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Social Construction of Diagnostic Technologies in India

Shivmohan Prajapati[1], Dr. Kunal Sinha[2]

[1] Ph.D. Research Scholar, Department of Studies in Science, Technology and Innovation Policy at Central University of Gujarat, Gandhinagar, Gujarat, India
[2] Associate Professor, Department of Studies in Science, Technology and Innovation Policy at Central University of Gujarat Gandhinagar, Gujarat, India

Abstract:

How do prevailing socio-cultural structures mediate the innovation, adoption, and application of diagnostic technologies, and how do these technologies simultaneously reconfigure social norms, healthcare delivery, and gender relations? These questions lie at the heart of this paper, which critically interrogates the reciprocal and contested relationship between diagnostic technology and society in contemporary India. Authored from an interdisciplinary position bridging science and technology studies, gender studies, and innovation policy, the paper employs the Social Shaping of Technology (SST) framework alongside a mixed-methods approach incorporating healthcare professional interviews, regulatory policy analysis to argue that innovation trajectories in diagnostic technology are neither socially neutral nor policy-independent. The paper contends that cultural imperatives, economic constraints, and weak regulatory enforcement collectively mediate how diagnostic innovations including ultrasound imaging, rapid diagnostic tests are developed, diffused, and appropriated across diverse social contexts. Crucially, while these technologies have expanded healthcare access and reduced diagnostic delays in rural and resource-constrained settings, they have simultaneously been captured by patriarchal social structures to perpetuate gender-discriminatory practices, most critically sex-selective abortion. This represents a fundamental policy failure at the intersection of innovation governance and gender justice.

Keyword: Diagnostic Technology, Social Shaping, Innovation, Development, Co-Construction

1. Introduction

The relationship between society and technology is neither linear nor unidirectional; it is a dynamic, reciprocal, and deeply contested process in which each domain continuously shapes, constrains, and reconstitutes the other (Latour, 1996). This fundamental insight, now well established within science and technology studies (STS), challenges the persistent notion of technological determinism the assumption that technology develops according to an autonomous internal logic and subsequently imposes its consequences upon society. Scholars working within the traditions of the Social Shaping of Technology (SST) and the Social Construction of Technology (SCOT) have convincingly demonstrated that technological artifacts, systems, and innovations are not neutral instruments delivered from outside the social world; rather, they are produced within it, bearing the imprint of the cultural values, economic interests, institutional arrangements, and power relations that characterise the societies in which they emerge (MacKenzie and Wajcman, 1999; Bijker, Hughes, and Pinch, 1987). Technology, in this sense, is always already social and society, in turn, is always already technological.

This theoretical orientation carries profound implications for the study of healthcare innovation and diagnostic technology, where the stakes of misunderstanding the technology-society relationship are particularly high. Diagnostic technologies spanning traditional clinical methods, ultrasound imaging, rapid diagnostic tests, molecular diagnostics, and increasingly sophisticated artificial intelligence-driven systems have fundamentally transformed the landscape of healthcare delivery globally, and in India with particular force and consequence (Kumar and Patel, 2018). Yet to treat these technologies merely as technical solutions to clinical problems is to misread their social character entirely. As Parthasarathy (2010) has argued, the development, adoption, and application of diagnostic technologies are deeply embedded in societal values, economic structures, regulatory frameworks, and cultural norms that vary considerably across social contexts. Their consequences, similarly, extend well beyond the clinical encounter, reshaping healthcare practices, redefining the doctor-patient relationship, reconfiguring access to medical care, and as this paper will demonstrate reproducing and at times intensifying existing social inequalities (Berg, 1997).

