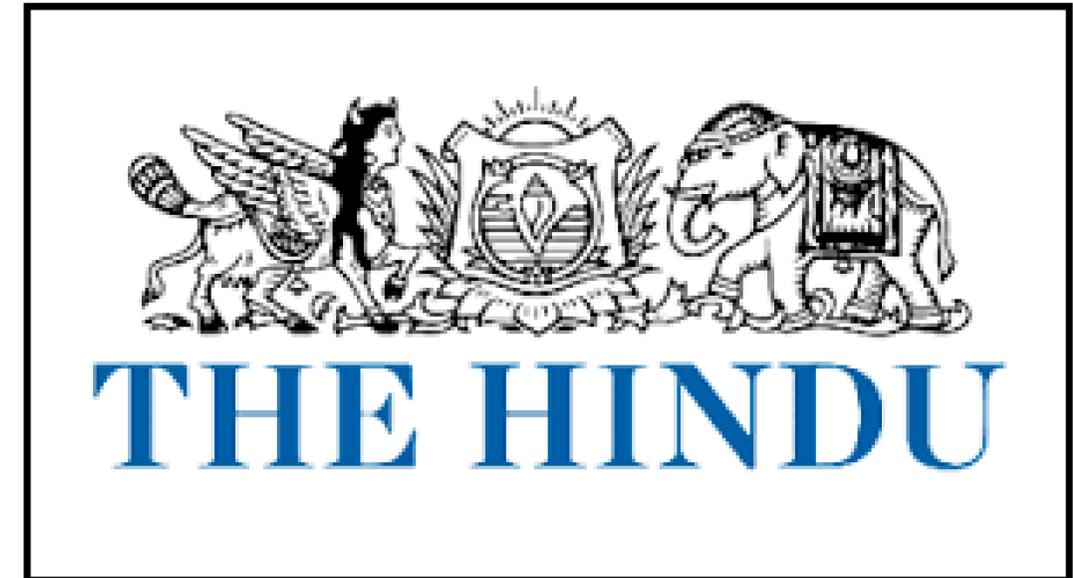




# Topics



- GAPE LIMITATION
- YOUTH SUICIDE
- HEALTH EQUITY
- UNIVERSAL HEALTH COVERAGE
- Port of Baltimore
- Fabrication Technology
- Mains



By saurabh pandey sir



# Target Mains 2024/25



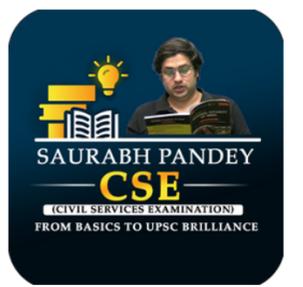
Q" Suicide in young people is best understood as multidetermined and the result of interaction between biological, psychological, familial, and social cultural factors" Discuss

प्रश्न" युवा लोगों में आत्महत्या को बहु-निर्धारित और जैविक, मनोवैज्ञानिक, पारिवारिक और सामाजिक सांस्कृतिक कारकों के बीच बातचीत के परिणाम के रूप में सबसे अच्छी तरह समझा जाता है।" चर्चा करें

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# Answer review



PRACHI

Que "Bharatiya Nyaya Sanhita (BNS) 2023, inculcate contemporary social changes in criminal justice system" Examine.

Ans - Bharatiya Nyaya Sanhita 2023 replaced the Indian Penal Code 1860, introducing new offences, elevating court-attached-down offences and enhancing penalties for various offences.

③ Mob lynching ← - BNS specifies separate penalty for mob lynching with imprisonment - ment.

① Terrorism - BNS defines terrorism as an act, includes to threaten unity, integrity and security of country.

② Sedition - BNS repeals offences of sedition, which was criticised as colonial relic that curbed free speech.

④ Petty Organised Crime - such as organised pick pocketing, snatching, theft are punishable with imprisonment.

⑤ Community Service - As a form of punishment for specific crimes.

Some Key Changes in BNS 2023

Concerns regarding these changes -

Section 106(2) of Bharatiya Nyaya Sanhita 2023, provides for a max<sup>m</sup> 10 years of imprisonment in case of fatal accident if the accused person escapes without reporting to police, seems disproportionate.

• This provision is unconstitutional, because Article 20(3) of Indian Constitution provides the right against self-incrimination.

• Section 112 introduces the offence of 'Petty organised crimes' such as theft, snatching, cheating, gambling, selling of examination question papers, or any other similar criminal acts.

• However, 'any other similar criminal acts' of the section is undefined and open-ended.

• Section 143 deals with the sufficiency offences.

Sub-sec<sup>n</sup> (6) - deals with sufficiency of a child multiple number of times.

Subsec<sup>n</sup> (7) - Sufficiency of a person by a public servant or police officer.

• Both provisions provide only for life imprisonment. and do not provide any discretion to judiciary for punishment.

Conclusion - The Bharatiya Nyaya Sanhita 2023 represents a significant contemporary social changes in criminal justice system, aimed to uphold constitutional principles such as justice and dignity of each individual and also aim to enhancing the current legal framework and promote safety and security to all.



