2022) 18–30.

<sup>241</sup> Competition Act 2002, ss 3–4.

<sup>242</sup> Maurice E Stucke and Ariel Ezrachi, 'Artificial Intelligence and Collusion: When Computers Inhibit Competition' (2017) 2017 University of Illinois Law Review 1775, 1782–1807.

<sup>243</sup> NITI Aayog, *Responsible AI for All: Approach Document for India* (Government of India 2021) 40–45.

<sup>244</sup> Ariel Ezrachi and Maurice E Stucke, *Virtual Competition: The Promise and Perils of the Algorithm-Driven Economy* (Harvard University Press 2016) 83–108.

<sup>245</sup> Sherman Antitrust Act 1890; algorithmic pricing enforcement developments in the United States.

<sup>246</sup> Richard Whish and David Bailey, *Competition Law* (10th edn, Oxford University Press 2021) 530–546

<sup>247</sup> Competition Commission of India, *Market Study on Artificial Intelligence and Competition* (2025).  
<https://www.cci.gov.in/images/marketstudie/en/market-study-on-artificial-intelligence-and-competition1759752172.pdf>

<sup>248</sup> European Commission, *Competition Policy for the Digital Era* (2019) 45–56.

Its also vital to make Indian regulatory bodies stronger and more tech savvy. The Competition Commission of India needs more experts in machine learning, data science, digital economics and policy to handle the complicated world of algorithmic pricing and coordination.<sup>249</sup> Building better AI investigation tools and working together across tech and healthcare regulators will help enforcement keep up in digital pharma markets.

The study stresses the need to balance tech innovation with fairness and consumer protection. AI in pharma delivers significant benefits better healthcare access, improved logistics, predictive management and more efficient distribution.<sup>250</sup> Competition rules should not get in the way of useful new technology or responsible AI adoption. Instead regulators need to find the right balance to keeping the market open and innovative while stopping unfair pricing, concentration and algorithm driven competition problems.

Protecting consumers and public health remains front and center in regulating AI powered pharma markets since medicine prices are closely tied to healthcare access and fairness.<sup>251</sup> If autonomous pricing keeps drug costs high, it can hit those who need affordable healthcare the hardest. That's why good competition law is vital to public welfare in digital healthcare.

The study also shows why global regulatory cooperation is more important than ever. AI-driven pharma markets operate across borders, leveraging tech networks and multinational platforms that share data globally.<sup>252</sup> This means international teamwork and harmonized competition rules are key to tackling algorithmic coordination and market dominance on a global scale.

Looking ahead future research on AI and competition law in pharmaceutical markets will be especially important as technology continues to move quickly. New studies could examine real-world data on algorithmic pricing, compare how courts handle AI liability, explore interdisciplinary approaches to regulation, and examine how competition law interacts with data protection and healthcare governance.<sup>253</sup> Researchers might also want to address ethical questions about AI in pharma, examine the public health effects of predictive pricing, and assess how algorithmic governance will shape long-term access to healthcare and market competition.

his study finds that AI driven pharmaceutical pricing and distribution have a real potential to enable tacit collusion and market coordination in Indian fast-changing digital healthcare sector. Existing competition law just is not enough to handle this kind of tech driven behavior since it was designed for old-school, human-driven anti-competitive conduct. That's why adaptive legal reforms, clear rules for algorithmic accountability, stronger institutions and a focus on consumer welfare are all critical to keep competition fair and healthcare accessible in the age of AI.

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