# STROKE CARE IN INDIA: SMALL SOLUTIONS TO BIG PROBLEMS

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Review

International Journal of Stroke WSO

# Stroke in India: A systematic review of the incidence, prevalence, and case fatality

Stephanie P Jones[1], Kamran Baqai[1], Andrew Clegg[1], Rachel Georgiou[1], Cath Harris[1], Emma-Joy Holland[1], Yogeshwar Kalkonde[2], Catherine E Lightbody[1], Pallab K Maulik[3,4,5], Padma MV Srivastava[6], Jeyaraj D Pandian[7], Patel Kulsum[1], PN Sylaja[8], Caroline L Watkins[1] and Maree L Hackett[1,9]; on behalf of the NIHR Global Health Research Group on IMPROVIng Stroke carE in India (IMPROVISE) Collaboration

International Journal of Stroke
0(0) 1–9



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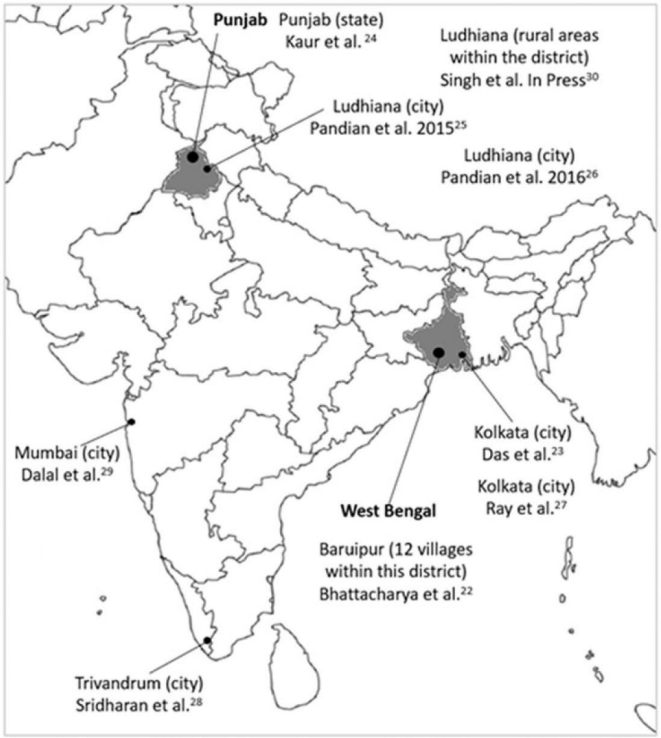
journals.sagepub.com/home/wso

SAGE

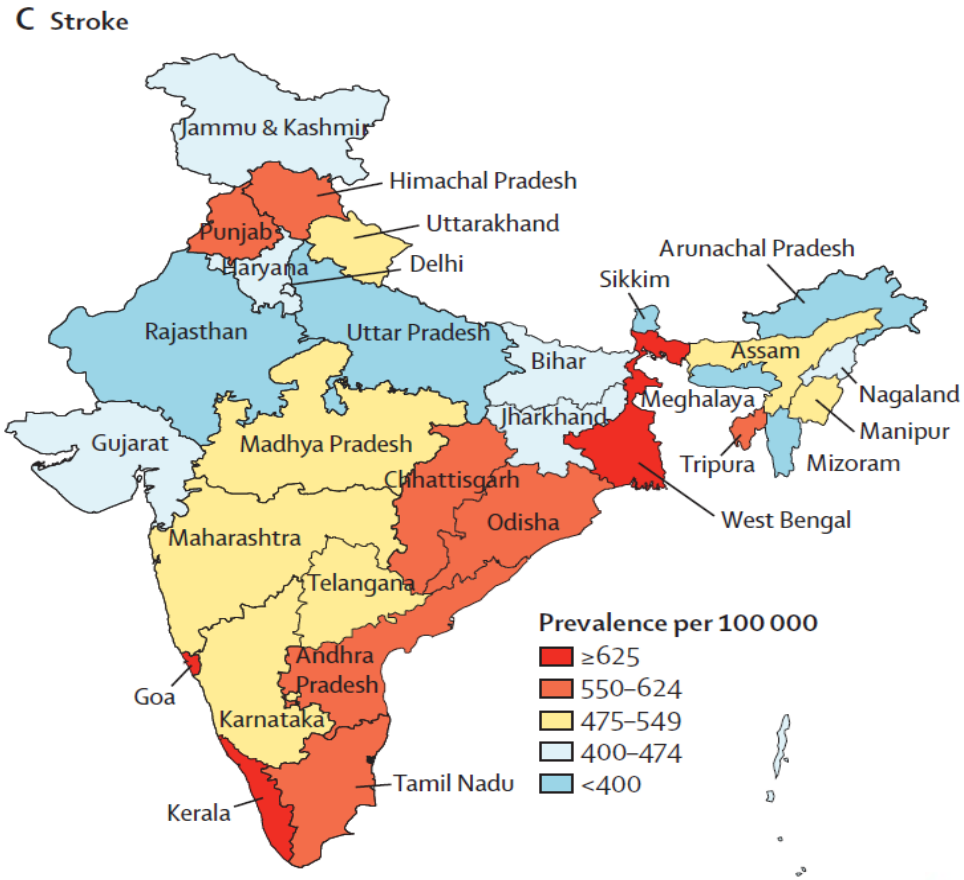
**Figure 2.** Location of studies assessing the incidence, prevalence, and outcome of stroke in India.




- Prevalence-26 to 757/100,000
- Incidence 119-152/100,000
- Case fatality rate: 22 to 42%

# The changing patterns of cardiovascular diseases and their risk factors in the states of India: the Global Burden of Disease Study 1990–2016

*India State-Level Disease Burden Initiative CVD Collaborators**




*Lancet Glob Health* 2018; 6: e1339–51

# Stroke risk factors in India

**A** All strokes

| | Global | Central Asia | Central Europe | Eastern Europe | High-income Asia Pacific | Australasia | High-income North America | Southern Latin America | Western Europe | Andean Latin America | Caribbean | Central Latin America | Tropical Latin America | North Africa and Middle East | South Asia | East Asia | Oceania | Southeast Asia | Central sub-Saharan Africa | Eastern sub-Saharan Africa | Southern sub-Saharan Africa | Western sub-Saharan Africa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High systolic blood pressure | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| High body-mass index | 2 | 2 | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 5 | 4 | 2 | 4 | 3 | 2 | 3 |
| High fasting plasma glucose | 3 | 3 | 3 | 5 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 2 | 6 | 2 | 3 | 3 | 4 | 3 | 4 |
| Ambient particulate matter pollution | 4 | 4 | 6 | 7 | 13 | 5 | 12 | 6 | 9 | 3 | 6 | 4 | 7 | 4 | 3 | 2 | 12 | 5 | 5 | 9 | 4 | 5 |
| Smoking | 5 | 5 | 4 | 3 | 6 | 2 | 4 | 4 | 4 | 8 | 4 | 6 | 4 | 6 | 6 | 3 | 5 | 4 | 8 | 7 | 5 | 9 |
| Diet high in sodium | 6 | 10 | 5 | 12 | 14 | 7 | 11 | 10 | 12 | 9 | 14 | 8 | 8 | 17 | 10 | 4 | 8 | 7 | 14 | 5 | 14 | 11 |
| Household air pollution from solid fuels | 7 | 14 | 16 | 19 | 20 | 19 | 20 | 19 | 19 | 11 | 5 | 10 | 15 | 14 | 5 | 12 | 3 | 6 | 2 | 2 | 8 | 2 |
| High LDL cholesterol | 8 | 8 | 7 | 4 | 5 | 6 | 6 | 9 | 5 | 5 | 7 | 7 | 6 | 5 | 11 | 8 | 11 | 9 | 10 | 12 | 7 | 8 |
| Kidney dysfunction | 9 | 9 | 11 | 8 | 8 | 11 | 8 | 11 | 10 | 7 | 8 | 5 | 9 | 7 | 9 | 11 | 7 | 8 | 9 | 10 | 9 | 7 |
| Diet low in fruits | 10 | 11 | 12 | 11 | 9 | 8 | 10 | 13 | 11 | 13 | 12 | 11 | 13 | 13 | 7 | 13 | 6 | 11 | 6 | 6 | 6 | 6 |
| Diet high in red meat | 11 | 7 | 9 | 9 | 4 | 10 | 5 | 5 | 6 | 6 | 13 | 9 | 5 | 15 | 19 | 7 | 10 | 14 | 15 | 14 | 11 | 14 |
| Low temperature | 12 | 6 | 8 | 6 | 10 | 9 | 7 | 8 | 7 | 10 | 19 | 15 | 19 | 8 | 17 | 9 | 15 | 20 | 16 | 15 | 12 | 20 |
| Alcohol use | 13 | 12 | 10 | 10 | 7 | 12 | 9 | 7 | 8 | 15 | 9 | 13 | 10 | 20 | 15 | 10 | 14 | 13 | 11 | 11 | 10 | 10 |
| Lead exposure | 14 | 17 | 18 | 18 | 16 | 17 | 18 | 17 | 18 | 16 | 11 | 12 | 16 | 10 | 8 | 14 | 17 | 16 | 12 | 13 | 15 | 13 |
| Second-hand smoke | 16 | 15 | 13 | 14 | 18 | 14 | 16 | 14 | 17 | 18 | 17 | 17 | 17 | 12 | 14 | 15 | 13 | 15 | 18 | 16 | 16 | 16 |
| Diet low in vegetables | 17 | 19 | 19 | 17 | 15 | 18 | 14 | 15 | 16 | 12 | 10 | 14 | 11 | 18 | 12 | 19 | 9 | 12 | 7 | 8 | 13 | 12 |
| Diet low in whole grains | 18 | 13 | 14 | 13 | 17 | 16 | 15 | 16 | 15 | 17 | 18 | 18 | 18 | 9 | 18 | 16 | 16 | 17 | 17 | 18 | 19 | 17 |
| Low physical activity | 19 | 18 | 17 | 16 | 12 | 15 | 17 | 18 | 14 | 19 | 16 | 19 | 12 | 11 | 20 | 18 | 18 | 18 | 19 | 20 | 17 | 18 |
| High temperature | 20 | 20 | 20 | 20 | 19 | 20 | 19 | 20 | 20 | 20 | 20 | 20 | 20 | 19 | 16 | 20 | 20 | 19 | 20 | 19 | 20 | 15 |

# Stroke burden in India


- **3 patients** suffer from stroke **every minute**
- Stroke is India's **4th leading cause of death** and **5th leading cause of disability**
- One-month case **fatality rates from 18% to 42%**
- **Dismal rate (<1%) of thrombolysis**

**BIG PROBLEM! SMALL AWARENESS**

# Existing treatment gaps in India:

- Use of thrombolysis for stroke ( a dismal 0.5% of all strokes receive thrombolysis);
- 24/7 availability of stroke physicians
- Use of stroke care maps and implementation of stroke care pathways.
- Presence of a stroke unit
- A stroke team
- Sufficient community awareness program which are essential key elements necessary to provide optimal stroke care to the community.
- Efficient public emergency ambulance system

# Key determinants of stroke treatment access in India

- Per capita gross national income
- Availability of operators and centers
- Presence of pre-hospital stroke-triage systems

# Critical components of pre-hospital system for stroke care

- Quick recognition of stroke symptoms by patients and care givers.
- Awareness about calling ambulance urgently.
- First responder training on clinical stroke assessment.
- Field triage based on stroke severity assessment.
- Pre-Hospital communications with the receiving hospital.
- Rapid inter-hospital transfer as needed.

