

Surgeons as co-creators: the SuFI model for embedding innovation in surgical education

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Abstract

While the traditional apprenticeship model in surgical training remains valuable, it often underutilizes the surgeon's potential as a co-creator of solutions to pressing clinical challenges. As surgical device development increasingly emphasizes locally relevant and immediate problem-solving issues, innovation in surgical education is no longer optional but an essential component of modern training.

This commentary introduces the *Surgeons for Innovation (SuFI)* program, a nonprofit collaborative program spearheaded by surgeons, researchers, and engineering teams. Designed as a structured yet adaptable model, SuFI integrates innovation training directly into surgical education in India.

The program fosters collaboration among surgeons, researchers, and engineers to co-develop effective, and scalable medical devices of relevance to the

local and global users. Its framework is built on four pillars:

- (1) design conceptualization
- (2) access to incubators
- (3) regulatory approvals and
- (4) a repository of problem statements.

Through this approach, SuFI will successfully guide surgeon-engineer teams from problem identification to prototype development, patenting, and market launch of effective, patient-centered devices inspired by real surgical needs. By positioning surgeons as co-creators rather than passive end-users, SuFI strengthens the national innovation ecosystem and aligns with calls to institutionalize innovation within medical curricula. This model offers a potential blueprint for advancing surgical education, particularly in resource-constrained settings.

Keywords: Surgical education, Innovation, Frugal innovation, Surgeon-engineer collaboration, India

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1. Introduction

The apprenticeship model of surgical education, which prioritizes the transfer of technical skills, is increasingly insufficient for addressing the complex, resource-constrained healthcare challenges of the 21st century. A new paradigm is emerging that positions surgeons not merely as end-users of technology, but as co-creators of innovative solutions.¹ This approach, often referred to as "surgineering," formalizes the partnership between surgical and engineering disciplines to solve problems in the operating theatre.²

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Evidence suggests that interdisciplinary partnerships between surgeons and engineers accelerate medical device development,³ although barriers such as disciplinary silos and communication gaps persist.⁴

The Surgeons for Innovation (SuFI) program represents a structured and scalable model for embedding this collaborative ethos directly into surgical training in India. This commentary outlines how SuFI addresses the gaps in traditional surgical education and positions itself as a significant contributor to the global dialogue on surgical

education and innovation, with a contextually relevant approach.^{5,6}

2. The Indian Context: Frugal Innovation and Policy Alignment

SuFI is deeply rooted in India's unique innovation ecosystem, which is characterized by the concept of "frugal innovation." This philosophy, also known as *jugaad*, emphasizes developing high-impact, affordable solutions by embracing constraints as catalysts for creativity.⁷ While this improvisational ingenuity has long existed, the challenge has been to transition from ad-hoc solutions to a systematic, formalized process that can lead to commercialization and academic publication. Exemplars such as Aravind Eye Care and Narayana Health demonstrate the potential of frugal systems and devices to achieve both affordability and high quality.^{8,9}

SuFI addresses this by institutionalizing frugal innovation within surgical training while leveraging India's supportive policy environment.

- **Atal Innovation Mission (AIM):** Launched by NITI Aayog, AIM strengthens India's innovation culture by supporting incubation centers and entrepreneurship programs nationwide.¹⁰
- **BIRAC BioNEST:** A network of biotechnology incubators providing infrastructure, technical expertise, and funding opportunities for healthcare innovations.¹¹
- **ICMR/DHR Policy (2022):** A landmark framework enabling medical professionals to engage in innovation, intellectual property development, and startup creation while receiving academic recognition.¹²
- **Medical Device Rules (MDR 2017):** Provide the regulatory pathway for device approval and commercialization in India.¹³
- **Startup India IPR Policy:** Offers patent-fee rebates and IP support for clinician-innovators.¹⁴

By aligning with these initiatives, SuFI bridges clinical insights with institutional infrastructure, regulatory approvals, and entrepreneurial opportunities, thereby creating a pipeline from surgical idea to societal impact.

3. The SuFI Collaboration Model

The SuFI program is built on four interconnected pillars that distinguish it from informal collaborations:

3.1 Structured Mentorship

A guided collaboration between clinicians, engineers, and design experts ensures that multidisciplinary teams overcome communication and cultural barriers while progressing through the innovation cycle.

Training models in design thinking have shown promise in building innovation skills among medical students and surgical trainees.¹⁵⁻¹⁷

3.2 Regulatory and Policy Advocacy

SuFI emphasizes compliance with regulatory frameworks and aligns with national policies to ensure that trainee innovations are academically recognized and commercially translatable.

3.3 Access to Incubators

Partnerships with national incubation hubs (AIM, BioNEST) offer infrastructure, funding, and technical resources to transform concepts into prototypes and market-ready devices.

3.4 Problem Statement Repository

A continuous feedback system gathers real-world surgical challenges, ensuring that projects remain patient-centered and clinically relevant. This aligns with biodesign principles of *needs finding*^{5,6} and mirrors India's grassroots innovation platforms, such as the National Innovation Foundation and the Honey Bee Network.^{18,19}

4. Preliminary Outcomes

Although SuFI is a relatively young program, its early outcomes highlight its potential. It has successfully guided clinician-engineer teams from **problem identification to prototype development, patent filing, and translational planning.**²⁰

Case Example: The *am-SafeX Catheter*

- **Clinical Insight:** Need for a safer urinary catheter to prevent displacement and associated complications.
- **Innovation:** Incorporation of an additional proximal drainage eye and obturator system to enhance balloon anchorage.
- **Outcome:** Progression from concept to functional prototype, currently advancing toward validation and market introduction.

Comparable examples in India—such as gasless laparoscopy devices developed through frugal,

participatory design—demonstrate the feasibility and global relevance of such innovations.^{21–23}

These outcomes illustrate SuFI's role as a bridge between clinical insights and deployable innovations, demonstrating how structured mentorship and institutional support can accelerate frugal device development.

Conclusion

By embedding innovation development within surgical training, SuFI reframes the surgeon's role from end-user to **co-creator of solutions**. This shift cultivates a mindset where problem-solving becomes integral to professional identity.

Future directions include:

- Scaling SuFI across medical institutions to institutionalize innovation curricula.

- Building international collaborations to extend India's frugal innovation model globally.
- Establishing metrics to evaluate innovation literacy among surgical trainees and the long-term clinical impact of devices developed through SuFI.

Ultimately, SuFI provides a **blueprint for resource-constrained health systems**, demonstrating how structured, context-sensitive, and policy-aligned models can drive sustainable medical innovation.

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