India represents a particularly significant and instructive context in which to examine these dynamics. As a society marked by extraordinary socio-economic diversity, entrenched cultural hierarchies, rapid but uneven technological adoption, and a healthcare system navigating the competing pressures of public need and market logic, India offers a site where the mutual shaping of technology and society is rendered with unusual clarity and urgency (Kumar and Patel, 2018). The diffusion of diagnostic technologies across India's vast and heterogeneous landscape has not followed a uniform trajectory; it has been mediated at every stage by economic constraints, infrastructural deficits, regulatory capacities, and the deeply rooted socio-cultural norms that govern social life including, critically, those pertaining to gender. The consequence is a paradox that sits at the centre of this paper's analytical concern: diagnostic technologies that carry genuine potential to improve healthcare outcomes, expand access to medical services in rural and underserved regions, and reduce the burden of preventable disease have simultaneously been appropriated most starkly in the case of ultrasound-enabled sex-selective abortion as instruments for reinforcing patriarchal gender hierarchies and perpetuating systematic discrimination against women and girls.

This paper investigates this paradox through a sustained critical examination of the mutual shaping of society and diagnostic technology within the Indian healthcare ecosystem. It proceeds from the argument that neither technological optimism nor technological pessimism constitutes an adequate analytical or policy response to the complexities at hand. What is required, rather, is a theoretically grounded, empirically attentive, and policy-relevant analysis of the specific socio-cultural, economic, and institutional conditions under which diagnostic innovations are developed, adopted, and applied and of the ways in which these conditions determine whether technological capability serves emancipatory or oppressive ends. Drawing on the SST framework, a systematic review of secondary literature, regulatory policy analysis, and interviews with healthcare professionals, this study seeks to provide precisely such an analysis, generating insights that can meaningfully inform policymaking, guide more equitable technology design, and contribute to the broader scholarly discourse on innovation governance in resource-constrained and socially complex settings (World Health Organization, 2021).

The argument developed across this paper is directed at both scholarly and policy audiences. For scholars of innovation studies and science policy, it contributes to theoretical debates on the co-evolution of technology and society, with particular attention to the role of gender, culture, and institutional context in mediating innovation trajectories. For policymakers and healthcare governance practitioners, it offers a pointed reminder that the equitable and ethical deployment of diagnostic technology in India and across the Global South more broadly cannot be achieved through technical regulation alone. It demands a fundamentally

different kind of policy imagination: one that is gender-sensitive, culturally reflexive, ethically grounded, and structurally attentive to the relations of power within which all technology ultimately operates.

2.1 Theoretical Foundations: The Social Construction of Technology

The theoretical scaffolding of this paper rests on the Social Construction of Technology (SCOT) framework, which represents one of the most significant intellectual contributions to science and technology studies in the latter decades of the twentieth century (Bijker, Hughes, and Pinch, 1987). SCOT fundamentally challenges the determinist assumption that technology follows an autonomous developmental logic, imposing its consequences upon a passive society. Instead, it argues that technological artifacts, systems, and innovations are shaped at every stage from conception through design to deployment by social factors, including cultural values, political interests, economic imperatives, and institutional arrangements. Technology, in this reading, is not a neutral instrument; it is a social product, imbued with the priorities, assumptions, and power relations of those who create, regulate, and use it. This insight is not merely theoretical; it carries direct and urgent implications for innovation policy, particularly in contexts such as India where the social conditions mediating technological development are marked by deep structural inequality.

Within healthcare, the SCOT perspective has proven especially generative. Timmermans and Berg (2003) demonstrated persuasively that diagnostic technologies are co-constructed by medical practitioners, patients, institutional frameworks, and regulatory bodies, each bringing distinct interests and normative assumptions to bear upon technological form and function. Diagnostic tools, in this sense, carry implicit assumptions about medical norms, patient behaviour, and the organisation of healthcare delivery assumptions that are rarely made explicit in either clinical or policy discourse, yet which profoundly shape who benefits from technological innovation and who does not. This paper builds directly upon this insight, extending it into the specific socio-cultural and institutional context of contemporary India.