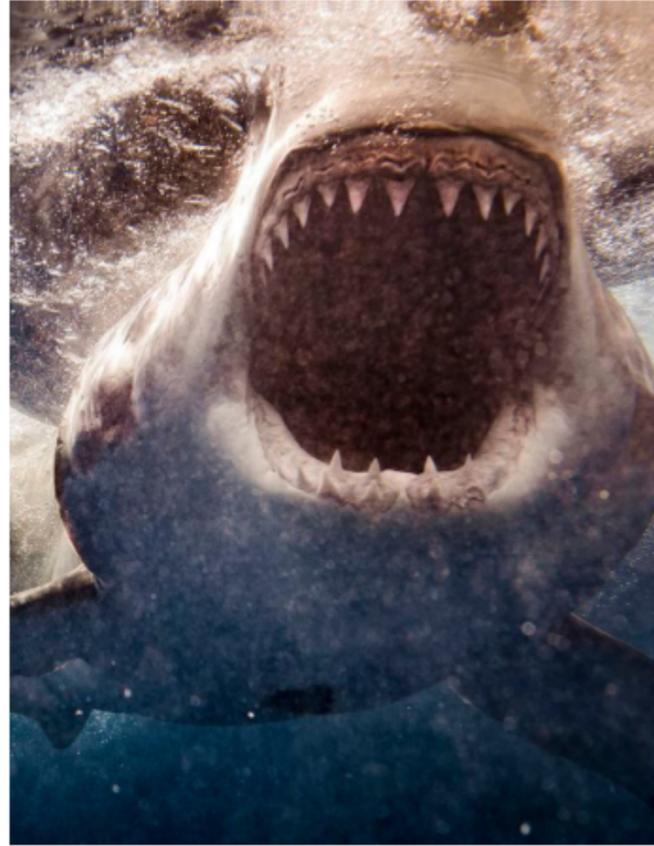
# Gape limitation: are you a big eater?

Arkatapa Basu

In ecology, 'gape limitation' stands for the idea that a predator can only eat things that fit in its mouth. Imagine a snake trying to eat a rabbit. If the rabbit is too big to fit in the snake's mouth, gape limitation says the latter won't be able to eat it. Researchers pay attention to the concept because it specifies which animals can eat which other animals. For example, small predators can only eat small prey, while bigger predators can eat bigger prey. From the prey's point of view, if a predator's mouth isn't big enough to devour it, perhaps those animals are safe from that predator. This barrier can in turn lead to evolutionary pressure that selects the predator's ability to eat smaller prey or, conversely, adaptations in the predator's behaviour to overcome gape limitation.

Gape limitations also influence how animals evolve over time. Prey animals might get faster or grow bigger to avoid being eaten by predators with smaller mouths. On the other hand, predators may evolve larger mouths to eat larger prey.

Understanding gape limitations is essential to predicting how changes in predator or prey populations, changes in habitats, and/or environmental disturbances could affect the structure and function of



Small predators can only eat small prey, while bigger predators can eat bigger prey. GETTY IMAGES

ecosystems. The study of gape limitations also helps researchers understand the intricate dynamics of animal interactions and the cascading effects they have on biodiversity.



**For feedback and suggestions**

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# GAPE LIMITATION



- In ecology, ‘gape limitation’ stands for the idea that a predator can only eat things that fit in its mouth. Imagine a snake trying to eat a rabbit.
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# VOLCANIC VORTEX



- **Volcanic vortex rings emerge from a new pit crater on the north side of the southeast crater of the Etna Volcano in Sicily, Italy, on Friday.**
- **While the physical conditions under which volcanic vortex rings form are still not entirely known, scientists believe they are the result of a combination of fast gas release at the top of the magma conduit and regularity in the shape of the emitting vent.**

**BIG SHOT**



Volcanic vortex rings emerge from a new pit crater on the north side of the southeast crater of the Etna Volcano in Sicily, Italy, on Friday. While the physical conditions under which volcanic vortex rings form are still not entirely known, scientists believe they are the result of a combination of fast gas release at the top of the magma conduit and regularity in the shape of the emitting vent. AP

The Hindu analysis by saurabh pandey sir



# Gone too soon — the subject of youth suicide in India

**S**uicide is the tragic and untimely loss of human life, all the more devastating and perplexing because it is a conscious volitional act.

India has the dubious distinction of having the highest number of suicides in the world. The National Crime Records Bureau (NCRB) reports that 1.71 lakh people died by suicide in 2022. The suicide rate has increased to 12.4 per 1,00,000 – the highest rate ever recorded in India. But these figures are underestimated due to an inadequate registration system, the lack of medical certification of death, stigma and other factors. Unfortunately, 41% of all suicides are by young people below the age of 30. Suicide is the leading cause of mortality for young women in India. A young Indian dies by suicide every eight minutes, which is a loss to family, society, the economy and future of the country. Suicide in the young is a major public health problem in India.

