

The scope of teledermatology in India

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ABSTRACT

Telemedicine describes the application of information and communication technologies in the entire range of functions that involve the health sector. Several medical and surgical specialties utilize tele-consultation. Dermatology is the best clinical specialty in the use of communications technology because of its inherently visual nature in both diagnosis and follow-up, which makes it easily applicable to virtual medicine. Teledermatology embraces great potential for revolutionizing the delivery of dermatologic services to remote and distant locations by means of telecommunications and information technology. It encompasses consultations between a patient (and the primary healthcare provider) and a dermatologist for diagnosis and management advice. Teledermatology also covers dermatological education for health professionals and for consumers. Teleconsultations reduce time and increase the chances of access to one or more consultants as the patient or referring doctor desires, irrespective of the distance between the two. Its usefulness in the field of surgery and aesthetic surgery is immeasurable as there are only a few experts in the field of aesthetic surgery available currently in comparison to the dermatology population and the ever growing awareness and demand of the patients towards aesthetics. As the field of teledermatology is advancing in leaps and bounds the day is not far off when an aesthetic surgeon will be able to perform his skill from his own office on a patient in a distant locality with the help of a qualified and trained assistant. By adopting high-tech medical communication, high-performance computers, high-resolution cameras, and fiber-optic equipment's the entire world shrinks!

Key words: India, teledermatology, telemedicine

INTRODUCTION

A simple definition of Telemedicine (TM) is, "The use of electronic information and communications technologies to provide and support health-care when distance separates participants." Efforts in TM began in the early 1960s by NASA.^[1]

Diseases of the skin or subcutaneous tissue constitute major portion of ailments treated by family doctors. The specialists (Dermatologists) community in most of the countries are clustered around urban areas, limiting access to specialists for many patients in rural locations. Hence, an increasing proportion of patients with skin disease are being diagnosed and managed without ever seeing a dermatologist. The dermatologic needs of many communities worldwide are thus underserved. Especially, the remote rural areas suffer from a scarcity of dermatologists as well as limited means of communications and transportation. However, a recent advance in the provision of health-care and medical education through the use of information and

communication technologies (ICT) is exceedingly inspiring.

WHO defines TM as "The delivery of health-care services, where distance is a critical factor, by all health-care professionals using ICT for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health-care providers, all in the interests of advancing the health of individuals and their communities". The term 'Teledermatology' (TD) was introduced by Prednia and co-workers way back in 1995.^[2] Dermatologists in the peripheral and remote regions need to reach these specialists for the benefit of their patients and teledermatology is an invaluable tool for this purpose.^[3] An increased collaboration between dermatologists and primary health-care providers is required in order to address high patient demand and to provide education and support.^[4] Teledermatology is definitely a step forward in better dermatological care in general and aesthetic care in particular

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THE SYSTEM AND TOOLS OF TELEDERMATOLOGY

Practice of TM includes transfer of medical data, consultation, diagnosis, treatment, education, and health-care delivery.

Infrastructure used in a TM system will include minimum standards for all the

- Hardware
- Software
- Connectivity
- Centers

Hardware will include standards and guidelines for all the following

- Basic TM platform,
- Servers,
- Clinical devices,
- Videoconferencing units,
- Communication hardware and
- Power support.

Software

Software includes the following components.

- An operating system
- Licensed TM S/W (with PIR with the mandatory fields)
- Appropriate User Interface (UI)
- Back-end Data Base with the mandatory tables/fields (if applicable)

Connectivity

Connectivity: Options for TM services

VSAT - Very Small Aperture Terminal

PSTN - Public Switched Telephone Network

ISDN - Integrated Services Digital Network

Leased Line

Wireless LAN/WAN– Local Area Network/Wide Area Network

Centers

Telemedicine consultation center

TM consulting center is the site where the patient is present. In a TM Consulting Centre, equipment for scanning/converting, transformation, communicating for medical information of the patient can be available but it is not essential. A TM consulting center usually has a general practitioner (GP) or in very remote locations a Registered Medical Practitioner who will be able to communicate to the telemedicine specialty center (TSC) the symptoms/problems of the patient.