2.2 Cultural Determinants of Diagnostic Technology Adoption

Cultural factors constitute a primary and persistently underestimated mediating force in the adoption and application of diagnostic technologies in India. Banerjee and Sood (2015) demonstrated that the acceptance of diagnostic tools in maternal and child healthcare is significantly conditioned by their alignment, or misalignment, with prevailing cultural beliefs and traditional healthcare practices. Technologies perceived as consonant with existing cultural frameworks are adopted more readily; those that disrupt established norms encounter resistance, negotiation, and adaptation. This finding carries important implications for innovation policy: it suggests that the design and deployment of diagnostic technologies cannot be treated as purely technical exercises, abstracted from the cultural environments in which they must operate.

More critically, cultural forces do not merely shape the pace and pattern of technology adoption; they actively determine the ends to which technological capabilities are directed. In a society historically organised around patriarchal norms and the systematic privileging of male over female life, diagnostic technologies have been drawn into the reproduction of gender inequality in ways that represent one of the most serious ethical and policy challenges in contemporary Indian healthcare. The widespread use of ultrasound technology for sex-selective abortion a practice that persists despite the legislative prohibition established by the Pre-Conception and Pre-Natal Diagnostic Techniques (PCPNDT) Act of 1994 stands as the most consequential illustration of this dynamic. Here, a clinically significant innovation has been systematically appropriated to serve deeply entrenched cultural imperatives, demonstrating with stark clarity that technological capability and social

outcome cannot be understood independently of the cultural context in which technology is embedded. Son preference, sustained across generations by socio-cultural, religious, economic, and institutional factors, has not been dismantled by technological progress; it has been technologically enabled, refined, and extended into new domains of social life.

2.3 Political Economy of Diagnostic Innovation

The political and economic dimensions of diagnostic technology development in India are equally significant and equally complex. Government policy has played a decisive role in shaping the innovation landscape, most notably through initiatives such as the Make in India campaign, which has sought to stimulate indigenous diagnostic technology development tailored to local healthcare needs (Patil, 2019). Such policy interventions reflect a recognition that the global diagnostic technology market, dominated by multinational corporations, does not inherently produce innovations suited to the resource-constrained, infrastructurally uneven, and epidemiologically distinct conditions of the Indian healthcare system. The political impetus toward indigenisation is therefore both economically rational and socially significant.

Yet the realisation of this policy ambition has been substantially constrained by persistent deficits in infrastructure, public healthcare funding, and regulatory capacity deficits that shape not merely the pace of innovation but its geographic and social distribution. Sundararajan et al. (2017) documented how low-cost diagnostic tools in rural India are designed and deployed in response to the imperatives of resource-constrained environments, prioritising affordability, portability, and ease of use over the diagnostic sophistication available in urban tertiary care settings. This bifurcation of diagnostic capability along geographic and socio-economic lines is not a technical accident; it is a policy outcome — the product of institutional choices about resource allocation, regulatory priority, and the governance of healthcare markets. It raises fundamental questions about equity and justice in innovation policy that deserve far greater attention in both scholarly and governmental discourse.

2.4 Equity, Ethics, and the Limits of Technological Progress

The adoption of advanced diagnostic technologies in India has generated measurable improvements in healthcare delivery, expanding access to early disease detection, improving diagnostic accuracy, and contributing to better patient outcomes across a range of clinical conditions. The emergence of point-of-care testing (POCT) devices has been particularly transformative in remote and underserved areas, enabling rapid and reliable diagnostics outside traditional laboratory settings and facilitating timely treatment interventions (Frontiers in Lab-on-a-Chip Technologies, 2024). Similarly, the integration of artificial intelligence into diagnostic systems has enhanced both efficiency and accuracy across multiple medical specialties, with the Indian government's National Strategy for Artificial Intelligence explicitly framing AI-driven diagnostics as an instrument of equitable and inclusive social development (NITI Aayog, 2023).

Yet these advances exist in profound tension with equally well-documented patterns of inequity and ethical failure. Anand and Chakravarty (2020) demonstrated that technological advancement in diagnostics has not uniformly benefited all segments of Indian society; rather, it has in many instances exacerbated existing disparities in healthcare access, concentrating the benefits of innovation among those already advantaged by geography, economic status, and social position. The persistence of data privacy concerns, infrastructural deficits, and affordability barriers further complicates the narrative of technological progress, revealing a landscape in which the emancipatory potential of diagnostic innovation is consistently mediated and frequently constrained by the structural conditions of inequality within which it operates.