## There is no single factor

Suicide is a complex human behaviour and it is futile to locate a single causative factor. Suicide in young people is best understood as multidetermined and the result of interaction between biological, psychological, familial, and social cultural factors.

A current review of adolescent suicides in India shows that the most commonly reported risk factors were mental health problems (54%), negative or traumatic family issues (36%), academic stress (23%), social and lifestyle factors (20%), violence (22%), economic distress (9.1%) and relationship factors (9%). Physical and sexual abuse, examination failure, intergenerational conflicts, parental pressures and caste discrimination are associated with youth suicide.

There are specific sociocultural factors for suicide among young girls and women. Arranged and early marriages, young motherhood, low social status, domestic violence and economic dependence are well documented. Rigid gender roles and discrimination have also been



**Dr. Lakshmi Vijayakumar**

is Founder, SNEHA, a suicide prevention centre, Head of the Department of Psychiatry, Voluntary Health Services (VHS) Chennai, Honorary Associate Professor, University of Melbourne and Member, World Health Organization Network on Suicide Prevention and Research

No young lives should be lost by suicide in India due to silence and inaction

implicated. Failure in examinations drove 2,095 people to suicide in 2022. A system of education with an emphasis on scoring marks, and a one-point examination system, along with parental pressure and high expectation from oneself and the educational institutions contribute to suicides. Enormous competition to get into colleges, media hype around results, the shame associated with failure, and months of pent-up pressures and emotions result in a highly emotionally wrought state. Competitive examinations have also pushed many students to the edge. Tragically, even after obtaining a seat in prestigious professional colleges, academic pressure has led to many suicides.

Alcohol and substance use are known risk factors in youth suicides. The last two decades have witnessed a marked increase in Internet use among the young. A meta-analysis from 19 States of India revealed that almost 20% of college students are net addicts. One-third of young people are cyber-bullied. And of this sub-set, one third are suicidal. Teens who used social media for more than two hours a day are more suicidal.

The media has a strong influence on vulnerable young people. Sensational reporting of suicide, particularly by a celebrity, is followed by increased suicidal behaviour. Following the death of a very popular young male actor in India, there was a significant increase in searches on Google on “how to commit suicide”.

## There are solutions

The view that suicides cannot be prevented is a commonly held one as people believe that it is an individual's choice. Or it is because of socio-economic factors which are beyond their control. For an overwhelming majority of young people who engage in suicidal behaviour, there is often an alternate, appropriate resolution of their problems. Young people can be taught problem solving, impulse control and emotional

regulation skills along with improving help-seeking behaviour. Early identification of mental distress and provision of care in a youth-friendly environment are essential. Adopting a healthy lifestyle (a good diet, regular physical activity, moderate and appropriate use of the Internet, cultivating supportive friendships, yoga and meditation) improves mental health and reduces suicide in the young.

Improving the family environment by reducing domestic violence and alcohol consumption, and providing economic assistance to the needy have been shown to reduce suicidal behaviour. Educational reforms such as alternative assessment methods and provisions to explore the potential of a

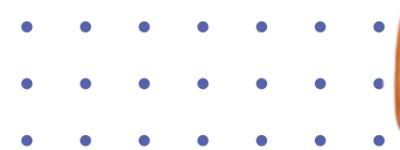
young person are needed. Societal changes to reduce stigma and discrimination based on caste, religion and sexuality need to be addressed. Political will, intersectoral collaboration and commitment, and community participation are needed.

## A strategy that needs more visibility

The Ministry of Health constituted a task force in November 2019 to develop a National Suicide Prevention Strategy for India. The final strategy was launched on November 21, 2022 with the objective of reducing suicide by 10% by 2030.

The strategy has recognised that collaboration between the Ministries of Health, Education, Information and Broadcasting, and Social Welfare is essential. The strategy focuses on the need to leverage educational institutions and youth organisations to promote mental health and reduce substance and behavioural addictions through school health ambassadors and youth clubs.

The immediate task is to disseminate the strategy to all States in India and stakeholders. Budgetary allocations are necessary and the strategies need to be implemented at the earliest at the State, district and community levels.