# Some crucial insights from mapping stroke care in India

- In 2020 in India, a remarkably low stroke center rate per million:
  - 0.41 for IVT-C
  - 0.26 for EVT-C
- The median duration to the nearest IVT-C and EVT-C stroke centers was 3.04 hours & 3.46 hours.
- Only 23.9% and 17.6% of the population has 1-hour access to an IVT-C and EVT-C respectively.
- Considerable regional disparities in geographical access to stroke care

Asif et al, Int J Stroke 2025

# Pronounced stroke care disparity between different zones within India

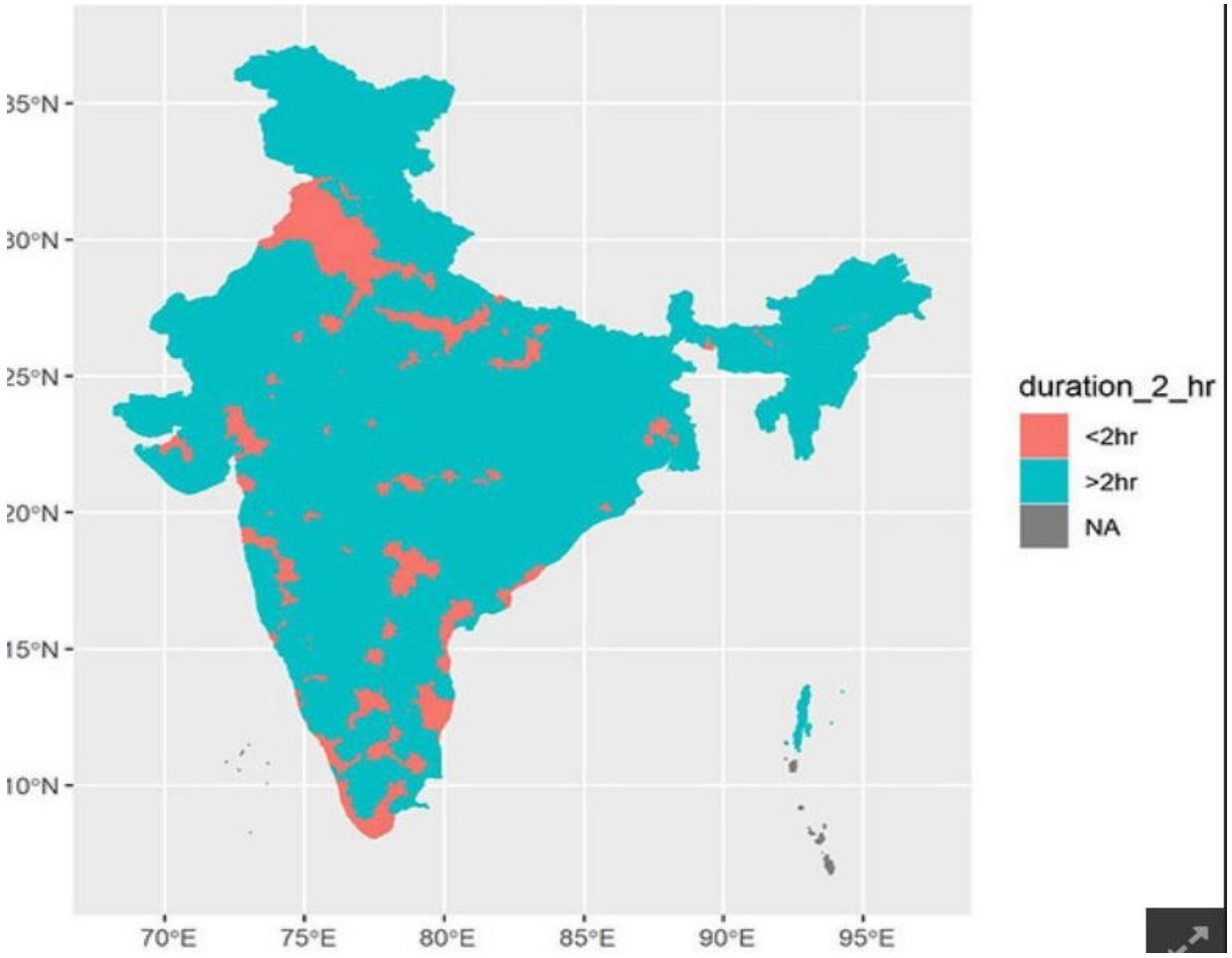
- This inequity has been noted for overall life expectancy as well.
- Reflection of ?
  - Broader healthcare infrastructure
  - Inequalities arising from combination of geographic limitations
  - Political and socio-economic factors
  - Access to basic public amenities.

# Table 2: Summary of travel distance and duration to the nearest stroke center (IVT and EVT-capable) across geographic region in India.

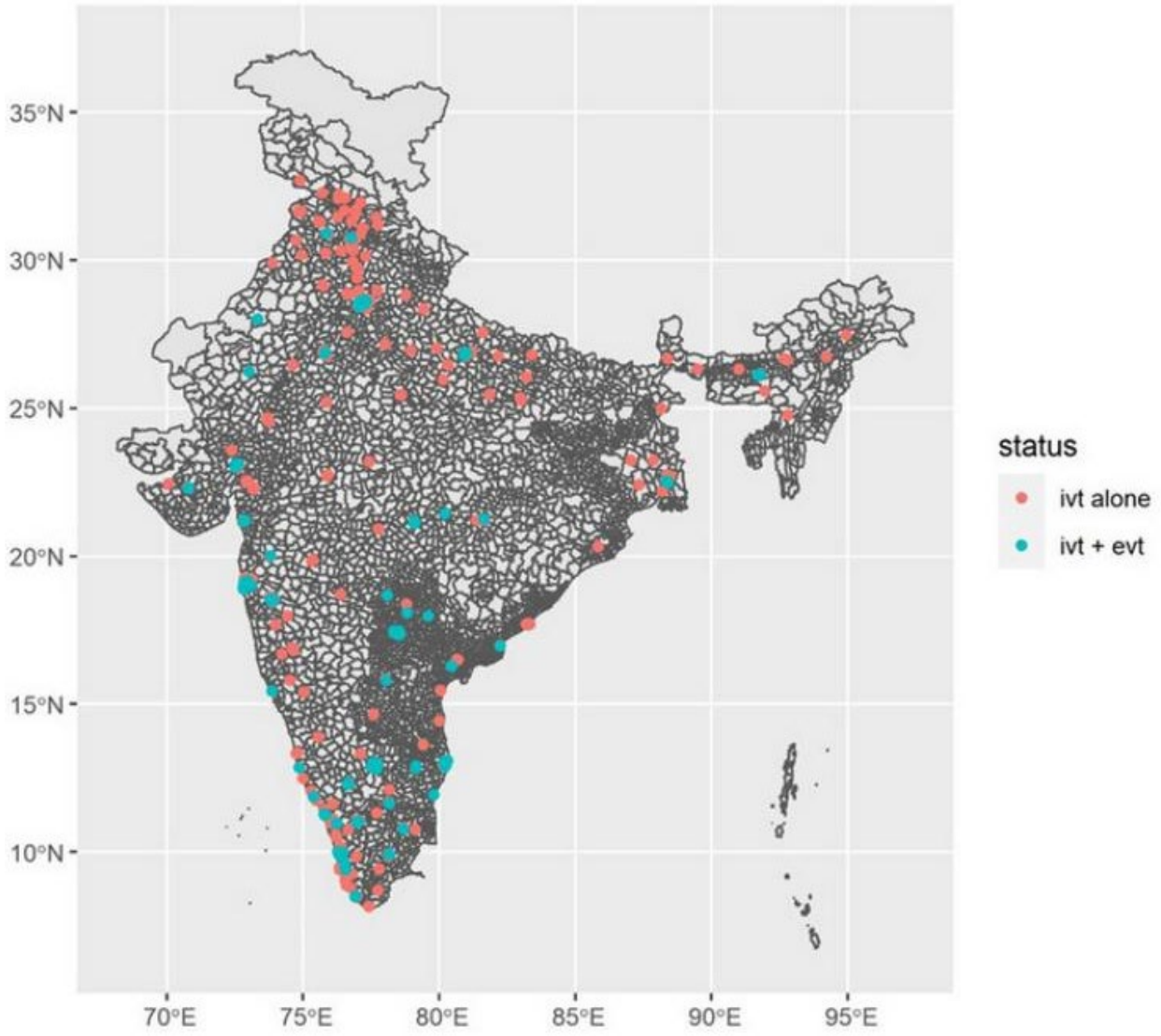
| Parameter | Overall | South Zone | West Zone | North Zone | Central Zone | East Zone | North-East Zone |
|---|---|---|---|---|---|---|---|
| Population Centres [1] | 14,452 | 2,832 | 2,565 | 2,434 | 3,887 | 2,128 | 906 |
| IVT Capable Stroke Centres | 566 | 211 | 167 | 112 | 42 | 23 | 11 |
| EVT Capable Stroke Centres | 361 | 127 | 112 | 64 | 31 | 20 | 7 |

Asif et al, Int J Stroke 2025

# Access to stroke care hospitals in India



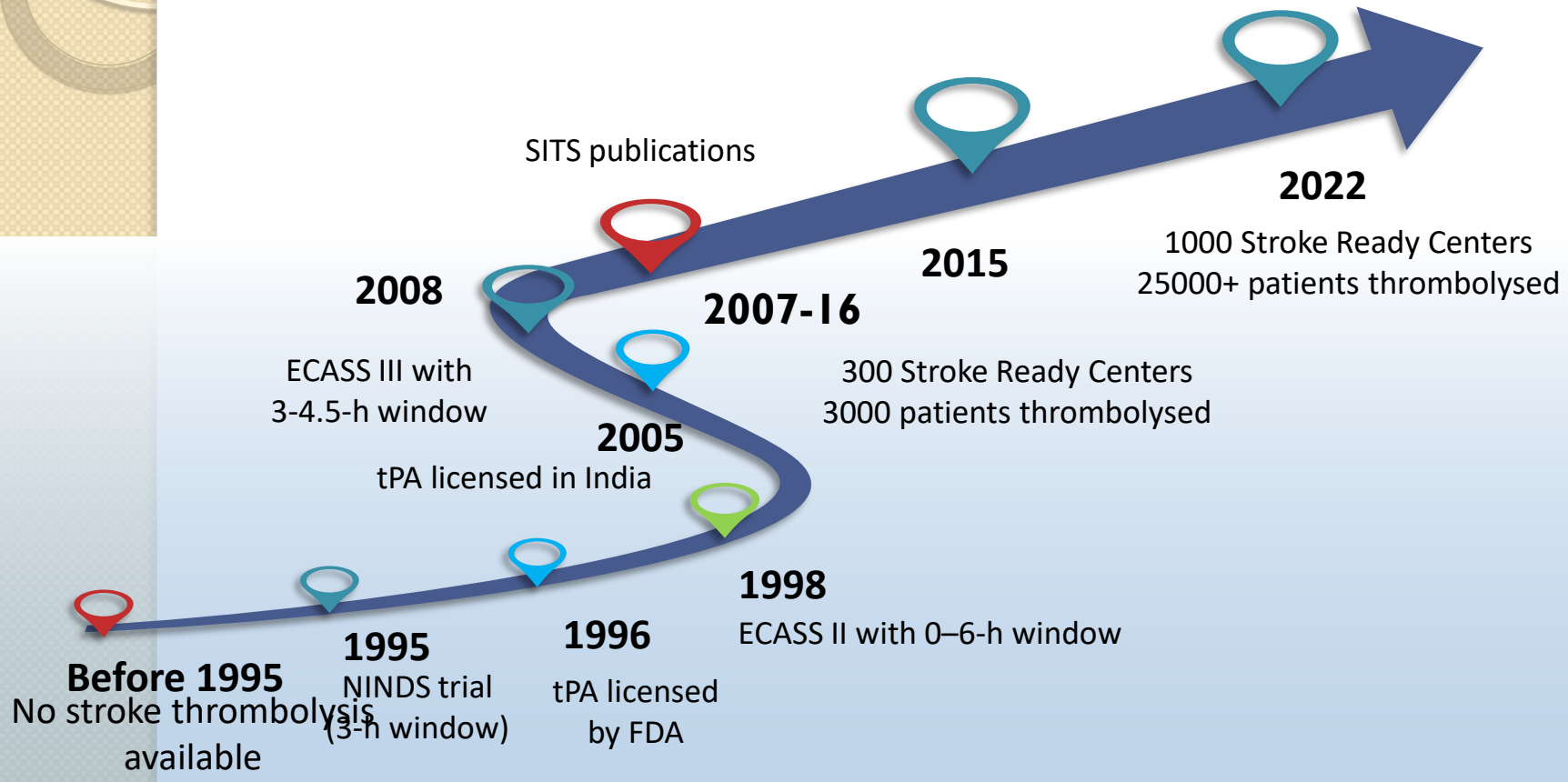
# Distribution of IVT and EVT center in India