Most fundamentally, the ethical dimensions of diagnostic technology deployment in India cannot be adequately addressed through technical or regulatory measures alone. The appropriation of ultrasound technology for sex-selective purposes representing a direct and catastrophic failure of innovation governance illustrates that ethical outcomes depend not on the properties of the technology itself, but on the social, cultural, and institutional context in which it is embedded. This demands a conceptual and policy reorientation of considerable depth: one that moves beyond the governance of technology as such, toward the governance of the social conditions that determine how technology is used, by whom, and to what ends.

2.5 Towards a Policy-Relevant Synthesis

The literature reviewed in this section converges on a set of interconnected arguments that carry direct implications for science and innovation policy in India. First, diagnostic technologies are socially constructed artifacts whose development, adoption, and application are fundamentally shaped by the cultural, economic, and institutional contexts in which they operate. Second, the relationship between technology and society is bidirectional and dynamic: society shapes technology, and technology reshapes society, in a continuous process of co-evolution that is mediated by relations of power, inequality, and cultural normativity. Third, the governance of diagnostic technology in India has thus far proven inadequate to the ethical and equity challenges this co-evolutionary dynamic has generated most critically in the domain of gender, where the failure to align innovation policy with social justice imperatives has had devastating demographic and human rights consequences.

What the literature reveals, in sum, is that India's diagnostic technology landscape is not merely a healthcare governance challenge; it is a science and innovation policy challenge of the first order. Meeting it requires policy frameworks that are simultaneously technically informed, culturally reflexive, gender-sensitive, ethically grounded, and structurally attentive to the conditions of power and inequality within which all technological innovation ultimately takes place. The sections that follow develop this argument through original empirical analysis, contributing to a growing body of scholarship that insists with increasing urgency — that innovation policy and social justice cannot be pursued independently of one another.

3. Findings and Analysis: Diagnostic Technology and Society in India

3.1 Culture, Economy, and the Politics of Diagnostic Access

The trajectory of diagnostic technology development and adoption in India cannot be understood without sustained attention to the societal forces that have actively shaped it. Culture, economic stratification, disease burden, and policy architecture do not constitute the background conditions of technological innovation in India; they constitute its very substance. This section advances the argument that Indian society has been and continues to be a primary determinant of which diagnostic technologies are developed, how they are designed, where they are deployed, and who ultimately benefits from their use.

Cultural beliefs and practices represent one of the most consequential, and most consistently underestimated, forces mediating diagnostic technology adoption in India. The coexistence of traditional medicine systems Ayurveda, Siddha, and Unani alongside modern biomedical diagnostics does not produce a straightforward displacement of the former by the latter. Rather, it generates a complex and negotiated landscape of selective adoption, in which the uptake of modern diagnostic tools is substantially conditioned by their perceived alignment with culturally accepted health beliefs and practices (Kumar et al., 2020). Societal trust in diagnostic technologies, the evidence suggests, is not a simple function of clinical efficacy; it is a social achievement, constructed through the ongoing interaction between technological capability and cultural

legitimacy. This insight carries direct implications for innovation policy: the design and communication of diagnostic technologies must engage seriously with the cultural frameworks through which communities evaluate, interpret, and ultimately accept or resist medical innovation.

India's profound economic stratification constitutes an equally powerful mediating force. Advanced diagnostic technologies CT scanning, MRI, molecular diagnostics, genetic testing remain disproportionately concentrated in urban centres and private healthcare facilities, effectively placing them beyond the reach of the rural majority and the economically disadvantaged (Rao et al., 2021). This geographic and socio-economic bifurcation of diagnostic capability is not an incidental feature of India's healthcare landscape; it is a structural outcome of investment patterns, market dynamics, and policy priorities that have historically privileged urban, private, and technologically sophisticated healthcare over accessible, community-based, and preventive alternatives. The consequence is a diagnostic divide that maps almost precisely onto India's existing inequalities of class, caste, and geography a pattern that neither market forces nor technical innovation alone have proven capable of resolving.