# YOUTH SUICIDE



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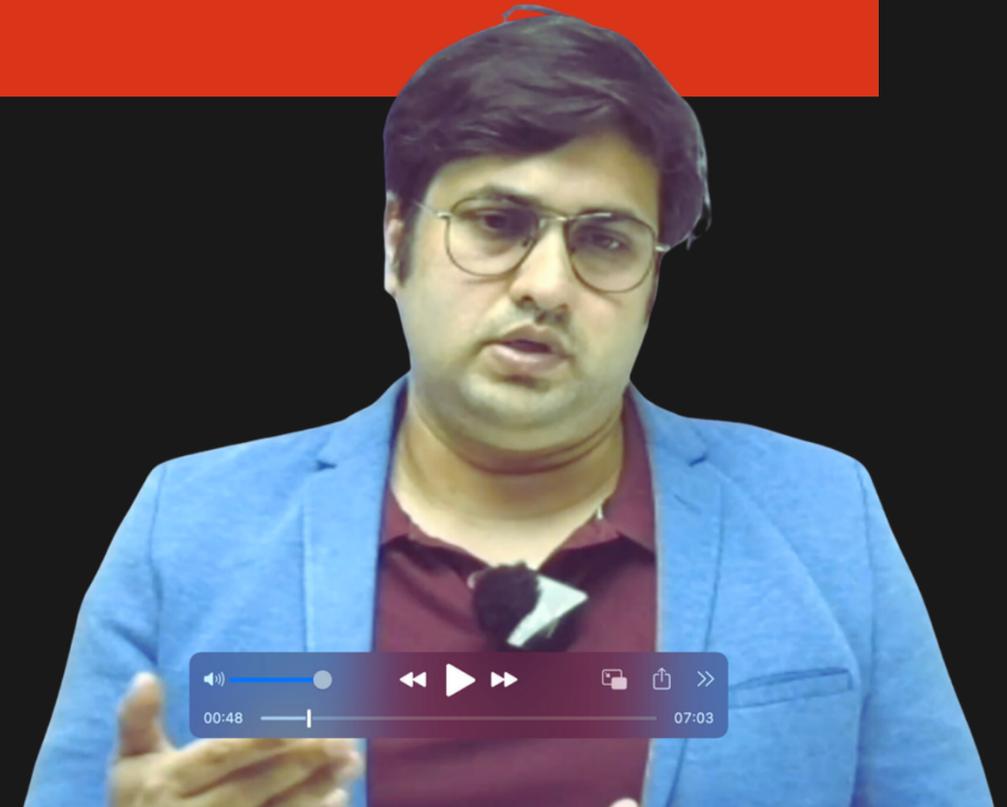
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# Shaping India's path to inclusive health care



World Health Day, which is observed every year on April 7, unites us around health equity, an essential topic at the heart of global health and justice. The World Health Organization (WHO) has declared health to be a fundamental human right. The theme this year is "My Health, My Right".

There is an alarming gap in health-care access, highlighted by the COVID-19 epidemic, environmental crises, and growing socio-economic gaps. Even though over 140 nations recognise health as a constitutional right, the WHO Council on the Economics of Health for All reports that more than half the world's population needs complete access to essential health services. With the passage of World Health Day 2024, it is clear that promoting health equity is a source of optimism for millions of people, going beyond social justice or legislative change.

## The meaning of health equity

Health equity ensures that every person has an equal opportunity to achieve their highest health potential, no matter what their circumstances. Recognising that social, economic, and environmental factors impact health outcomes, this idea goes beyond genetics. WHO's mission is to eliminate unfair and preventable disparities in health among different social and economic categories.

True health equity addresses the root causes of health inequities such as poverty, discrimination, limited access to high-quality education, a healthy diet, clean water, fresh air, and housing, and merely grants equal access to health care. For example, a child born into poverty in a rural area has no access to clean water, wholesome food, or immunisations, which lays the foundation for chronic health problems.

These differences are made worse by pandemics, climate change, and sociopolitical unrest. India is diverse and has wide socioeconomic gaps. Thus this predicament strikes a chord. Access to health care in rural areas is significantly less than in metropolitan areas. Social and economic barriers exacerbate this disparity.

To guarantee that everyone may live a healthy life, attaining health equity necessitates a comprehensive strategy that goes beyond legislative reform to address the socioeconomic determinants of health. Realising each person's potential for health demands a concerted effort by governments, communities, and individuals to tear down these obstacles.

The road to health equity is fraught with difficulties, ranging from deeply ingrained social injustices to global systemic health concerns, particularly in multicultural countries such as India. Diverse populations need help to get access to high-quality health care in this place.

The global challenges are: The fight for health equity confronts global challenges that transcend borders and call for collective international action. The COVID-19 pandemic has starkly revealed that infectious diseases target

## Dr. K. Madan Gopal

is an Adviser in Public Health Administration, National Health Systems Resource Centre and a former Senior Consultant with NITI Aayog

## Professor Dr. Suneela Garg

is Chair of the Programme Advisory Committee, National Institute of Health and Family Welfare, Ministry of Health and Family Welfare, New Delhi

## Dr. K.S. Uplabdh Gopal

is a health-care professional

India's health equity issues require a comprehensive approach that goes beyond improvements in health-care facilities

marginalised and vulnerable groups the most, thus widening the health equity gap. Climate change poses a serious health risk since it disproportionately impacts low-income and vulnerable people. The health-care provision is severely hampered by conflicts, which destroy infrastructure, uproot communities, and shut off access to vital medical services.

## India's health equity challenge

With a large and diversified population, India faces persistent obstacles to health equity, including notable differences in health-care outcomes and access. Even though access to health care has improved over the past 20 years, there is still much work to be done in rural India. According to the 2011 Census, urban slums make up over 17% of India's metropolitan areas, and exhibit serious health disparities. Health risks are increased by overcrowding, poor sanitation, and restricted access to clean water. Infectious diseases, such as tuberculosis, are 1.5 times more common in slums than in non-slum areas, according to the Indian Council of Medical Research.