# Main challenges in stroke care in India

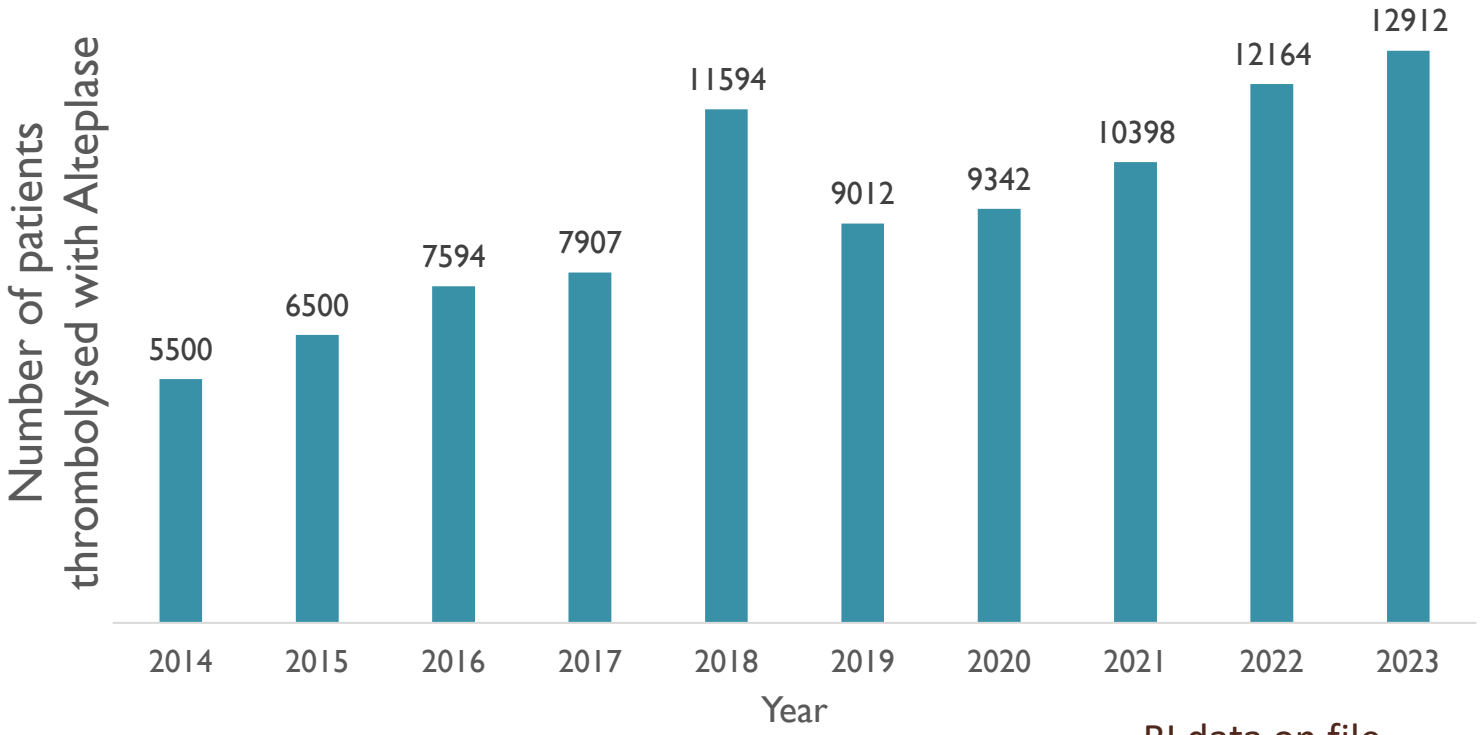
- Prehospital stroke systems of care are often underdeveloped in low-middle income countries (LMICs).
- Significant delays in symptom recognition, decision to seek medical assistance & transporting the patient to the stroke center.
- Ambulance services are not used !
- Patient is first transported to the nearest health care facility which may not be a stroke center.
- Multiple delays in the inter-hospital transfer to the stroke center.

# Stroke in India: Journey so far!



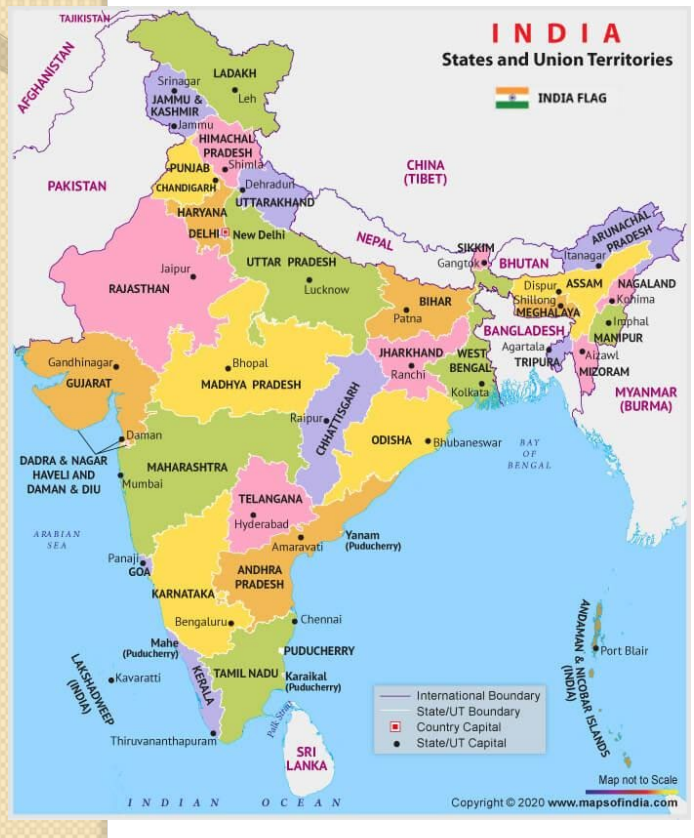
# Year-wise patients thrombolysed with Alteplase

Number of patients thrombolysed with Alteplase in past 10 years in India: ~92000 patients




BI data on file

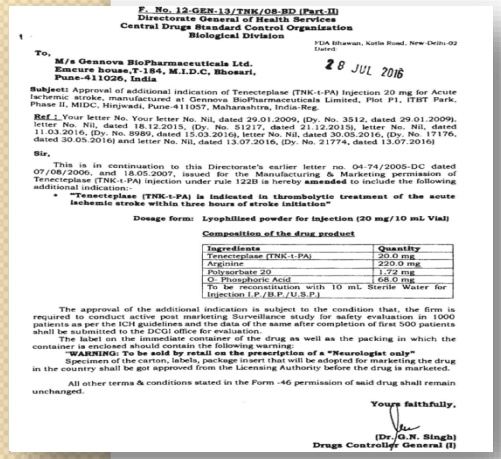
# State-wise thrombolysis with Alteplase in 2023




| Statewise Alteplase usage | 2023/12 |
|---|---|
| State | Total Units |
| MAHARASHTRA | 3,978 |
| KARNATAKA | 3,402 |
| TELANGANA | 2,514 |
| PUNJAB | 1,790 |
| MUMBAI | 1,719 |
| UTTAR PRADESH | 1,726 |
| GUJARAT | 1,517 |
| KERALA | 1,211 |
| MADHYA PRADESH | 897 |
| ANDHRA PRADESH | 701 |
| TAMILNADU | 599 |
| HARYANA | 630 |
| DELHI | 599 |
| RAJASTHAN | 451 |
| CHENNAI | 395 |
| ASSAM | 193 |
| KOLKATA | 145 |
| JAMMU & KASHMIR | 94 |
| GOA | 45 |
| JHARKHAND | 36 |
| WEST BANGAL | 29 |
| BIHAR | 28 |
| ORISSA | 22 |
| UTTARAKHAND | 4 |
| CHATTISGARH | - |
| HIMACHAL PRADESH | - |

# Regulatory issues

EUROPEAN MEDICINES AGENCY
SCIENCE MEDICINES HEALTH



F. No. 12-GEN-13/TNK/08-BD (Part-II)
Directorate General of Health Services
Central Drugs Standard Control Organization
Biological Division

FDA Bhawan, Kotla Road, New-Delhi-02
Dated: 28 JUL 2016

To,
M/s Genanova BioPharmaceuticals Ltd.
Encure house,T-184, M.I.D.C, Bhosari,
Pune-411026, India

Subject: Approval of additional indication of Tenecteplase (TNK-t-PA) Injection 20 mg for Acute Ischemic stroke, manufactured at Gennova BioPharmaceuticals Limited, Plot P1, ITBT Park, Phase II, MIDC, Hinjwadi, Pune-411057, Maharashtra, India-Reg.

Ref : Your letter No. Your letter No. Nil, dated 29.01.2009, (Dy. No. 3512, dated 29.01.2009), letter No. Nil, dated 18.12.2015, (Dy. No. 51217, dated 21.12.2015), letter No. Nil, dated 11.03.2016, (Dy. No. 8989, dated 15.03.2016), letter No. Nil, dated 30.05.2016, (Dy. No. 17176, dated 30.05.2016) and letter No. Nil, dated 13.07.2016, (Dy. No. 21774, dated 13.07.2016)

Sir,

This is in continuation to this Directorate's earlier letter no. 04-74/2005-DC dated 07/08/2006, and 18.05.2007, issued for the Manufacturing & Marketing permission of Tenecteplase (TNK-t-PA) injection under rule 122B is hereby amended to include the following additional indication:-

- "Tenecteplase (TNK-t-PA) is indicated in thrombolytic treatment of the acute ischemic stroke within three hours of stroke initiation"

Dosage form: Lyophilised powder for injection (20 mg/10 mL Vial)

Composition of the drug product

| Ingredients | Quantity |
|---|---|
| Tenecteplase (TNK-t-PA) | 20.0 mg |
| Arginine | 220.0 mg |
| Polyaorbate 20 | 1.72 mg |
| O- Phosphoric Acid | 68.0 mg |
| To be reconstitution with 10 mL Sterile Water for Injection I.P./B.P./U.S.P.) | |

The approval of the additional indication is subject to the condition that, the firm is required to conduct active post marketing Surveillance study for safety evaluation in 1000 patients as per the ICH guidelines and the data of the same after completion of first 500 patients shall be submitted to the DCGI office for evaluation.