It is precisely this structural inequity that has driven some of the most significant and policy-relevant innovations in Indian diagnostic technology. The development and diffusion of portable, low-cost, point-of-care diagnostic devices represents a direct response to the imperatives of resource-constrained environments, prioritising affordability, portability, and operational simplicity over the diagnostic sophistication available in well-resourced clinical settings (Patil et al., 2019). India's dual burden of communicable and non-communicable diseases has further intensified this imperative, creating urgent demand for scalable, rapid, and accurate diagnostic solutions capable of addressing conditions as diverse as tuberculosis, dengue, diabetes, and cardiovascular disease simultaneously (World Health Organization, 2018). Community-driven innovations portable diagnostic kits adapted for rural settings, telemedicine platforms leveraging community health workers, grassroots diagnostic networks exemplify how Indian society has not merely responded to available technology, but has actively shaped its development toward locally relevant ends (Bhargava and Singh, 2018).

Policy frameworks have played an indispensable, if uneven, role in this process. The National Health Mission has explicitly prioritised the strengthening of diagnostic infrastructure in rural and underserved areas, deploying subsidies and public-private partnerships to extend the reach of affordable diagnostic solutions beyond the urban private sector (Ministry of Health and Family Welfare, 2021). The Make in India initiative has similarly sought to stimulate indigenous diagnostic innovation, reducing dependence on imported technologies and aligning product development with local healthcare needs (Patil, 2019). These policy interventions represent meaningful acknowledgements of the structural conditions mediating diagnostic access yet their implementation has been constrained by persistent deficits in infrastructure, trained human resources, and sustained public investment, limiting their transformative potential in practice.

3.2 Access, Empowerment, and Ethical Paradox

If society shapes diagnostic technology, the converse is equally and, in some respects, more consequentially true. Advanced diagnostic innovations have profoundly reshaped Indian society, altering healthcare practices, reconfiguring relationships between patients and providers, expanding individual agency, and generating new ethical and governance challenges of considerable complexity. This section examines the transformative social impact of diagnostic technology in India, attending equally to its emancipatory possibilities and its deeply troubling ethical dimensions.

The expansion of telemedicine platforms and mobile diagnostic units represents perhaps the most unambiguously progressive dimension of this transformation. By bridging the geographic and infrastructural gaps that have historically excluded rural and remote populations from meaningful healthcare access, these technologies have extended the reach of diagnostic medicine into communities previously served, if at all, only by severely under-resourced primary healthcare facilities (Ramesh and Gupta, 2020). The social consequences of this expansion are significant: earlier disease detection, more timely treatment, reduced catastrophic health expenditure, and a measurable shift in the relationship between rural communities and healthcare systems that have long treated them as peripheral. The COVID-19 pandemic accelerated this transformation dramatically, normalising telemedicine as a mainstream modality of healthcare delivery and demonstrating its viability at scale a development with enduring implications for the governance of diagnostic access in India.

The integration of artificial intelligence into diagnostic systems represents an equally significant, if more complex, transformation. AI-powered diagnostic analysis has enhanced accuracy and efficiency across multiple clinical specialties, with the potential to partially compensate for India's severe shortage of specialist physicians particularly in radiology, pathology, and oncology by augmenting the diagnostic capabilities of generalist practitioners in primary care settings (Manipal Trutest, 2023). The Indian government's National Strategy for Artificial Intelligence has explicitly framed AI-driven diagnostics as an instrument of equitable and inclusive development, aligning technological ambition with social policy objectives (NITI Aayog, 2023). Increased diagnostic availability has also generated measurable shifts in health-seeking behaviour, empowering individuals and communities to engage more proactively with preventive healthcare a development of considerable public health significance in a country where late-stage disease presentation has historically imposed enormous burdens on both patients and healthcare systems (Narang et al., 2021).