Disparities across caste and gender are profound. National Family Health Survey (NFHS)-5 (2019-21) data indicates that Scheduled Castes and Scheduled Tribes experience higher child mortality and lower immunisation rates. Additionally, 59% of women in the lowest wealth quintile suffer from anaemia, almost double the rate in the highest quintile, demonstrating the intersection of caste, gender, and economic status in health outcomes.

Non-communicable diseases (NCDs) account for more than 60% of all fatalities in India. The Public Health Foundation of India points out the necessity for equitable treatment access and preventive health care, stating that the economic effect of NCDs could surpass \$6 trillion by 2030.

A critical shortage of doctors exacerbates these issues, with WHO data indicating only 0.8 doctors per 1,000 people, which is below the advised ratio. Even though over 75% of health-care professionals work in metropolitan regions, which only account for 27% of the population, the shortage is particularly severe in rural areas. If other medical practitioners are considered, the ratio might be balanced.

India's health equity issues require a comprehensive approach beyond improvements in health-care facilities to address more extensive socioeconomic determinants of health. To move India toward universal health coverage and a more equitable future, the government, civil society, health-care providers, and communities need to work together.

Governments and officials may influence the state of health through funding, creative policies, and laws. For instance, India's Ayushman Bharat initiative provides free health coverage to the bottom 40% economically, demonstrating a commitment to reducing health disparities.

The National Health Mission (NHM), which

includes both the National Rural Health Mission (NRHM) and the National Urban Health Mission (NUHM), reduces the health-care gap between rural and urban India by expanding access, strengthening infrastructure, and providing essential services to vulnerable populations.

Achieving health equity requires raising health literacy. India should turn health equality into a shared, community-driven goal by including health education in the NHM, enabling its people to seek equitable care and make educated health decisions.

Together with the government, the public and private health-care sectors provide services to underprivileged communities, emphasising preventive education, workforce development, and infrastructure enhancement.

Non-governmental organisations and civic societies engage in direct community outreach to draw attention to and resolve regional health concerns. Their collaboration with international and governmental organisations allows them to tailor health initiatives that are culturally sensitive to the community's unique needs.

International institutions such as WHO, the Global Fund, and Gavi support health initiatives in places with limited resources and promote sharing information and resources to enhance health-care systems, especially in countries such as India.

Through innovation and technical growth, particularly in digital health, the commercial sector and charitable organisations advance accessibility and affordability while extending reach and efficacy.

Research institutes and academic institutions offer crucial insights into health inequalities and the efficacy of interventions, assisting in creating evidence-based practices and policies supported by scientific studies.

## Tap these organisations

Organisations with a strong local presence are essential for health equity. They actively participate in every phase, from planning to evaluation, to guarantee the relevance and effectiveness of health programmes. They also have a thorough understanding of their community's requirements.

Successful collaborations, essential for achieving health equity, depend on open communication, respect for one another, and common goals. They are prepared to adapt to shifting health concerns and community demands because they strongly emphasise empowering communities, sharing knowledge, and building capacity.

Effective collaboration among many sectors, ranging from policymakers to grassroots organisations, may significantly enhance health equity and pave the path for a time when access to high-quality health care would be a shared reality rather than a privilege.

The views expressed are personal





# HEALTH EQUITY

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# Implementing universal health coverage

Universal health coverage (UHC) signifies universal accessibility to comprehensive, high-quality health services, without financial hardship. UHC ensures that people receive care whenever and where ever they need it. It covers the full continuum of essential health services, from health promotion to prevention, treatment, rehabilitation, and palliative care. The delivery of these services relies on strong, efficient, and equitable health systems deeply rooted in the communities. UHC is built on the ethos of strengthening primary healthcare to ensure that all health needs are addressed in an integrated manner, supported by a well-equipped health and care workforce.

On December, 12, 2012, the UN General Assembly unanimously endorsed a resolution urging countries to accelerate progress towards UHC. In India, the high level expert group report, submitted to the Planning Commission in 2011, outlined a government intent to increase public financing for health to 2.5% of India's GDP during the 12th Plan (2012-17). The economic growth of the country makes this increase feasible. The National Health Policy, 2017 articulates "the attainment of the highest possible level of good health and well-being, and universal access to good quality health care services without anyone having to face financial hardship as a consequence" as its goal, which aligns with the UHC target.

## Right to health

India lacks a constitutional provision for the fundamental right to basic health. However, the Directive Principles of State Policy in Part IV of the Constitution provides a basis for the right to health. Article 39 (e) of the Constitution directs the state to secure the health of workers; Article 42 emphasises just and humane conditions of work and maternity relief; and Article 47 casts a duty on the state to raise the nutrition levels and standard

## Aruna Bhattacharya

leads the urban health/public health domain at the School of Human Development, Indian Institute for Human Settlements, Bengaluru

The two critical components of the UHC policy – strengthening primary healthcare and reducing out-of-pocket expenditure – demand focused attention

of living, and to improve public health. The Constitution not only mandates the state to enhance public health but also endows the panchayats and municipalities to strengthen public health under Article 243G.