The label on the immediate container of the drug as well as the packing in which the container is enclosed should contain the following warning:

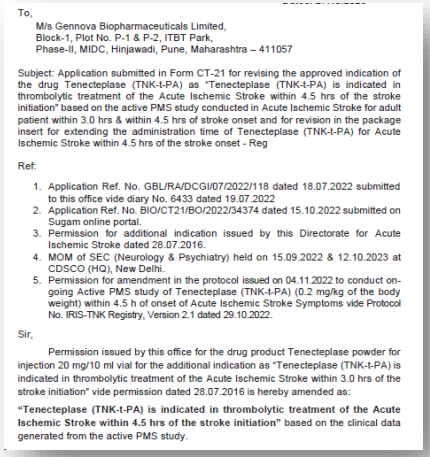
"WARNING: To be sold by retail on the prescription of a "Neurologist only"

Specimen of the carton, labels, package insert that will be adopted for marketing the drug in the country shall be got approved from the Licensing Authority before the drug is marketed.

All other terms & conditions stated in the Form -46 permission of said drug shall remain unchanged.

Yours faithfully,

(Dr. G.N. Singh)
Drugs Controller General (I)



To,
M/s Gennova Biopharmaceuticals Limited,
Block-1, Plot No. P-1 & P-2, ITBT Park,
Phase-II, MIDC, Hinjawadi, Pune, Maharashtra – 411057

Subject: Application submitted in Form CT-21 for revising the approved indication of the drug Tenecteplase (TNK-t-PA) as "Tenecteplase (TNK-t-PA) is indicated in thrombolytic treatment of the Acute Ischemic Stroke within 4.5 hrs of the stroke initiation" based on the active PMS study conducted in Acute Ischemic Stroke for adult patient within 3.0 hrs & within 4.5 hrs of stroke onset and for revision in the package insert for extending the administration time of Tenecteplase (TNK-t-PA) for Acute Ischemic Stroke within 4.5 hrs of the stroke onset - Reg

Ref:

1. Application Ref. No. GBL/RA/DCGI/07/2022/118 dated 18.07.2022 submitted to this office vide diary No. 6433 dated 19.07.2022
2. Application Ref. No. BIO/CT21/BO/2022/34374 dated 15.10.2022 submitted on Sugam online portal.
3. Permission for additional indication issued by this Directorate for Acute Ischemic Stroke dated 28.07.2016.
4. MOM of SEC (Neurology & Psychiatry) held on 15.09.2022 & 12.10.2023 at CDSCO (HQ), New Delhi.
5. Permission for amendment in the protocol issued on 04.11.2022 to conduct on-going Active PMS study of Tenecteplase (TNK-t-PA) (0.2 mg/kg of the body weight) within 4.5 h of onset of Acute Ischemic Stroke Symptoms vide Protocol No. IRIS-TNK Registry, Version 2.1 dated 29.10.2022.

Sir,

Permission issued by this office for the drug product Tenecteplase powder for injection 20 mg/10 ml vial for the additional indication as "Tenecteplase (TNK-t-PA) is indicated in thrombolytic treatment of the Acute Ischemic Stroke within 3.0 hrs of the stroke initiation" vide permission dated 28.07.2016 is hereby amended as:

"Tenecteplase (TNK-t-PA) is indicated in thrombolytic treatment of the Acute Ischemic Stroke within 4.5 hrs of the stroke initiation" based on the clinical data generated from the active PMS study.

On 14 December 2023, the Committee for Medicinal Products for Human Use (CHMP) adopted a **positive opinion** recommending a change to the terms of the marketing authorisation for the medicinal product tenecteplase.

**Indicated in adults for the thrombolytic treatment of acute ischaemic stroke (AIS) within 4.5 hours from last known well and after exclusion of intracranial haemorrhage.**

***2016***

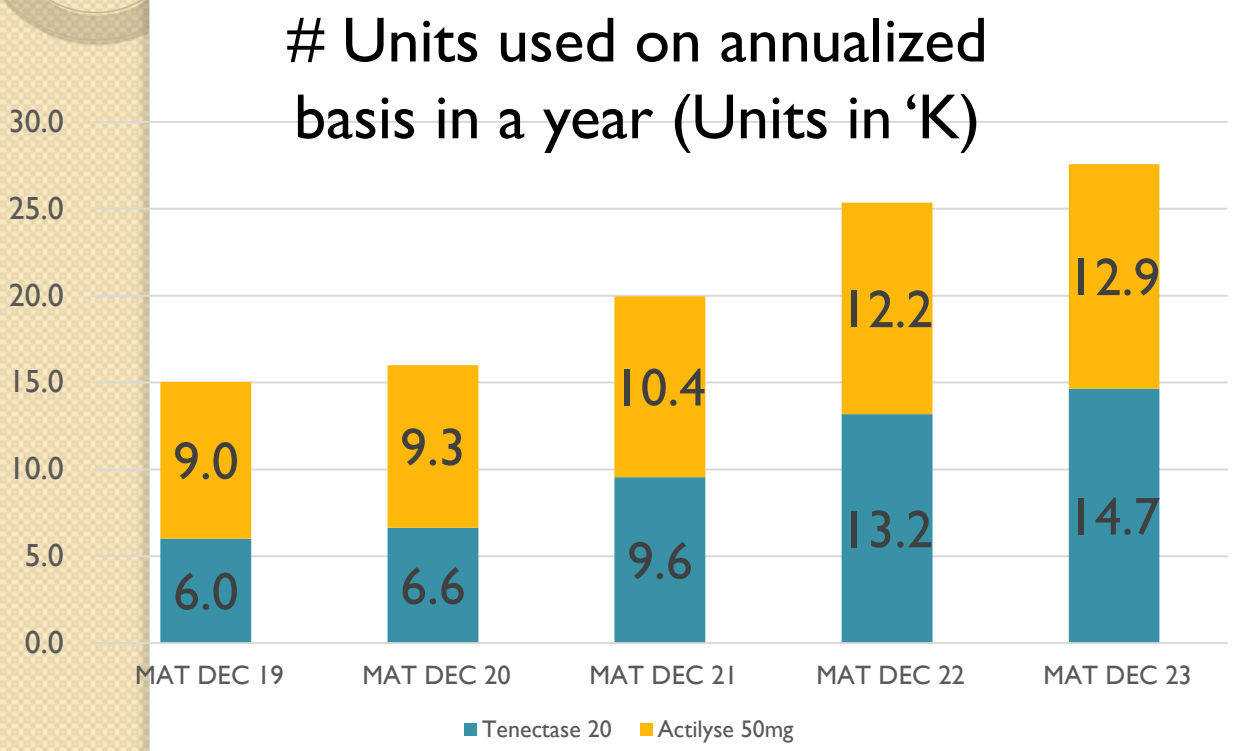
**Tenecteplase (TNK-t-PA) is indicated in thrombolytic treatment of the Acute Ischemic Stroke within 3 hrs of the stroke initiation**

***2023***

***Tenecteplase (TNK-t-PA) is indicated in thrombolytic treatment of the Acute Ischemic Stroke within 4.5 hrs of the stroke initiation***

Reference : https://www.ema.europa.eu/en/medicines/human/variation/metalyse

# Tenecteplase is driving incremental thrombolysis in India




15K to 27K

**Total Lysis** increase in 5 Yrs

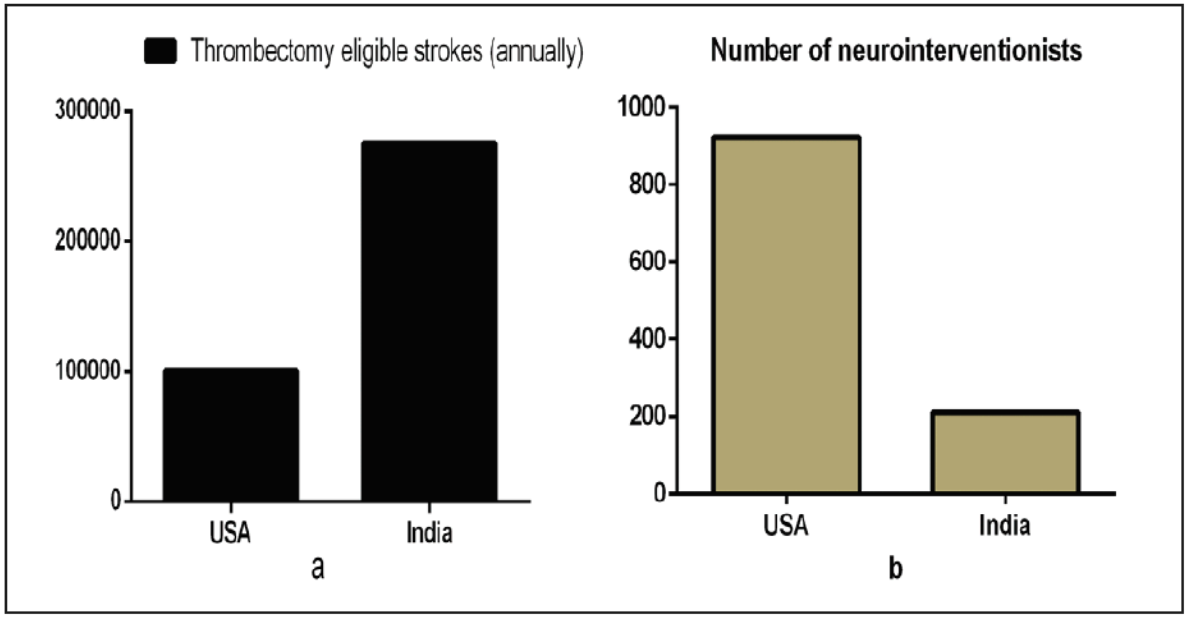
6K to 15K

**Tenectase** increase in 5 Yrs

Out of total **incremental 12K** Lysis, **9K is driven** from Tenecteplase

- Source- IQVIA- MAT Dec'23
- Alteplase data include usage in PE also

# Demand-supply mismatch of neuro-interventionalists and thrombectomy-capable centers: 73% belong to the private sector




Some cities single Neurointerventionist covers few centers

**Figure 1**. A Graphical Comparison of Incidence of Thrombectomy Eligible Strokes in India and USA Annually, Along With the Number of Interventionalists Available to Manage Them.

