

Open Call for Ideas

Smart Remote Lymphedema Monitoring and Self-Assessment

(Use Case by NTFGH)

1. Background

Lymphedema is a chronic condition that requires regular and long-term limb volume monitoring to guide treatment decisions and evaluate patient outcomes. Current assessment practices rely on manual circumferential measurements taken at every 4 cm interval along the affected limb, followed by manual data entry and volumetric calculations. As a result, patients must attend frequent in-person appointments, while clinicians spend considerable time performing measurements and administrative tasks.

In addition, current clinical monitoring only detects lymphedema after visible limb volume changes occur. Yet the earliest pathophysiological change, a shift in extracellular fluid composition detectable via bioimpedance analysis, precedes measurable volume changes. This missed clinical window represents a critical opportunity for early intervention to alter disease trajectory and improve patient outcomes.

With the growing focus on digital health, remote patient monitoring, and virtual care, there is an opportunity to transform lymphedema management with a solution that enables patients to self-monitor at home while allowing clinicians to remotely track disease progression and intervene when necessary. An ideal solution would capture both the earliest subclinical fluid changes and subsequent volume progression, providing a comprehensive and continuous picture of lymphedema status across the full disease continuum.

2. Challenge Statement

How might we enable patients with lymphedema to accurately measure and monitor limb volume from home while providing clinicians with real-time insights to support early intervention, reduce unnecessary hospital visits, and improve long-term care outcomes?

Furthermore, how might we extend detection capability beyond limb volume measurement to capture subclinical extracellular fluid shifts, since this is the earliest indicator of lymphedema onset and progression, thereby enabling intervention before irreversible volume changes occur?

3. Current State

Today, limb volume assessment is a manual, clinic-based process that is time-consuming for clinicians and inconvenient for patients. Measurements must be collected manually, transcribed into spreadsheets, and reviewed during scheduled appointments. This creates risks of transcription errors, inconsistencies between assessors, and delays in identifying changes in a patient's condition.

The current standard monitoring tools, which includes tape measurements and 3D scanning, detect limb volume changes but miss the preceding extracellular fluid shift, the earliest and most actionable stage of lymphedema. Bioimpedance analysis (BIA) can detect subclinical

lymphedema before volume changes manifest, but remains a standalone clinical device, unintegrated into home-based or remote monitoring workflows.

Patients with chronic lymphedema often require frequent monitoring, making repeated hospital visits physically demanding, costly, and disruptive, particularly for the elderly or individuals with limited mobility. Furthermore, clinicians have limited visibility of a patient's condition between visits, reducing opportunities for early intervention. While commercial limb measurement devices exist, they are often expensive and confined to specialist centres, limiting broader deployment across healthcare settings and home environments.

4. Desired Future State

We are seeking innovative ideas that digitise and simplify lymphedema monitoring through a portable and affordable solution that patients can use independently at home. Measurements should be automatically captured, analysed, and securely transmitted to a clinician's dashboard, enabling continuous remote monitoring while reducing the need for routine in-person visits.

Clinicians should be able to track trends over time, receive alerts when significant changes occur, and initiate virtual or in-person follow-up when required. The solution should empower patients to take a more active role in self-management while improving accessibility, clinical efficiency, and continuity of care.

Specifically, the desired solution should be capable of:

- Detecting extracellular fluid shifts at the subclinical stage through integrated biosensing capability, enabling the earliest possible clinical intervention
- Measuring limb volume changes through digitised, automated scanning to replace manual tape measurements
- Correlating fluid shift data with volume data over time to provide a comprehensive longitudinal profile of lymphedema progression
- Alerting clinicians when fluid shift changes are detected even in the absence of volume change, which represents the highest-value early intervention window

5. Key Design Requirements

Proposed ideas should:

- Enable accurate, standardised home-based limb volume measurement with automated data capture, volume calculation, and secure transmission to clinicians.
- Detect extracellular fluid shifts preceding volume changes for subclinical lymphedema identification and earliest intervention.
 - Provide unified fluid-volumetric assessment across staged findings:
 - Fluid shift, no volume change → subclinical; early intervention/monitoring
 - Fluid shift, early volume change → early clinical stage requiring prompt management

- Fluid shift, significant volume change → established lymphedema, active treatment
- Provide remote monitoring capabilities through clinician dashboards, trend tracking, automated alerts, and integration with telehealth workflows to support timely intervention.
- Deliver an affordable, portable, and user-friendly solution that is accessible to patients with varying levels of digital literacy while meeting healthcare privacy and security requirements.

6. Expected Outcomes

a. Improved Patient Care and Access

- Empower patients to self-monitor from home, reduce unnecessary hospital visits, and improve access to timely care through continuous monitoring and earlier detection of deterioration.

b. Enhanced Clinical Efficiency

- Reduce manual measurement, data entry, and administrative burden while enabling clinicians to proactively identify and prioritise patients requiring intervention.
- Provide clinicians with a unified, multi-modal data view combining fluid status and volumetric trends, replacing the current fragmented approach of using separate devices for separate parameters.

c. Scalable and Sustainable Digital Care

- Provide a cost-effective remote monitoring solution that can be deployed across hospitals, community settings, and home care environments to support long-term rehabilitation and chronic disease management.
- Support a prospective surveillance model for high-risk populations (e.g., post-mastectomy, post-cancer treatment patients) where early detection can prevent progression to established lymphedema.

7. Invitation to Pitch

We welcome ideas from startups, digital health companies, and multidisciplinary teams that can transform lymphedema management through remote monitoring and virtual care. The ability to detect the earliest pathophysiological changes, especially fluid shift preceding volume change, would represent a meaningful advancement in lymphedema care and a genuine clinical innovation with potential for significant patient impact

This challenge is intentionally solution-agnostic, allowing participants to propose a wide range of ideas and approaches that improve self-management, support proactive care, enhance clinical efficiency, and advance the future of digital rehabilitation.