The theme of International UHC day is 'Health for all: Time for Action' and of World Health Day is 'my health - my right'. How should access to health be envisaged? Given that health is a state subject and the UHC policy is envisaged at the national level, there is a need for discourses on implementation. India has a large migrant population: the total number of inter-State migrant workers was about 41 million (Census 2011), and the total migration rate was 28.9% (Periodic Labour Force Survey, 2020-21). With 49% of the population living in urban slums, according to UN-Habitat/World Bank, the focus should be on ensuring the availability and accessibility of primary health services.

Isaiah Berlin spoke about two types of freedom. The first is 'freedom from' or negative freedom; the second is 'freedom to' or positive freedom. 'Freedom from' means the absence of obstacles or constraints, whereas 'freedom to' recognises the possibility of autonomously determining and achieving individual or collective purposes. The discourse on health as a human right must be seen as the second freedom, where every citizen has the possibility to achieve health and wellness as part of their rights to access to public health.

The constitutional right to health is critical to breaking the vicious cycle of poverty and poor health that will otherwise continue to perpetuate inequality in all spheres of life, including education, opportunity, wealth, and social mobility.

The two critical components of the UHC policy – strengthening primary healthcare and reducing out-of-pocket expenditure –

demand focused attention. To align electoral mandates with UHC implementation, political leaders should consider the following suggestions.

## Four suggestions

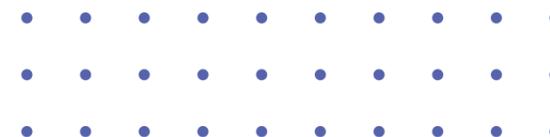
The first is to address urban migrants' health needs, and reforms in informal sectors. Given the surge in migration and mobility, primary healthcare needs a shift in vision. There is a need to include the element of mobility and portability of access to health care services to aid continuity of treatment.

The second is to simplify the reimbursement processes for reducing out-of-pocket expenditure. The design of cash transfers and reimbursement in India's public healthcare system needs adaptation for migrant and marginalised communities.

The third is to create inclusive health systems. We need to integrate health management information system dashboards with both public and private systems and ensure better information systems considering language barriers and diversity in the urban context.

The fourth is to implement community-based primary healthcare in urban and peri-urban areas with seamless referral systems. We need to foster integration of services at the primary healthcare level, ensuring follow-up and adherence to healthcare.

A healthy population is an empowered population. The lighter the disease burden, the better the country's financial health. This election, UHC can be a transformative offering of political parties. Committing to investing in health systems and effectively implementing UHC necessitates political will, substantial investment, and a clear, long-term vision. Establishing a coherent policy pathway to execute the national UHC policy consistently across States is imperative for its success.





# UNIVERSAL HEALTH COVERAGE

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## steps

- The first is to address urban migrants' health needs, and reforms in informal sectors.
- The second is to simplify the reimbursement processes for reducing out-of-pocket expenditure.
- The third is to create inclusive health systems.
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The Hindu analysis by saurabh pandey sir





# What would be the impact of the Baltimore bridge collapse?

How will the workers in the port be affected by the collapse of the Francis Scott Key Bridge? What are the other factors affecting supply chains across the world?

**Simona Stan**

**T**he collapse of the Francis Scott Key Bridge on March 26 has put a spotlight on the Port of Baltimore, one of the busiest harbours in the U.S., which paused shipping and immediately halted all vessel traffic in and out.

The port remained open to trucks following the incident, but the loss of maritime traffic is expected to cost \$9 million a day. The overall economic toll is likely to be higher as billions of dollars of goods are rerouted amid the prospect of supply chains being snarled for months. It will also mean a loss of tax revenue for the city and state.

Here, a supply chain and logistics expert from the University of Montana explains the short- and long-term impacts of the crash on supply chains.

## How important is the Port of Baltimore?

The Port of Baltimore is the ninth largest U.S. port by overall trade volume. In 2023 alone, it moved around 50 million tonnes of goods between the U.S. and other countries, much of it in large shipping containers, like those stacked on the ship that rammed into the bridge. Although it's smaller than other ports on the East Coast and in the Gulf of Mexico, it still plays a critical role in processing U.S. international trade traffic. That's especially true for some products, such as automobiles, heavy machinery and coal. It also handles a large share of U.S. sugar imports.

## What's the short-term impact of its closure on supply chains?

The immediate impact will be felt by the 15,000 or so workers in the port and

about 1,40,000 others who depend on it. It doesn't mean they'll be laid off, but drastically less traffic would mean less work to go around. Companies and consumers should expect some delays for packages that would have otherwise been processed by the port. How long depends on how much time it takes for ships to be rerouted to other terminals, but it should only add a matter of days or up to a week or two. Baltimore accounts for only 4% of overall East Coast trade, so it shouldn't have a major impact. Dealers will probably experience some delays receiving imported cars and light trucks, but things should be resolved within days or weeks.