# Distribution of neuro-intervention centers across India

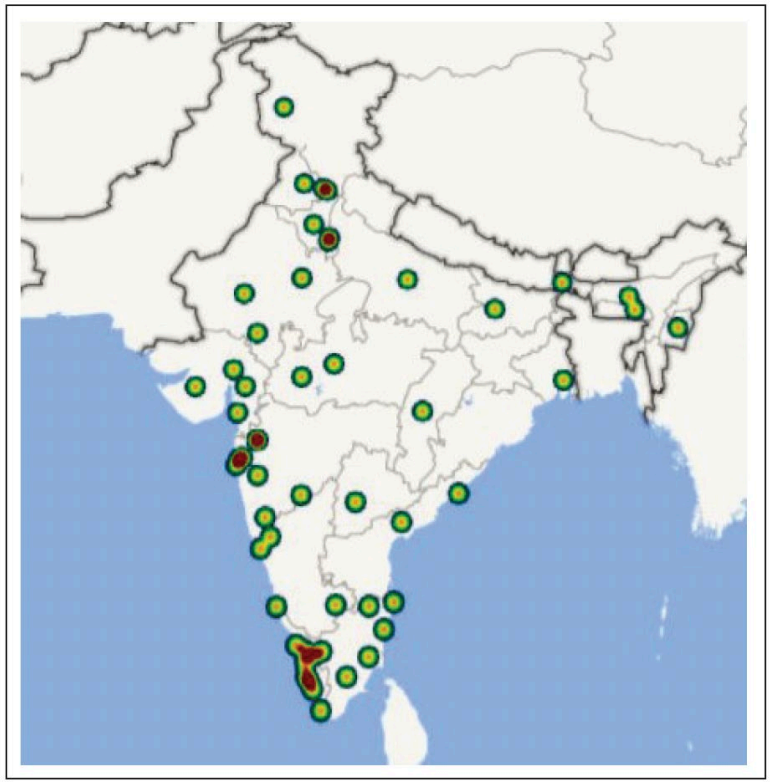


**Figure 2.** A Graphical Representation Showing the Distribution of Neurointerventional Centers Across the Various States of India.

- Predominantly in larger urban areas
- Inequality between states
- Disparities between the broad 5 regions of north, south, central eastern, and western India.

# Mechanical thrombectomy 2020 White paper: Key recommendations for policy makers

- Create  a task force that includes neurologists, neurointerventionalists, EMS personnel, community physicians, stroke-trained nurses, stroke coordinators, and administrators who deal with a high volume of stroke cases.
- Assess the stroke disease and economic burden of stroke and LVO stroke in the region of focus.
- Assess the efficacy of the existing systems in place for the management of stroke and identify key gaps.

# Mechanical thrombectomy 2020 White paper - 2

- Assess the cost and therapeutic effectiveness of existing public and private health systems and conduct a detailed analysis of clinical and cost benefits to the patients and overall population in your region.
- Help in establishing local and regional certification programs for stroke hospitals to be recognized in offering stroke services.
- Develop a policy framework and specific policies that aim to reduce the burden of stroke and improve clinical outcomes.
- Each region may need a unique set of policies but there are examples of effective policies globally available that can serve as starting points for the region.

# Mechanical thrombectomy 2020 White paper - 3

- Create government – supported funding mechanisms for patients in resource constrained settings who will benefit from MT for LVO stroke.
- Develop stroke education programs focusing, seeking emergency care, and available stroke system resources.
- Set up specialized regional thrombectomy systems of care that are equipped to carry out MT.
- Increase the number of training programs for neurointerventionalists with an aim to create adequate talent for the management of LVO stroke.

# Some images from real world stroke care in India: Triage area

# Some images from real workd stroke care in India : Emergency room

# Some images from real workd stroke care in India : Heart Command center

# Initial assessment and emergency  casualty

# Casualty medical officer area

# Emergency area

# “ Stroke Unit ” (used as storage area !)

# Objectives of Telestroke
# "Optimal Stroke Care for All"

- To make high quality of stroke care available to traditionally under privileged population
- Save time!
- Reduce costs of medical care

# Telestroke: India's Option or Necessity?

- Low penetration of healthcare services
- 90% facilities in cities where 30% live!
- Primary health care facilities in rural areas inadequate
- Telestroke: Need of the hour!

# Telestroke: The Promise

- Taking modern healthcare to remote areas using information technology
- Significant role in training of medical personnel
- Decrease in price and complexity of IT makes it economically viable

# Telestroke: Challenges and Barriers

- Technical: related to the transfer of images as regards quality and clarity
- Inadequate internet connectivity
- Financial constraints
- Social acceptability
- Time constraints

# Telestroke: Challenges often seen in low-middle income countries (LMICs)

- Telestroke networks provide access to stroke neurologists expertise but still fundamentally rely on local workforce at regional hospitals.
- Integrating telestroke care is not as simple as adding a phone or video call to existing local pathway.
- Effective implementation requires mechanisms to increase awareness of telestroke processes and staff training in hyperacute stroke therapies and workflow.
- Changing workflow practises to suit the uptake of a telestroke pathway relies on staff training and education. The staff in rural and semi urban settings are non-specialist, over worked, and transient compared to staff based at metropolitan hospitals.

# Telestroke: What is required

- Recognition of diverse realities at ground level, of different geographical regions.
- Mapping and recognition of different telestroke network sizes, and levels of complexity.
- Framework of globally applicable and acceptable recommendations, adaptable to diverse resource settings, maintaining core quality standards

# A low cost telestroke model in the State of Himachal Prdesh

Neurol India. 2016 Sep-Oct;64(5):934-40. doi: 10.4103/0028-3886.190243.

**Telestroke in resource-poor developing country model.**

Sharma S[1], Padma MV[2], Bhardwaj A[3], Sharma A[3], Sawal N[1], Thakur S[4].

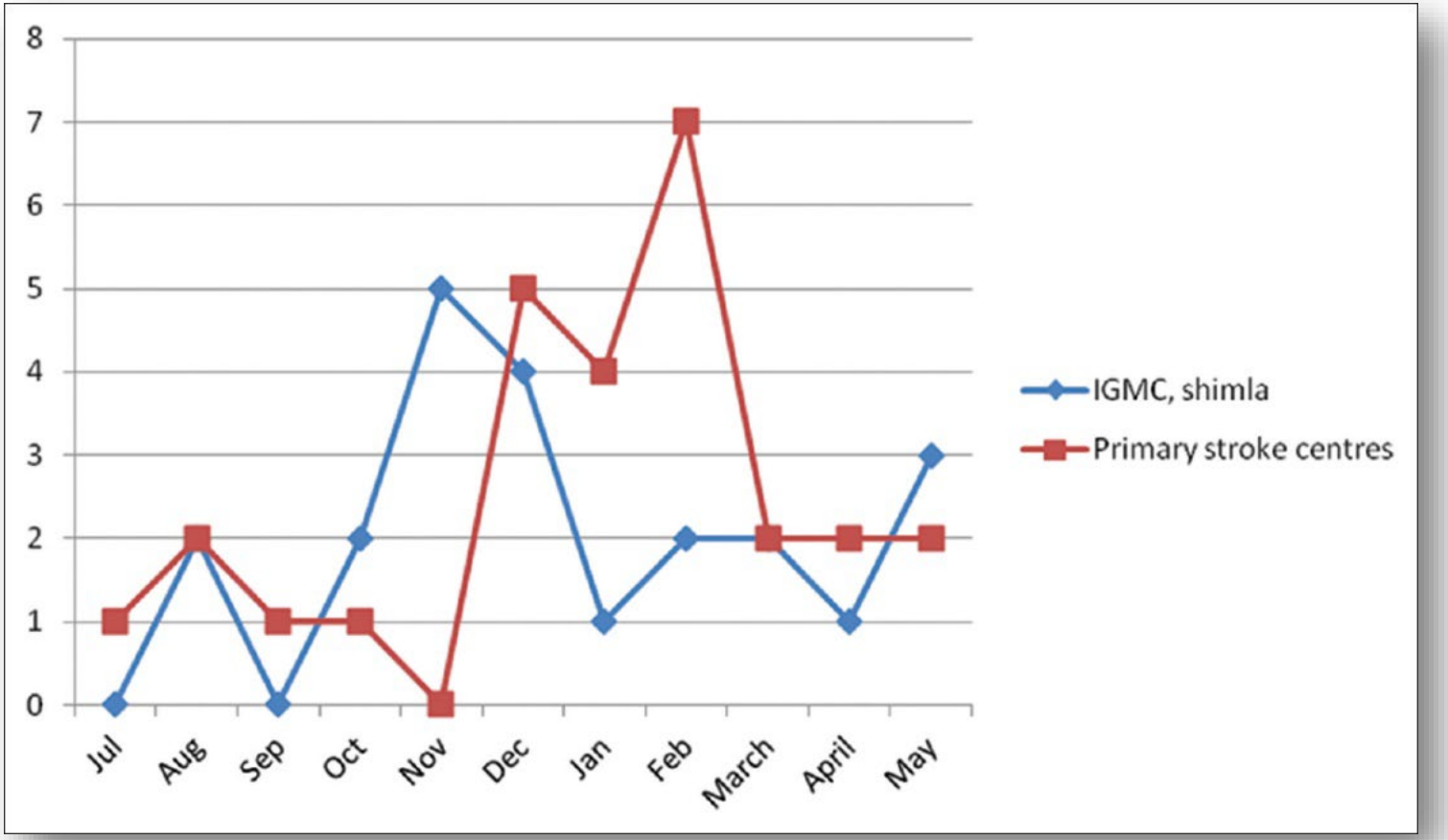
**Author information**

1 Department of Neurology, Indira Gandhi Medical College, Shimla, Himachal Pradesh, India.
2 Department of Neurology, All India Institute of Medical Sciences, New Delhi, India.
3 Department of Neurology, Dr. Rajendra Prasad Government Medical College, Tanda, Himachal Pradesh, India.
4 Department of Radiology, Indira Gandhi Medical College, Shimla, Himachal Pradesh, India.

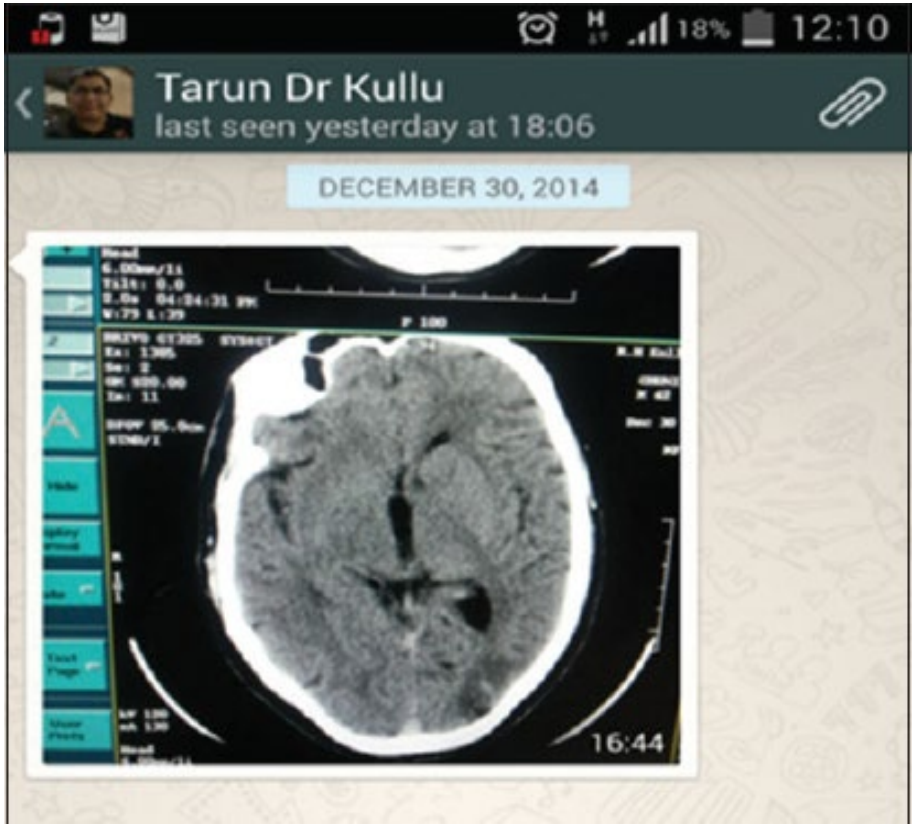

# Telestroke project Himachal Prdesh: Methods

- Project was launched in 2014
- Medical Officers in district hospitals (MBBS graduates , internal medicine post graduates, ER doctors) were trained in treatment of stroke through workshops
- rTPA was made available at all  centres free of cost.
- 4 neurologists at 2 tertiary care centres were made available for consult through phone
- Design: Smart phone (WhatsApp) based hub and spoke telestroke model was used with two tertiary care hospitals with neurologists as hub and 12 district hospitals without on site neurologists as spokes