Telemedicine specialty center

TM specialty center is a site, where the specialist is present. He can interact with the patient present in the remote site and

view his reports and monitor his progress. A specialty center is generally located in a specialty or super specialty hospital catering to specific specialties or all specialties.^[5]

TELEDERMATOLOGICAL MODELS

There are three major teledermatology models. The store-and-forward and real-time video conferencing are the two most common modalities with the hybrid model that includes elements of video conferencing (live-interactive teledermatology) and store-and-forward technologies emerging as the third new modality. The various models applied in TM are depicted in Figure 1. Each modality has its advantages and disadvantages.

Store and forward technique

SAFT involves transmission of digital images from one system to another and asynchronous evaluation is practiced. This technique does not require simultaneous presence of the health-care professional (the consultant) and the patient. About 80-90% of dermatological conditions may be diagnosed by SAFT. SAFT has been found to be less expensive, easy to set up, practice, and maintain apart from the low-cost electronic equipments, quick electronic transfer of high quality digital images and universal access to the health-care workers, which enhance the practice of SAF. SAF uses digital camera with an average 640 × 480 pixels image resolution. A 720 × 500 pixel image can be considered equivalent to a 1490 × 1000 pixel image for most store-and-forward teledermatology consultations.^[6] The images are rapidly transferred and stored in JPEG (Joint Photographers Expert Group) format using the internet, which is used for e-mail consults and mobile telederm consults. The Digital Imaging and Communications in Medicine (DICOM) format is being used by the major TM centers.

Real time videoconference

Zelickson and Homan demonstrated video conference (VC) teledermatology in their nursing home setting way back in 1997.

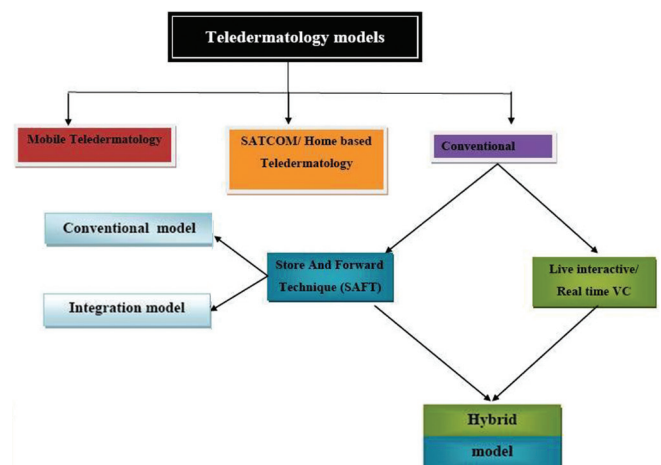


Figure 1: Figure depicting various models applied in telemedicine

In case of video consultation, video-conferencing equipment is used to connect the patient, often with their GP or Nurse present, with a distant consultant. The evaluation of diagnostic accuracy varies between 54-80% compared to face-to-face consultation.^[7] Initial studies on economic evaluation considered VC to be expensive whereas, more recent studies have confirmed it to be economical. This has been possible due to the improved technology and decrease in the hardware cost. In VC teledermatology the interactive video allows the examining physician to interact with both the patient and the presenter at the far end. This helps in achieving high levels of physician and patient satisfaction compared to SAFT. Such direct and two-way interaction allows the physician to establish a better rapport with the patient, ask further historical questions, and request certain images of the patient from the presenter.

Hybrid model

The combination of SAF TD in the first step, followed by VC TD in the second step is called Hybrid TD. It saves time, clarifies doubts and avoids misinterpretation from both the ends. This process achieves best physician and patient satisfaction.^[8]

Other models

Mobile or cellular teledermatology

Health (also written as m-health or mobile health) is a term used for the practice of medical and public health, supported by mobile devices that includes, mobile phones, and Personal Digital Assistants (PDA) (like Laptops and Hand held Computers), for health services and information. In short it is "The delivery of health-care services via mobile communication devices".

The inbuilt camera provided in mobile portable devices captures digital images, which is then computed, and delivered for dermatology care at a distance. They provide immediate image access and direct interaction and it is possible to obtain clarification. According to Kroemer, *et al.* clinical and dermoscopic tele-evaluations demonstrated strong concordance with gold standard ($\kappa=0.84$ for each) and similarly, high sensitivity and specificity for all diagnostic categories. With regard to the detailed diagnoses, clinical image tele-evaluation was superior to teledermoscopy.^[9] Melanoma screening with cellular phones using mobile teledermoscopic images revealed a diagnostic agreement of 90% compared to face-to-face consultation.^[10]

Mobile telehealth also refers to mobile TM units that reach the door step of the rural population to deliver health-care facility. It is supposedly the best mode of true door-step delivery of health-care with effective follow-up.