Yet these advances exist in profound and unresolved tension with equally significant patterns of ethical failure and social harm. The adoption of advanced diagnostic tools has raised serious concerns about data privacy, algorithmic bias, and the equitable distribution of technological benefit concerns that existing regulatory frameworks have proven inadequate to address (Manipal Trutest, 2023). More fundamentally, the misuse of prenatal diagnostic technologies for sex determination and the facilitation of female foeticide represents a catastrophic ethical failure at the intersection of diagnostic innovation and gender justice one that demands sustained analytical and policy attention. Here, a technology of genuine clinical significance has been systematically appropriated to serve the deeply entrenched cultural imperative of son preference, with devastating demographic consequences: India's skewed sex ratio at birth stands as the most visible and morally urgent testament to the failure of innovation governance to address the social conditions determining how technology is used.

3.3 Co-Construction and Policy Implications

The analytical picture that emerges from the foregoing examination is one of dynamic, reciprocal, and deeply contested co-construction. Diagnostic technology and Indian society do not stand in a simple relationship of cause and effect; they constitute one another through an ongoing process of mutual shaping that is mediated at every stage by relations of power, cultural normativity, economic inequality, and institutional capacity. This co-constructive dynamic simultaneously productive of significant healthcare advances and of serious ethical and equity failures defines the central policy challenge this paper addresses.

The evolution of diagnostic technology in India from basic pathological testing to advanced imaging, molecular diagnostics, and AI-driven systems reflects global scientific progress refracted through specifically Indian social, economic, and cultural conditions (Nundy et al., 2020). The resulting technological landscape is neither simply a reflection of global innovation trajectories nor a purely local product; it is a hybrid formation, shaped by the interaction between global knowledge flows and local institutional, cultural, and economic realities. Understanding this hybridity is essential to developing policy frameworks adequate to India's diagnostic governance challenges.

Three interconnected policy imperatives emerge from this analysis. First, equity must be treated as a foundational design principle of diagnostic innovation policy not as an afterthought to be addressed through redistributive mechanisms after technologies have been developed for privileged markets. This requires deliberate policy investment in innovation pathways oriented toward affordability, accessibility, and community-level deployment from the outset of the development process. Second, cultural sensitivity must be institutionalised within innovation governance frameworks, ensuring that diagnostic technologies are designed and communicated in ways that engage meaningfully with the diverse cultural contexts in which they must operate including, critically, the gendered cultural contexts that determine how reproductive diagnostic technologies are used. Third, and most urgently, the governance of diagnostic technology must explicitly address the gender dimensions of innovation not as a specialist concern but as a central priority of science and innovation policy. The persistent misuse of prenatal diagnostic technology for sex selection, despite decades of legislative prohibition, demonstrates unambiguously that technical regulation is insufficient in the absence of broader social policy engagement with the cultural and structural conditions sustaining son preference and gender discrimination.

The co-construction of diagnostic technology and Indian society, properly understood, is therefore not merely a descriptive finding about the relationship between innovation and social context. It is a normative argument about the kind of innovation policy India needs one that is equity-oriented, culturally informed, gender-sensitive, and institutionally serious about the governance of the conditions under which technological capability is socially applied.

Conclusion

Diagnostic technology diffused India but shaped according to Indian society and culture. So existing problems of society reshapes with the technological development. Technology doesn’t adopt neutrally but adopt according the political-economic frame of society so diagnostic technology reshapes the gender as the society made hierarchy of gender. Sex identification technology promoted the abortion of female child latter period of time the PNDT act prevent it and now moving towards balance sex ratio. So social hierarchical boundaries make limitation of technological progress and hurdle for democratic development of technology. Governmental policies for technology development ignore the rural society and their participation in the technological process. The paper discussed the contemporary relevant of social construction of technology in the diagnosis and technological study. The structural inequality made difference in diagnostic resource distribution between rural and urban areas, but the advancement of diagnostic technology reducing the differences.

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