# Month-wise comparison of thrombolysis between primary Stroke Centers and tertiary Stroke Center (IGMC, Shimla)



# WhatsApp transmission of Computed Tomographic images



# Low cost telestroke model in Himachal Prdesh: Publications

## Telestroke: India's solution to a public health-care crisis

Stroke is a leading cause of morbidity and mortality in India. Yet much of the country is composed of rural, low-income and middle-income communities that lack access to essential neurological care. Telemedicine is helping to tackle this important problem. Jacquelyn Corley investigates.

*Lancet Neurol* 2017

Published Online
November 29, 2017
http://dx.doi.org/10.1016/S1474-4422(17)30423-4

Panorama

**Telestroke a viable option to improve stroke care in India**

Padma V. Srivastava[1], Paulin Sudhan[2], Dheeraj Khurana[3], Rohit Bhatia[1], Subash Kaul[4], P. N. Sylaja[5], Majaz Moonis[6], and Jeyaraj Durai Pandian[7]*

International Journal of Stroke

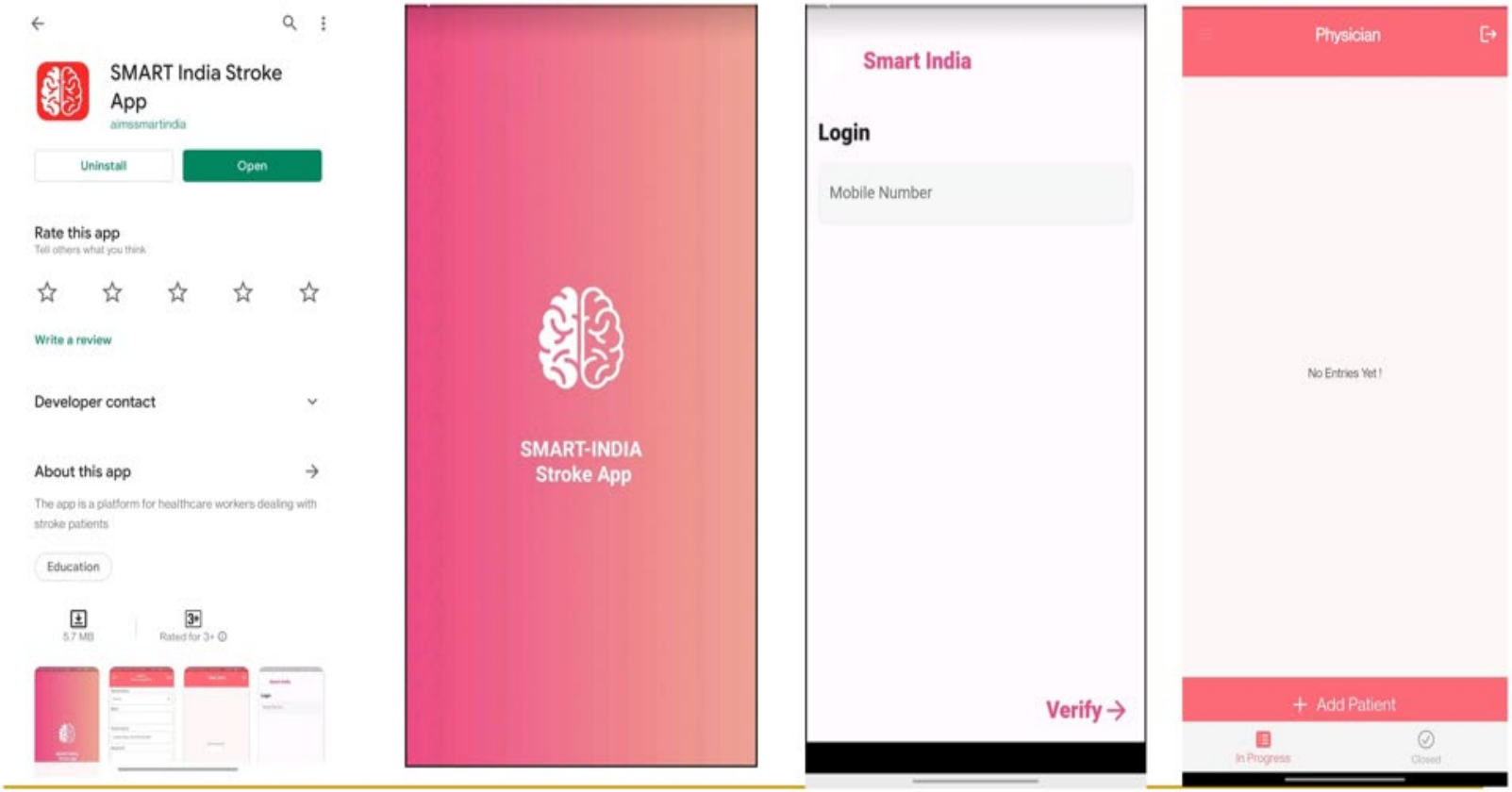
First Published October 1, 2014
https://doi.org/10.1111/ijs.12326

World Stroke Organization

# Telestroke using the SMART-India App

Primary purpose of providing a low-cost tele-stroke services of a neurologist and physiotherapist to physicians in district hospitals

## SMART INDIA App



# Telestroke : preparation of thrombolysis

# Telestroke : application of thrombolysis

# Telestroke : training of personeel

# Mobile stroke units in India

**ICMR'S MOBILE STROKE UNIT (MSU), DIBRUGARH, ASSAM PROVIDING STROKE CARE AT PATIENTS' DOORSTEPS IN REMOTE AREAS**

**Clot Buster Therapy Provided in MSU Saved a Stroke Patient - A first in Public Sector in the Country**

**8th March 2022 : 70 yr male, undiagnosed hypertension presented with left sided paralysis**

- Recognized Symptoms Early
- Contacted MSU within 1.5 hr
- MSU dispatched to patient's home - approximately 40 Km from Assam Medical College and CT done in MSU : 1 hr
- Time taken from Symptom Recognition to Clot Buster Therapy : < 3 hours!!


**ACT FAST!!**

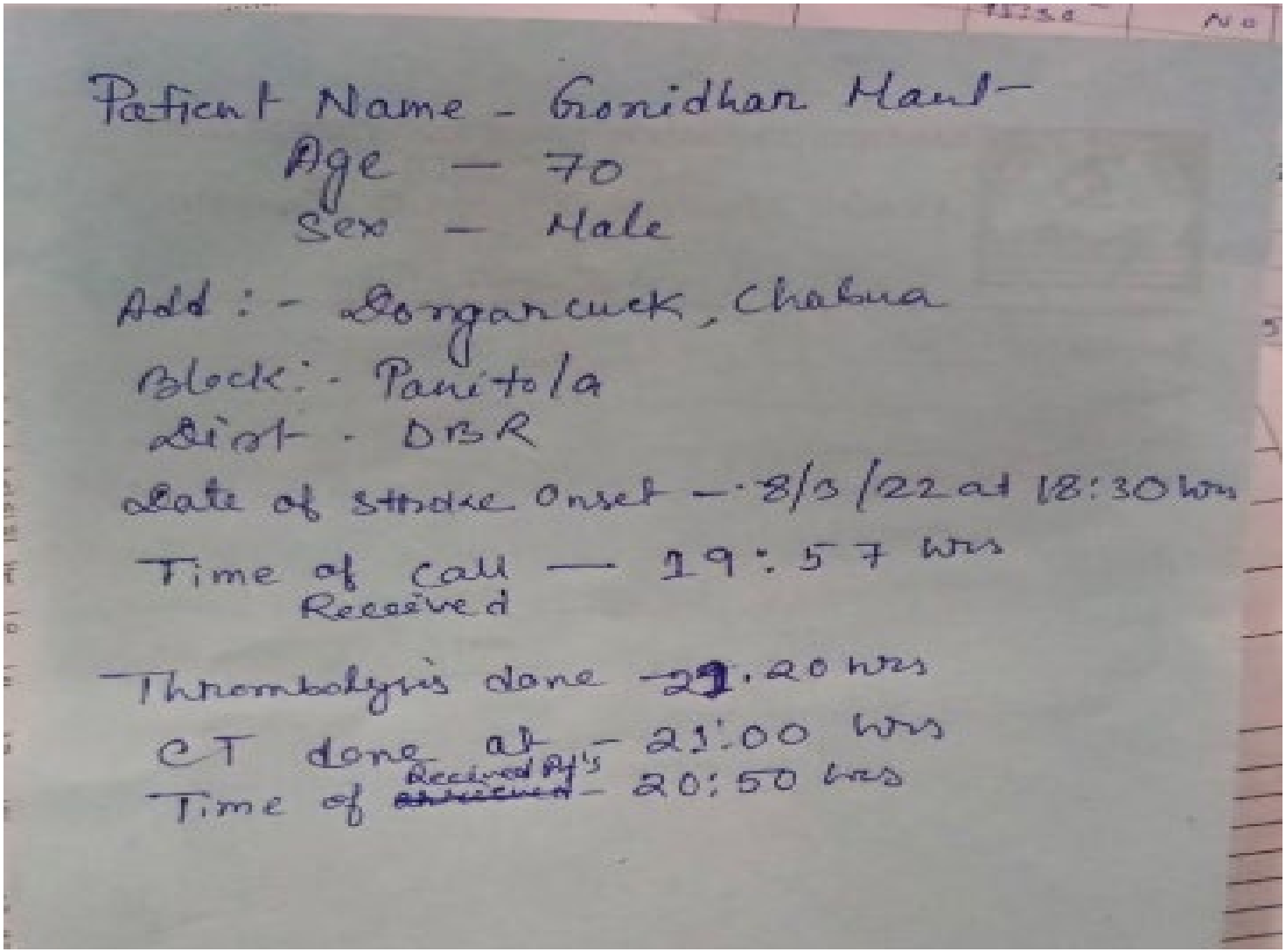
**Reach Stroke Hospital Early to Prevents Death and Disability**

icmr

Azadi Ka Amrit Mahotsav

Department of Health Research
Ministry of Health and Family Welfare
Government of India