Satellite communication network

SATCOM is an Indian Space Research Organization initiative to reach the unreached and inaccessible remote geographic

regions where connectivity cannot be established is achieved through satellite connectivity. Skin camps are organized by mounting SATCOM on a bus or a van that travels to those remote geographic regions where Integrated Services Digital Network connection cannot be established and establishes satellite network connectivity with a tertiary center and delivers dermatology care.^[11,12]

Home based teledermatology

Certainly in the future, mobile teledermatology specifically, will gain momentum and further enable "home-based" patient centered-medicine empowering citizens to adopt an active role in their own health management. In this way too, teledermatology may provide the platform for a flexible triage system for dermatologic disorders in addition to the continued monitoring of established conditions.^[13]

APPLIED TELEDERMATOLOGY

TM is practically put to use in all the aspects of health-care delivery except involving direct tactile contact with the patient. The role of TM in the following segments is highly useful due to the virtual nature of this clinical specialty, may be next only to teleradiology and telepathology an essentially non-clinical fields.

- Referral
- Consultation
- Diagnosis
- Treatment
- Review
- Follow-up
- Education and Teleconferencing
- Business plan

Tele referral

The time taken for a tele-referral is significantly lesser, when compared to that of the conventional referral. Through tele-referral the patient has an advantage of accessing a consultant/specialist irrespective of the distance between the referring doctor/nurse and the tele- consultant.

Tele-consult

Despite the relatively new terminology, tele-consulting has been around for many years. Technically, even calling a doctor on the phone for advice is encompassed in the tele-consulting sphere. In the last years, however, this has been further extended, with doctors taking part in live teleconferences or participating as viewers in a surgical table. In simple cases, the telephone network is used for voice, fax, and data transmissions, while in more complicated situations Ethernet networks are the usual preference.

Tele-diagnosis

Tele-diagnosis involves the doctor making an assessment without physical examination carried out by him, however,

rather based on data transmitted from a remote location. This can be simple photography, histopathology slides, dermoscopic and other investigatory findings.^[14]

Tele treatment

Tele treatment refers to treatment offered to the patient through telecommunication. The specialist at the TM specialty center could advise the consulting doctor at the TM consulting, center who maintains patient information record (PIR) about the course of treatment to be taken

PIR

PIR refers to all information pertaining to the patient for providing care using TM including, clinical as well as non-clinical information.

Clinical information

This includes history of the illness, associated signs and symptoms, relevant past and treatment history if any, clinical observations, clinical interventions, diagnostics, and treatments etc., relevant for providing care, using TM.

Non-clinical Information

Non-clinical information include information about the patient's environment, demographic information, life style, nature, and details of occupation or about related people, etc., with relevance to the patient.

Review and follow-up

After suggesting/giving treatment (medical or surgical) to a patient for a particular condition through face-to-face or tele consultation, it becomes very easy for the patient as well as the doctor who can have a follow-up through tele-consultation, which apart from saving time and travel ensures best outcome of the treatment. All the PIR, which is periodically updated through regular reviews, by the attending doctor/health-care worker are telecommunicated to the consultant who follows-up the patient directly or through the referring health-care worker. The acceptance of tele-dermatological monitoring of leg ulcer was very high by patients, home care nurses, and wound experts. Decreased health-care costs by reducing the number of visits to wound care centers or specialist physicians and improvement in quality of life for patients with leg ulcers using TM seems possible.^[8] TM offers great potential in the management of Leg ulcers.^[15]

Educational tool and teleconferencing

All the modalities of TM are great tools for education purpose and the Hybrid model serves the best purpose. Research demonstrated that students who participated via videoconferencing remotely asked four times as many questions of the faculty, and vice versa faculty to students, than occurred when students were physically present in

the operating room. Feedback from the study showed that students gained more from the TM experience than from being physically in the operating room as measured by several objective and subjective criteria.^[16] A similar response was observed in all the VCs so far held by the Indian Society of Teledermatology involving clinical, pathological and surgical aspects of dermatology (unpublished data). Education through web casting has the advantage of global visibility.

