In 2005, a group of dedicated clinicians in Sonderjylland, Denmark started to use telemedicine as a communications tool in wound care. “We got the idea, we started working on it and were luckily fully supported by the local board during the entire process.”

It was never a research project.¹

**A NEW ORGANISATION OF TREATMENT**

The telemedicine system was developed to facilitate communication among the different caregivers, clinicians, and specialists involved in caring for and treating patients with wounds. As an example, the system should facilitate communication among a tissue viability nurse in one municipality, another tissue viability nurse working in an outpatient clinic at a hospital situated 80 km away, and a medical doctor with interest in wound care working in a different hospital another 40 km away.

When the system was ready, the concept was introduced at a meeting of interested clinicians and tissue viability nurses in our region. The interest was overwhelming, and that gave us a good start. Over time, adjustments have been made with the objective of improving the functionality.

The system is low tech. All that is needed is a mobile phone, smart phone, or tablet and access to the Internet. Data are collected via the phone or tablet, managed by a web-based Wound Management System, and stored on dedicated servers. The database serves as a platform for data storage and communication; and because it is web based, access is not limited by geographical factors. The tables for wound assessment (according to TIME²), clinical investigations, and patient history were prepared with an eye for the requirements of the medical doctors as well as those of the tissue viability nurses working in the municipality and region.

We decided to work in very close contact with the specialists in the different sectors involved. By keeping all sectors involved, we managed to adapt the referral channels to fit the new possibilities for efficient information and knowledge sharing among caregivers, tissue viability nurses, and medical doctors. That means that the tissue viability nurse providing home care can admit the patient directly to the hospital when necessary. The nurse may also apply a compression bandage, if an ankle pressure measurement has been conducted; and steroid creams can be used for up to 14 days without previous approval from the general practitioner (GP), at the discretion of the medical doctor in the wound healing centre.

This was a joint decision made in collaboration with the GPs. The GP still receives information about the course of treatment related to the patient.

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Figure 1: A demonstration of the set up
The illustration provided in Figure 1 shows the data flow and communication among the involved parties. A tissue viability nurse is visiting a patient in the patient’s home. A photo of the wound is taken using the camera in a mobile phone, and the photo is transmitted to the patient “wound database” on the web server by the use of an identification programme on the phone. If an immediate specialist evaluation is needed, a text message and e-mail can be sent to the medical doctor in the outpatient wound clinic (upper right quadrant) with a notification that an emergency call is wanted. The medical doctor evaluates the photo in the database and calls the tissue viability nurse while she or he is still in the home of the patient. Via that direct contact, a plan for treatment can be agreed upon.

In most cases, the nurse enters relevant data when he or she has returned to the office after a visit to a patient’s home. The data may include, for example, the results of ankle pressure measurement, pulse palpation, investigation for neuropathy, as well as wound assessment according to TIME and a short description highlighting the possible problems to be addressed. The medical doctor responsible for the wound treatment reviews the patient information on a daily basis. Based on those assessments, the patient may be signed up for one of the following options:

- a first appointment for a visit to the outpatient clinic (in case the patient is new);
- a new appointment in case of deterioration (in case the patient has been examined previously for the same wound).

If there is no need for a specialist examination in the outpatient clinic, the medical specialist informs the tissue viability nurse that the planned treatment can be continued according to the relevant data that have been entered into the database.

During the first visit to the outpatient clinic, the results of the tests undertaken, for example, toe pressure measurement and X-ray and duplex scans, are entered into the relevant boxes, and a diagnosis is made. As the patient leaves the clinic, a message is sent directly to the electronic records of the primary healthcare provider organisations in the municipality, including those of the GP (direct transmission of data or information about new data in the database). This ensures that everyone involved in caring for the patient stays informed about the latest developments.