## What's the long-term impact?

The problem is that supply chains have been under stress from multiple directions lately.

Houthi attacks on ships in the Red Sea and Panama Canal bottlenecks have lengthened delivery times and increased costs for companies that rely on East Coast ports. The pause in maritime traffic at the Port of Baltimore adds one more point of pressure for trade in the region. This may lead more shippers that have a choice to send more freight through West Coast ports, which have not suffered much from the Red Sea attacks and Panama problems. This could also mean more business for trucking and rail companies if it means they have to transport more goods from the West to East Coast.

## How does this supply chain shock compare with other recent ones?

From a supply chain perspective, this was a freak accident. It's dramatic, it's graphic, and it forces people to pay attention to the issue. But unlike the Red Sea attacks or the impact from the COVID-19 pandemic, which have led to lingering supply chain problems, fallout from the bridge collapse will be temporary. That said, we'll likely see public pressure on companies to try to prevent such a thing from happening again – even though the risk of ships striking bridges is very low.

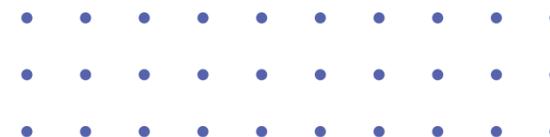
*The author is Professor of Marketing, University of Montana. This article has been republished from The Conversation.*

## THE GIST

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# Port of Baltimore

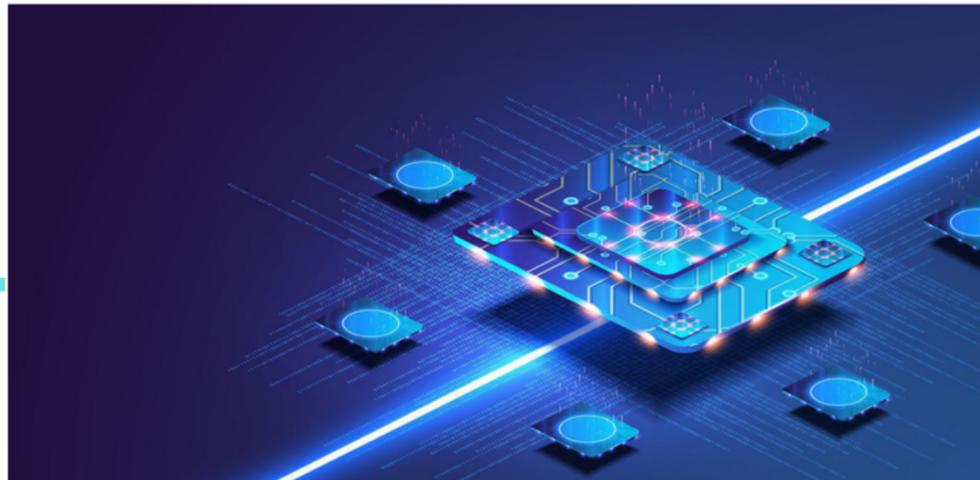
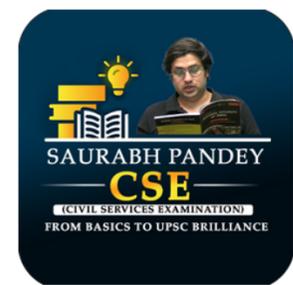
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# What is the technology behind manufacturing a semiconductor chip?

What has been the role of the transistor in the semiconductor revolution? What happens at an assembly and test plant? How has the semiconductor become smaller and smaller? What does India's current semiconductor ecosystem look like?

**Sandeep Rao**

**The story so far:** Semiconductor chip manufacturing capabilities are currently limited to very few regions in the world. With supply chain disruptions during the pandemic and recent geopolitical tensions, many companies and countries, including India, have realised the importance of investing in chip manufacturing infrastructure. The TATA group has partnered with Taiwan's Powerchip Semiconductor Manufacturing Corporation (PSMC) to set up a 300mm wafer fabrication plant in Gujarat. It will roll out its first 28nm chip in 2026. Two assembly and test plants in Gujarat and Assam have also been recently approved by the Government of India.

**What is a semiconductor chip? How is it manufactured?**

A semiconductor has properties between a conductor (which conducts electricity) and an insulator (which does not). In its purest form a semiconductor is a very weak conductor of electricity. However, its electrical properties can be changed by adding small amounts of certain substances called 'dopants'. By taking a pure semiconductor and carefully injecting certain parts with specific dopants, complex circuits can be 'printed' on the semiconductor.

The process is crudely analogous to creating an intricate work of art on a paper or a wall, by using a bunch of stencils and spray paints of different colours. The stencils are called 'masks' in the industry and the paint is analogous to the dopant.

**What is a transistor?** The transistor, one of the earliest electronic components to be built using a

semiconductor, is an extremely versatile device. In its most popular form it can function as an electronic switch. A typical semiconductor chip can have millions/billions of these interconnected switches that work together to perform various logical and computational operations.