Business plan

Though, tele-dermatology has enormous scope as an adjunct to current practice in the field, there are many challenges that it faces, right from the adoption of a new technology till reimbursement. The adoption challenges can embrace patients, technical, medico-legal, and financial aspects [Figure 2].^[17]

Although, tele-dermatology has been beneficial and cost-effective in some settings, many programs have failed, not because of the technology, however, because teledermatology was implemented in isolation. A thorough understanding of an organization's business process and business model is crucial before tele-dermatology is begun. Unless tele-dermatology is integrated into a correct business process and model, the likelihood of success is greatly reduced. Important steps therefore, include: (1) understanding how the organization delivers care; (2) analyzing the alternatives, including cost-benefit analysis; (3) obtaining organizational support; (4) formulating an execution plan; (5) training staff and monitoring the process. If implemented correctly in the appropriate setting, Teledermatology can significantly improve access and quality of care, while reducing or containing costs.^[18]

Teledermatology, as a business plan, can be utilized by not only practitioners, but also as a marketing place for

- Insurance and regulatory authorities
- Pharma industries in INDIA
- IT industries
- Technological tools like cameras and accessories

Mobile tele-dermatology platforms are being utilized in the clinical trials recruitment, compliance and retention and also post-marketing surveillance.

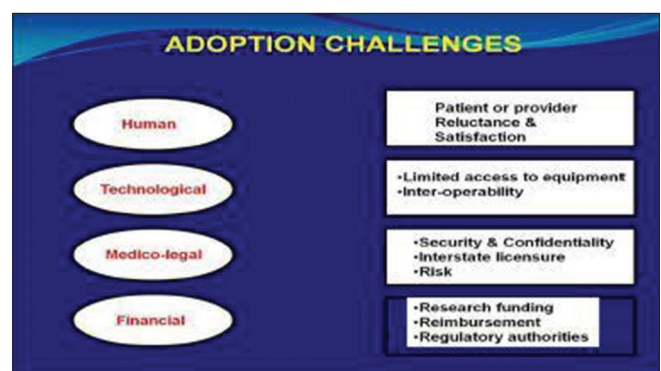


Figure 2: Adoption challenges in teledermatology

TELEDERMATOLOGY IN AESTHETIC SURGERY

As advancement in the field of tele-consultation, cooperative tele-surgery was introduced that involves a medical assistant local to the patient, and a doctor in a remote location. The medical assistant lacks the experience and expertise of the doctor, but has the advantage of physical access to the patient, can follow the consultant's instructions/advice and can also give immediate feedback. The doctor, using vocal and visual instructions, guides the assistant, who simply follows instructions. This combines the best of both worlds, and can be very helpful in the battlefield, where rapid assessment and immediate action can save up to 90% of the lives.

An extension of this concept is applied in aesthetic surgery.

SAFT can be used to screen and determine the suitability of the lesion for treatment by dermatosurgery. Some examples include conditions such as keloids, hemangiomas, scars, vitiligo lesions for grafting, hirsutism for laser assisted hair reduction, ageing changes of skin and images of scalp for hair transplantation etc. VC can also be used for pre-surgery counseling for aesthetic procedures. VC increases patient satisfaction as patient directly interacts with the aesthetic surgeon for any clarifications. Selected centers can have hybrid tele-dermatology to screen patients for procedures and counseling for aesthetic procedure. Mobile tele-dermatology is used to screen and deliver follow-up care after aesthetic surgery. Integration model finds its application in objective assessment after medical or surgical treatment of vitiligo and leg ulcers.^[19]

Clinical outcomes in skin cancer management via tele-dermatology, as measured by times to diagnosis and to surgical treatment, can be comparable to, if not better than, management by conventional referrals for remotely located patients.^[20]

Through VCs and webcasts dermatologists, residents and GPs get to learn more about the procedures and this helps in the teaching and learning.

Aesthetic surgeons can practice TM at different levels. The role of a tele-consultant practicing aesthetic surgery is almost the same as a consultant dermatophysician [Figure 3]. The remote surgery is an added tool, which the former uses to deliver aesthetic care to his patients.