# Simple but structured documentation



Patient Name - Gonidhar Haul-
Age — 70
Sex — Male

Add :- Borgaruck, Chabua
Block :- Panitola
Dist - DBR
Date of stroke onset — 8/3/22 at 18:30 hrs
Time of call Received — 19:57 hrs
Thrombolysis done — 21.20 hrs
CT done at — 21:00 hrs
Time of ~~arrived~~ Received By's — 20:50 hrs

# Restorative strategies after stroke: Indian Pilot Studies

- Autologous BM MNCs – IV
- Multi-center trial in 120 pts. – DBT
- GCSF in acute ischemic stroke – pilot study
- Multi center study – DBT
- BM MSCs – chronic stroke - DST

EXTRA Cerebrovascular Diseases

Cerebrovasc Dis Extra 2011;1:93–104
DOI: 10.1159/000333381
Published online: December 3, 2011


Original Paper

# Autologous Mesenchymal Stem Cells in Chronic Stroke

Ashu Bhasin[a] M.V. Padma Srivastava[a] S. Senthil Kumaran[b]
Sujata Mohanty[d] Rohit Bhatia[a] Sushmita Bose[d]
Shailesh Gaikwad[c] Ajay Garg[c] Balram Airan[e]

Departments of [a]Neurology, [b]Nuclear Magnetic Resonance and [c]Neuroradiology, [d]Stem Cell Facility and [e]Department of Cardiothoracic and Vascular Surgery, All India Institute of Medical Sciences, New Delhi, India

Journal of Stem Cells & Regenerative Medicine
ISSN 0973 - 7154

RESEARCH ARTICLE

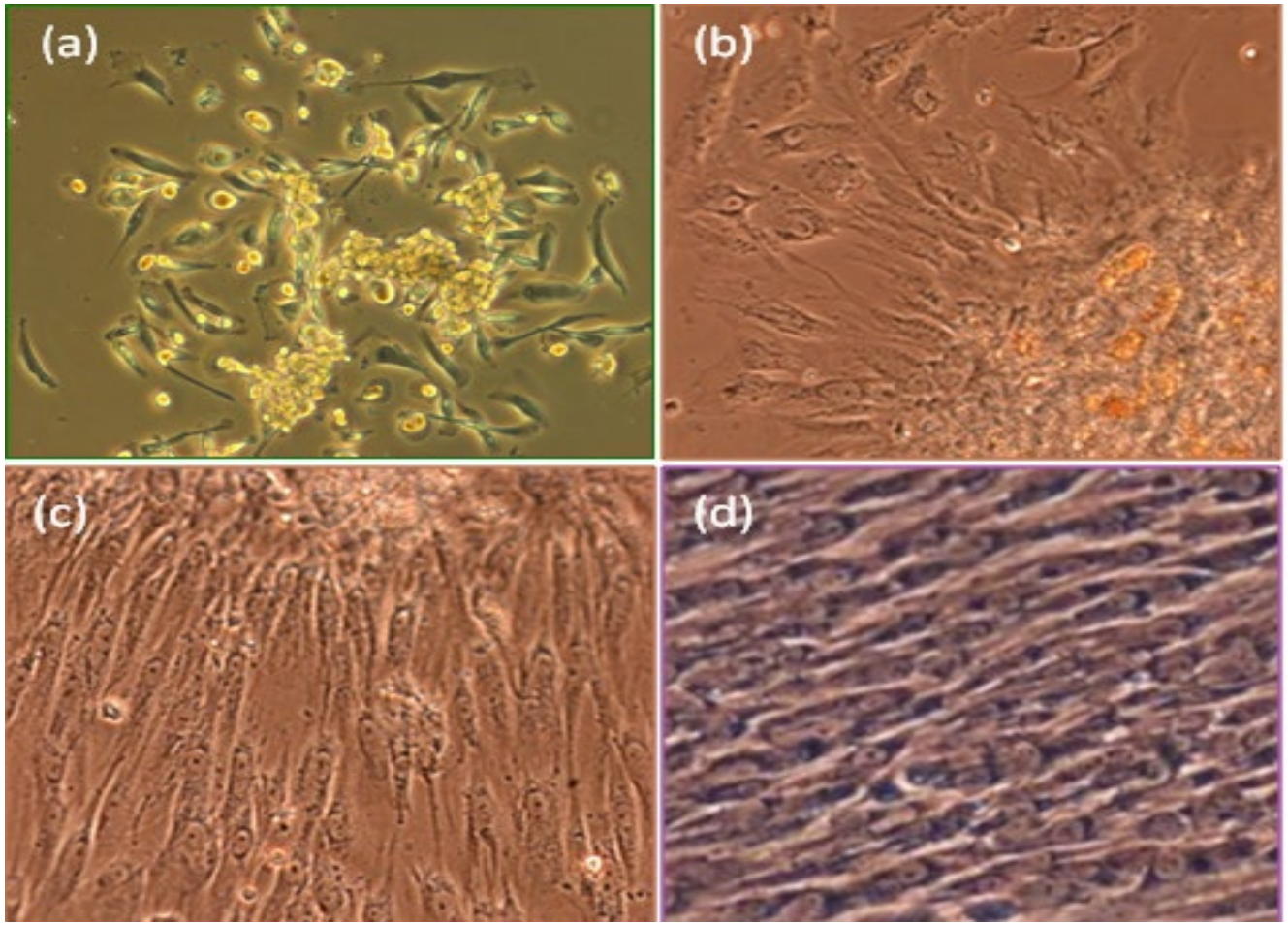
JSRM Code: 008030300134

# Autologous Intravenous Mononuclear Stem Cell Therapy in Chronic Ischemic Stroke

Bhasin A[1], Srivastava MV[1], Bhatia R[1], Mohanty S[1], Kumaran SS[1], Bose S[2]

# Expansion of mesenchymal stem cells

on day 3 (a), 7 (b), 10 (c) and at confluency (d).



Stem Cell
Research & Therapy

Bhasin et al., J Stem Cell Res Ther 2014, 4:3
http://dx.doi.org/10.4172/2157-7633.1000175

Review Article Open Access

# Stem Cells in Neurological Diseases: Indian Perspective

**Ashu Bhasin[1]*, Padma Srivastava MV[1]*, Rohit Bhatia[1], Senthil Kumaran[2] and Sujata Mohanty[3]**

[1]*Department of Neurology, All India Institute of Medical Sciences, India, New Delhi, India*
[2]*Department of NMR, All India Institute of Medical Sciences, India, New Delhi, India*
[3]*Stem Cell Facility, All India Institute of Medical Sciences, India, New Delhi, India*

Clinical Neurology and Neurosurgery xxx (2012) xxx–xxx

Contents lists available at SciVerse ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

# Stem cell therapy: A clinical trial of stroke

Ashu Bhasin[a], M.V. Padma Srivastava[a,*], Sujata Mohanty[b], Rohit Bhatia[a], Senthil S. Kumaran[c], Sushmita Bose[d]

[a] *Department of Neurology, All India Institute of Medical Sciences, New Delhi 110029, India*
[b] *Stem Cell facility, All India Institute of Medical Sciences, New Delhi 110029, India*
[c] *Department of N.M.R., All India Institute of Medical Sciences, New Delhi 110029, India*
[d] *Health Sciences Center, Texas Technical University, El Paso, TX, United States*

# Stem cell therapy in India : The InveST Study

Stroke
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association | American Stroke Association

**Intravenous Autologous Bone Marrow Mononuclear Stem Cell Therapy for Ischemic Stroke: A Multicentric, Randomized Trial**

Kameshwar Prasad, Alka Sharma, Ajay Garg, Sujata Mohanty, Shinjini Bhatnagar, Sharat Johri, Kunwar Karni Singh, Velu Nair, Ravi Shankar Sarkar, Sankar Prasad Gorthi, Kaukab Maqbool Hassan, Sudesh Prabhakar, Neelam Marwaha, Niranjan Khandelwal, Usha Kant Misra, Jayantee Kalita and Soniya Nityanand
for InveST Study Group

*Stroke.* 2014;45:3618-3624; originally published online November 6, 2014;
doi: 10.1161/STROKEAHA.114.007028
*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0039-2499. Online ISSN: 1524-4628

# Advanced physiotherapy regimes can be used in developing countries

- Constraint-Induced Movement Therapy (CIMT)
- Neuromuscular and Muscular Electrical Stimulation (NMES)
- Mirror Therapy
- Virtual Reality

Original Article

# Neural interface of mirror therapy in chronic stroke patients: A functional magnetic resonance imaging study

Ashu Bhasin, M. V. Padma Srivastava[1], Senthil S. Kumaran[1,2], Rohit Bhatia[1], Sujata Mohanty[2,3]

*Departments of Neurology, [1,2]N. M. R, and [3]Stem Cell Facility, All India Institute of Medical Sciences, New Delhi, India*

Volume 9 / Number 2 / April-June-2015

Indian Journal of
Physiotherapy and Occupational Therapy
An International Journal

*DOI Number: 10.5958/0973-5674.2015.00077.5*

# Comparison of Constraint Induced Movement Therapy and Neuromuscular Electrical Simulation on Clinical Outcomes in Chronic Stroke

**Aashrai SV Gudlavalleti [1], Vishal Taimni[2], Ashu Bhasin[3], M V Padma Srivastava[4]**

*[1]Research Associate, [2]Research Assistant, [3]Assistant Professor (DST-INSPIRE Faculty fellowship), [4]Professor of Neurology; Department of Neurology, All India Institute of Medical Sciences, New Delhi-110029, India*

# Role of non-invasive brain stimulation

- rTMS
- Transcranial direct current stimulation
- Theta-burst stimulation

Cureus
Part of SPRINGER NATURE

Open Access Original Article

# Cortical Neural Plastic Changes Post-stroke Using Bicephalic Transcranial Direct Current Stimulation: A Prospective Non-randomized Study

Ashu Bhasin [1], Gulafshan Iqbal [1], Rahul Sharma [1], Senthil S. Kumaran [2], Vishnu VY [1], Padma V. Srivastava [1]

1. Neurology, All India Institute of Medical Sciences, New Delhi, IND 2. Nuclear Magnetic Resonance (NMR), All India Institute of Medical Sciences, New Delhi, IND

**Corresponding author:** Padma V. Srivastava, vasanthapadma@gmail.com

**Review began** 06/25/2025
**Review ended** 07/17/2025
**Published** 07/23/2025



**DOI:** 10.7759/cureus.88586

## Abstract

### Background

Transcranial direct current stimulation (tDCS) has attracted attention among researchers as it has significant neurorehabilitative effects post-stroke. The purpose of the study was to investigate the safety, feasibility, and probable efficacy of bicephalic tDCS in improving hand function after stroke.