A transistor can also function as an amplifier (to amplify the weak signal received by your cell phone) and is an integral part of circuits that generate and process high frequency signals (such as those required in wireless communication technologies). Today all these different avatars of the transistor are routinely packed into a single semiconductor chip (such as the WiFi chip in your mobile).

The transistor demonstrated how a single device could be built out of a piece of a semiconductor. 'Printing' multiple devices onto a single piece of a semiconductor to create entire circuits was the next leap. Both these breakthroughs laid the foundation for the semiconductor revolution and have been aptly recognised by Nobel Prizes (in 1956 and 2000).

**What is fabrication technology?**

Technology has progressed at a relentless pace since the semiconductor chip was first conceptualised more than six decades ago. Newer manufacturing technologies have been introduced at a regular cadence. The level of miniaturisation of the semiconductor has increased by orders of magnitude. Sticking with the stencil analogy this is mainly due to the stencils being able to etch smaller and more intricate patterns. There have been equally impressive gains in the switching capability of the transistors. They are able to switch on-and-off faster (more computations per second) and with lesser power consumption (longer battery life and

lesser heat dissipation).

The industry has used labels like '45nm', '28nm' and '16nm' to introduce each new manufacturing technology. 'nm' is short for nano-meter and refers to an extremely small unit of length equal to one billionth of a meter. These numbers convey the level of miniaturisation that is achievable using a particular technology (so smaller is better). Though not always accurate, you can think of this number as representing the dimensions of single transistor. While traditionally electronic circuits have been laid out flat on the semiconductor, researchers are increasing looking to capitalise on the third dimension (height). As the length and breadth of a transistor switch decreases, increasing its height can help ensure reliable performance. Stacking entire circuits on top of one another is another way to continue to shrink semiconductor chip sizes.

**What is known as a wafer?**

A semiconductor chip is manufactured much like a postage stamp. A sheet of stamps is printed on a piece of paper and then each individual stamp is cut out. Similarly, an array (typically 300-400) of chips are printed on a circular piece of semiconductor (called a wafer in industry parlance). This is then diced to create individual chips. A larger wafer size allows more chips to be printed on a single wafer which makes chip production faster and cheaper. Wafer sizes used in the industry have constantly been increasing. The current state of art is 300mm which is approximately 12 inches (this refers to the diameter of the wafer). Efforts are ongoing to move to a 450mm wafer size. While moving to a larger wafer size has its technical challenges and capital expenses, it has proven to be economical in the long run.

Once the wafer has been diced into

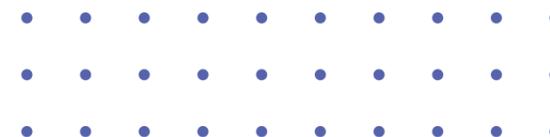
chips, each individual chip has to be packaged in a protective covering. Tiny wires have to be routed from the device to the boundary of the package. Some of these wires supply power, while other are used for feeding in and reading out signals and data. A chip also has to be tested – this includes verifying its functionality and stress testing (subjecting the chip to high temperature and voltages) – to ensure reliability during its lifetime. All this is performed in an assembly and test plant.

**What does India's semiconductor ecosystem look like?**

India has had a thriving chip design industry since the 1990s. Due to the magic of computer aided design it is possible to design a semiconductor chip entirely in software. The process of specifying the functionality of a chip, translating this functionality to electronic circuits, validating the circuits, optimising for speed, power consumption and size, can be done by a team of skilled engineers sitting at their desktops. The final design is abstracted into a file and sent to a fabrication plant for manufacturing. It's a bit like designing an entire graphic novel on your laptop and then sending the pdf to your publisher for printing.

India's foray into semiconductor manufacturing will benefit from the existing ecosystem for chip design which was fuelled by a steady supply of electronics and computer engineers. Semiconductor manufacturing being an essentially inter-disciplinary endeavour, could present opportunities to a wider array of professionals such as process and control engineers, data scientists, material scientists, physicists and chemical engineers to contribute meaningfully to this industry.

*The author is with Texas Instruments*





# Fabrication Technology

- **Fabrication involves the manufacture of individual components that make up larger assemblies or end products.**
- **This activity encompasses the working of metals and the incorporation of electrical and electronic devices into processors, circuit boards, and subassemblies for the components of navigation**



**Photolithography is a process used in the manufacturing of integrated circuits.**

**It involves using light to transfer a pattern onto a substrate, typically a silicon wafer.**

**The process begins with a photosensitive material, called a photoresist, being applied to the substrate**





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Q" Suicide in young people is best understood as multidetermined and the result of interaction between biological, psychological, familial, and social cultural factors" Discuss

प्रश्न" युवा लोगों में आत्महत्या को बहु-निर्धारित और जैविक, मनोवैज्ञानिक, पारिवारिक और सामाजिक सांस्कृतिक कारकों के बीच बातचीत के परिणाम के रूप में सबसे अच्छी तरह समझा जाता है।" चर्चा करें

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