Benefits of tele-surgery

- Cost-Effective
- Expertise from National and International Specialists
- Enhance and Extend the skill and range
- Three dimensional fashion
- Camera position can be controlled automatically through voice command

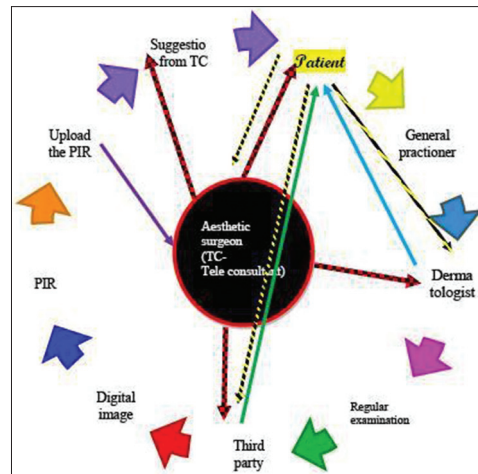


Figure 3: Role of dermatophysician and aesthetic surgeon in teledermatology

- Enhanced performance of surgeon without travel
- Reducing Fatigue
- Precise movements through robotic assistance

Cost convenience and enhanced performance are the ultimate aim of Tele-surgery.

Limitations of tele-surgery

TM relies heavily on the transmission of data between two locations. As the distance between these two locations increases, time lag is introduced. This increases feedback latency and after a point, renders real-time surgery impossible. Tests so far have been constrained to cable links, although, there is intense research towards increasing range using satellite links. The advent of broadband ATM networks will further speed up the process. Another important limitation is that the remote surgical unit's movement must not be allowed to deviate from or become misaligned with the hand movement. In practice, this means complicated feedback control and continuous monitoring of specific reference points. Finally, high prototype costs and bureaucratic governmental medical regulations do their part to slow down the wide-scale use of this technology.^[18]

In short the following are the shortcomings in performing tele-surgery

- Cost of installing and maintaining a robotic system
- Safety of the procedure
- Medico-legal
- Licensing and regulation
- Complications in Surgery
- Telesurgeon's mistake
- Technical failure

LEGAL ASPECTS

The advances in medical science, biomedical engineering on

one side and telecommunication and information technology on the other side are offering wide opportunities for improved health-care. Despite making huge strides in overall development, the health coverage to majority of population is still a distant dream in many countries.^[21] There is presently no Indian law that addresses the issues raised by the practice of TM in India. (Though there is an on-going initiative to address this gap). Though the advancement in the field of TM and tele-surgery is evolving tremendously, the legal and regulatory setting has not progressed proportionately.^[22]

Telemedicine's legal issues can be viewed as the following inter dependent areas

- (1) The traditional medico-legal issues not unique to the medium and therefore common to all
- (2) Conflicts in state law, which TM amplifies because it connects geographically separate facilities
- (3) Issues unique to TM^[23]

Security is a fundamental requirement for TM applications. Security strategies, designed to protect the privacy, authenticate, authorize, and maintain integrity. These are necessary to protect against the threats of eavesdropping, manipulation, impersonation, and unauthorized access to health-care information of individuals.

The following are some examples of security measures that must be built-in or addressed in any TM application system:

- Who can have access to individuals' health information?
- What kind of security technology is used for the above authentication, such as password, fingerprint, and smart card?
- What kind of encryption is used for storing medical data?
- What kind of encryption is used for transmitting medical information?

Security elements include storage security, network security, data encryption, audit trails etc.

Although, no TM malpractice cases have been filed to date, clarifying how responsibility for decision-making is shared between referring doctors and specialists is essential. Individuals making initial steps in this field are advised to contact their malpractice carrier and inform them of their interest in TM. It would not be regarded to be engaging in TM if the activity involved giving advice to a registered medical practitioner in another state and no fee is raised.

Reimbursement for services is an important issue. Currently, reimbursement is almost exclusively available for real-time interactive services, with store-and-forward system funding only provided on a very limited basis.