### Methods

We conducted a prospective non-randomized controlled study involving two groups of participants with chronic stroke. Participants were allocated to real tDCS (r-tDCS) and age-matched controls to sham tDCS (s-tDCS). The treatment session was for 20 minutes, along with physiotherapy for four weeks. The primary outcome measure was the Fugl-Meyer assessment (FMA), while secondary outcomes were the Action Research Arm Test (ARAT), modified Barthel Index (mBI), Brunnstrom stage, and functional magnetic

Archives of Rehabilitation Research and Clinical Translation (2020) 2, 100039


**Archives of Rehabilitation Research and Clinical Translation**

Archives of Rehabilitation Research and Clinical Translation 2020;2:100039

Available online at www.sciencedirect.com

Original Research

# Efficacy of Low-Frequency Repetitive Transcranial Magnetic Stimulation in Ischemic Stroke: A Double-Blind Randomized Controlled Trial

H. Sharma, MSc, PhD [a], V.Y. Vishnu, MD, DM [a], N. Kumar, MD [b], V. Sreenivas, MSc, PhD [c], M.R. Rajeswari, MSc, PhD [d], R. Bhatia, MD, DM [a], R. Sharma, BPT [a], M.V. Padma Srivastava, MD, DM [a]

# Robotics in stroke rehabilitation

**Centre for Advanced Research and Excellence in Disability & Assistive Technology (CARE-DAT) 2021**

Indian Institute of Technology Delhi (IIT Delhi)


Centre for Advanced Research and Excellence CARE-DAT Disability & Assistive Technology

INDIAN COUNCIL OF MEDICAL RESEARCH NEW DELHI

Sponsored By ICMR

All India Institute of Medical Sciences (AIIMS), Delhi


https://care-dat.iitd.ac.in/index.php

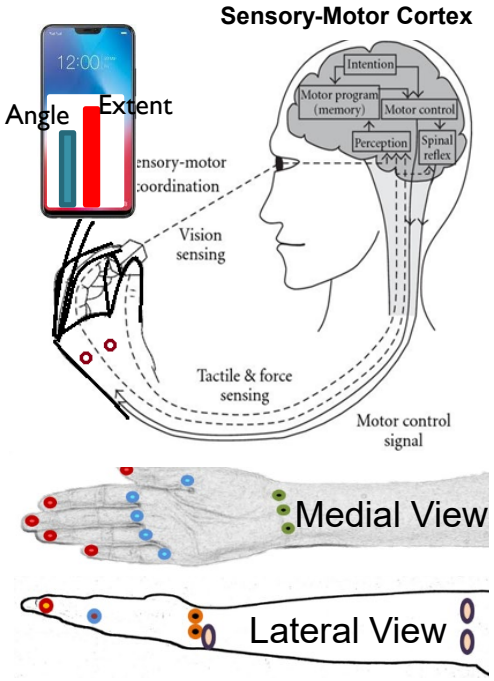
Care.dat2021@gmail.com

# Robotics in stroke rehabilitation

## Quantitative NeuroAssessment tools

- Sensor gloves with Neuro Feedback and mobile application
  - Rehabilitation based on sensors perception, analysis, computational diagnosis of non-normalcy, real-time feedback (joint-specific reinforcement)
- Brain-machine interface
- Targeting upper limb (UL)
- User friendly and affordable

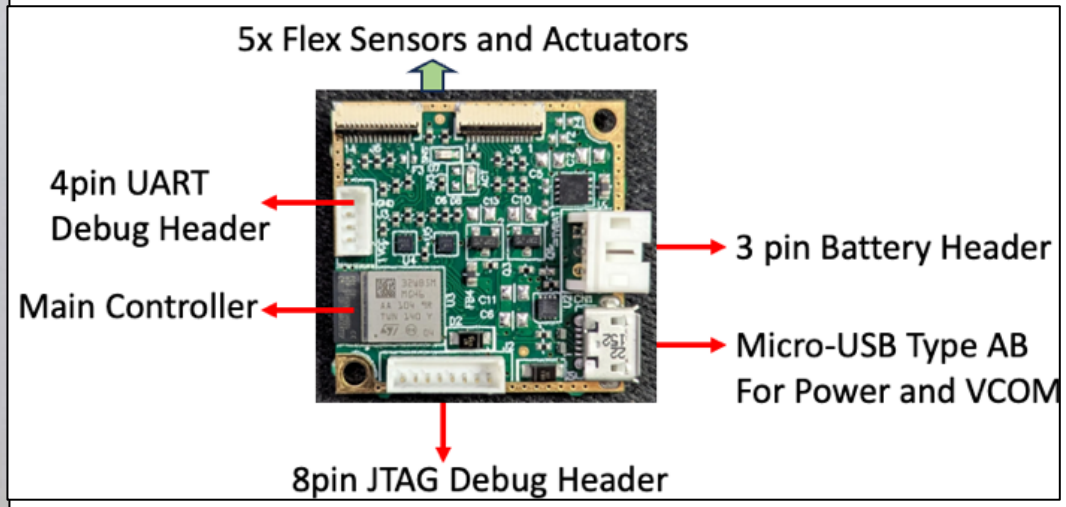
**Visual + Kinaesthetic Feedback**




Patent no.

# Robotics in stroke rehabilitation

## PROTOTYPE - 5



# Robotics in stroke rehabilitation

## PROTOTYPE - 6


**Final version**

Cotton, rexine, foam

14 sensors

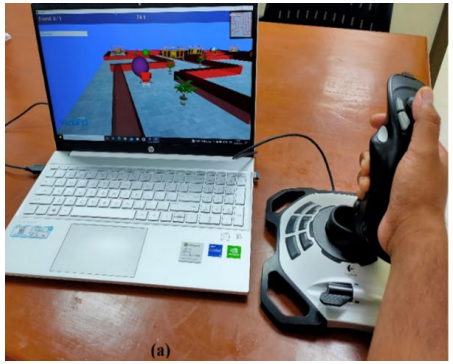
14 Actuators

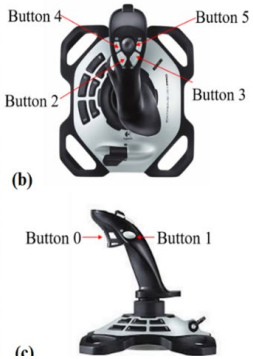
3 Pressure Sensors

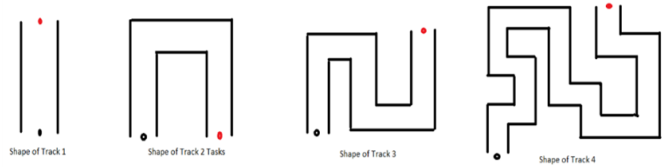
TRL : 6-7

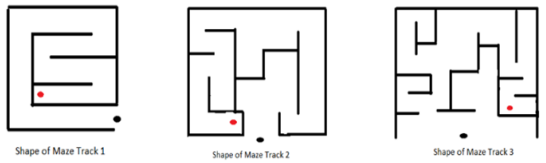
**PROTOTYPE – 6** : The glove is highly flexible, allowing for easy movement and effortless folding, making it both user-friendly and adaptable for various applications.

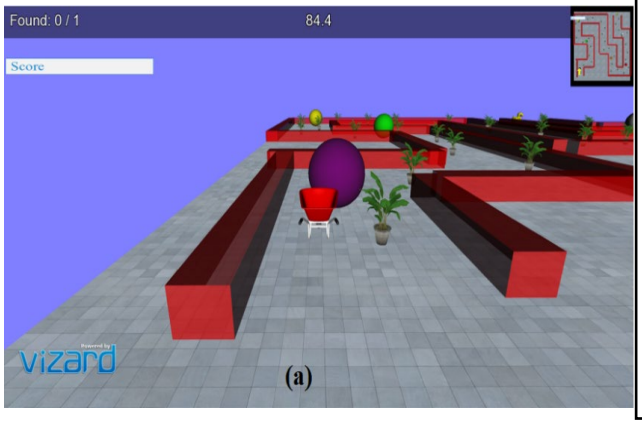
# Virtual reality for neuro-rehabilitation combined with a robotic exoskeleton

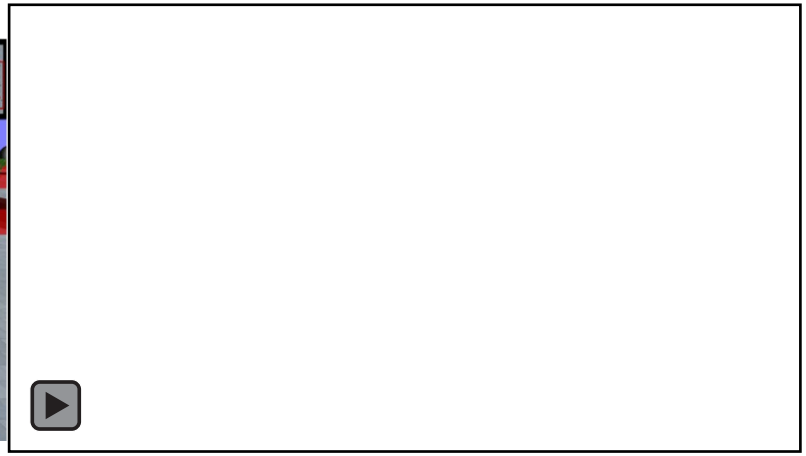


D Nath, N Singh, M Saini, P Srivastava, and Amit Mehndiratta, "Design and validation of Virtual Reality task for Neuro-rehabilitation of distal upper extremities", 2022 in **International Journal of Environmental Research and Public Health (IF 3.4)**, 19 (3), 1442.67.

# Education and teaching : primordial !


# Education and teaching : repeat – repeat-repeat



# Information, Education & Communication (IEC) Bureau (govt)

# Stroke awareness education in local language

# Implementation research project

**IMP**lementation of an **E**valuation and **T**reatment Package for **U**niform **S**troke Care and Outcomes in the Medical Colleges in India : An Implementation Research Study


Emergency care

Inpatient unit care

- Assess current practice of stroke care
- Identify deficiencies and barriers

- Implement best practice
- Optimise stroke care
- Improve patient outcomes

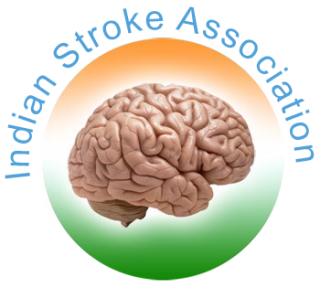
- Create trained manpower
- Module for training of medical colleges across India

- Self sustainable centres for stroke
- Mentoring for district hospitals
- Policy changes to improving stroke care

All India Institute Of Medical Sciences, New Delhi
All India Institute of Medical Sciences(AIIMS), Jodhpur
All India Institute of Medical Sciences, Bhubaneswar
All India Institute of Medical Science Rishikesh
Andhra Medical College
Atal Bihari Vajpayee Institute of Medical Sciences & Dr RML Hospital, NEW DELHI
Bangur Institute Of Neurology
Dr. Rajendra Prasad Government Medical College
Government Medical College, Amritsar
Guru Gobind Singh Medical College and Hospital
Government Medical College, Patiala
Government Medical College Thiruvananthapuram

Ganesh Shankar Vidyarthi Memorial Medical College
Government Medical College, Surat
Government Medical College, Kota
Indira Gandhi Institute of Medical Sciences
Lady Hardinge Medical College
Lokmanya Tilak Medical College & General Hospital, Mumbai
Pandit Bhagwat Dayal Sharma Post Graduate Institute of Medical Sciences
Sardar Patel Medical College. Bikaner
Sardar Vallabhbhai Patel Institue of Medical Sciences and Research
University College Of Medical Sciences
Vardhaman Mahavir Medical College & Safdarjung Hospital

# Indian Stroke Association (ISA) Objectives:




- Education
- Research
- Certification/Endorsement
- Guidelines
- Network: IMA/API/NSI/LAI/Critical care etc.
- Visibility/Partnerships: WHO/WSO/AHA/ASA/AINA/ESO/ etc

“Knowing is not enough; we must apply.
Willing is not enough; we must do.”


Johann Wolfgang von Goethe (1749-1832)