Interestingly, some progressive international insurance companies have begun endorsing the use of SAFT.^[3]

In the future, not using TM facility may be viewed as negligence of medical care as TM will result in improved care (that is, higher standard of care), and therefore, failure to refer may constitute negligence. Thus TM may affect the standard of care by elevating this to the point that not having tele-medical capacity is in fact substandard.^[24]

The following aspects are worth recalling as mandatory while practicing teledermatology:

- Other jurisdictions would not regard it as practicing TM in that location if a doctor has seen the patient earlier and the consultation is on the basis of a follow-up and continuing care and no fee is raised
- It would not be regarded to be engaging in TM if the activity involved is giving advice to a registered medical practitioner in another state and no fee is raised.
- Have an authorized registration by the local medical board/ multiple licensures wherever applicable.
- Be under cover of professional indemnity insurance and have an able legal advisor
- Get written consent from the patient explaining all details. With special reference to taking picture and the surgical procedure
- Preserve the PIR under security.
- Ask for relevant investigation when the data is insufficient or diagnosis is doubtful
- Call for a face-to-face consultation when in doubt.
- Use a disclaimer, which may read as "the medical opinion is only based on records available without direct contact with the patient and hence, this advice is only to guide the referring doctor and cannot equate face-to-face consultation".

BARRIERS AND LIMITATIONS TO TELEDERMATOLOGY

The requirement for internet-capable computers hinders adoption of teledermatology facilities in underdeveloped areas. Some of the major limitations include;

- Lack of adequate infrastructure for basic investigative follow-up
- Non availability and poor or lack access to adequate medications
- Lack of trained personnel to elicit history and correct findings
- Inadequate knowledge about digital imaging using a camera or mobile phone

The barriers can be at different levels

- Technological

- Cost of equipment
- Medico-legal
- State medical licensure
- Health Insurance Portability and Accountability Act [HIPAA] confidentiality and security
- Liability insurance
- Human
- Depersonalization of doctor-patient relationship
- Reimbursement
- Variable payer reimbursement for TD

WHAT'S NEW FOR FUTURE DIRECTIONS

Dermoscopy, a noninvasive, *in vivo* technique primarily used for the examination of pigmented lesions allows the visualization of subsurface skin structures in the epidermis, dermo epidermal junction, and upper dermis; these structures are usually not visible to the naked eye.

The most frequently cited concern was that the TM eliminates the unique relationship between a patient and his/her provider like the lack of identity of a doctor with his own handwriting, which is easily averted with the advancements in technology like the invention of e-pens.^[25]

Mobile Teledermatology, Tele dermoscopy, Tele dermatopathology, and Teledermoscopically-aided dermatopathology and Teledermatosurgery are rapidly developing fields in the yet young field of Teledermatology. Mobile teledermatology is a technically feasible and diagnostically reliable method of amplifying access to dermatologic expertise in underserved regions where access to internet-capable computers is unreliable or insufficient. Mobile teledermatology using cellular phones is an innovative and convenient modality of providing dermatologic consultations for diseases and skin cancer screening. Capturing dermatoscopic images via mobile phones, improves diagnostic accuracy.^[26] The adequacy of the triage and management decisions achieved using MMS referrals were similar to those obtained with other store-and-forward teledermatology methods.^[27]

Yet, the full potential of these advances cannot be reached without clinical and technical standards and guidelines. Some of the steps to make every individual benefit from tele-consult would be promotion of the growth of TM and increase availability of quality medical service through e health to those in need. Best results can be achieved by designing a framework for interoperability and scalability across TM services within the country and outside.

The role of TM and the internet in the dermatologist's future role in health-care delivery requires thorough study, examination, and consideration.

Dermato surgeons need to explore the feasibility of technology

application in the interest of the patient and conduct studies. There is need to hasten research and adopt novel and innovative techniques to deliver quality health-care to distant regions and achieve the goal to reach the unreached globally.

CONCLUSION

With proper standardization of imaging, equipment, procedures and recording, supported by user friendly legal and insurance regulations practice of tele-dermatology in general and aesthetic surgery in particular, will be made much easier. Courses and specialization on E-learning by introducing special courses with the Medical council's approval having a global standardization will have a long way to go in shrinking the world in terms of practicing dermatology in all its specialties including aesthetic surgery.

With advancement of knowledge and expanding facilities every day, no medical practitioner can keep up without help. By adopting high-tech medical communication, high-performance computers, high-resolution cameras, and fiber-optic equipments the entire world shrinks!

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