A network/task force is created for the particular patient. Typically, this will include the following profiles/individuals:

- A tissue viability nurse in the municipality
- A tissue viability nurse in the outpatient clinic
- The secretary in the outpatient clinic
- The medical doctor responsible for the treatment
- The general practitioner
- The caseworker in the municipality
- The podiatrist and orthopaedic shoemaker, in case the patient has a diabetic foot ulcer
- The patient

Thus, the implementation of a telemedicine system for the provision of wound care in the catchment area (250,000 inhabitants) of Sygehus Sønderjylland (Hospital of Southern Jutland) represents a good example of the integrated care and the facilitation of the interdisciplinary teamwork that are crucial for providing good wound care.

**DATA SECURITY**

To ensure that no ethical standards for data storage are violated, informed consent must be given by the patient before the patient records are established in the system. The system complies with Danish law and EU regulations concerning the protection of personal data. Data are stored on dedicated servers located at two secure data facilities in Copenhagen, Denmark (the system is NOT a so-called “cloud-based” solution). Data are transmitted using point-to-point encryption, ensuring that the location of sensitive data is known and controlled at all times. All data access is managed and logged in accordance with Title 21 CFR Part 11 of the FDA guidelines on electronic records, ensuring a detailed audit trail of user access to sensitive data. Clinical data are owned by the patient and are never accessed, handled, or otherwise used by non-clinical personnel. Likewise, clinical data are never shared with a third party (anyone not part of the team responsible for the treatment of the patient).

**QUALITY OF THE TREATMENT**

With regards to measuring the impact of the system locally, the web-based clinical database, which is a part of the telemedicine system, has shown to be of great value for collecting data on wounds and the effects of wound care. Thus, the system provides researchers interested in wound care with a substantial amount of data, which may be used to evaluate and eventually adjust current treatment methods to ensure that the optimal treatment solutions are used.

When handling patients with venous leg ulcers, post-thrombotic syndrome, and traumatic ulcers, we include information on the size of the wound. This provides...
us with valuable information about the healing rates, constituting a central factor for evaluating the quality of the treatment. The current service offered via telemedicine fulfills the requirements described in The Danish Quality Model, which is a national system for quality development across the sectors involved in healthcare (i.e. a system to create cohesive continuity of care for the patient and prevent mistakes and adverse events).

The average healing rates for selected groups of patients who were followed via the telemedicine system (collected from startup in 2005 until today, 2014) are given in Table 1.

<table>
<thead>
<tr>
<th>ICD code</th>
<th>Healing rate per week</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>I83.0</td>
<td>Venous leg ulcer</td>
<td>18%</td>
</tr>
<tr>
<td>I87.0</td>
<td>Post-trombotic syndrome</td>
<td>16%</td>
</tr>
<tr>
<td>S89.9</td>
<td>Traumatic ulcer of the lower limb</td>
<td>26%</td>
</tr>
</tbody>
</table>

To our knowledge, no other system is able to demonstrate healing rates online. Gelfand et al. suggest, however, that the % change in area, the log healing rate, and the log area ratio at the fourth week of care can serve as important surrogate markers of complete wound healing after 12 or 24 weeks of care. Thus, the numbers presented in Table 1 suggest good outcomes for the management of individuals within our system of care and, furthermore, may be predictive of the potential for further positive outcomes for other clients within our healthcare system.

We have also conducted a survey of the number of major amputations performed at our hospital prior to the introduction of cross-sectional collaboration and telemedicine and in the years following the implementation of the system. Preliminary results indicate a reduction of approximately 50% in the number of major amputations during the period from 2002 to 2012 (69 major amputations were performed in our catchment area in 2002 compared with 32 in 2012). However, the analysis and evaluation of those data have not yet been finalised.

With regards to user feedback, we have experienced that the implementation of the telemedicine system and the subsequent organisational changes are evaluated positively by our staff representatives as well as by patients.

Those evaluations are supported by a user evaluation report from the Capital Region of Denmark following the implementation of the same telemedicine system. The report was based on a qualitative evaluation, involving interviews with 40 persons including patients, relatives of patients, and nurses, doctors, and other staff members in the hospitals and municipalities.

As a result, the nursing staff members have taken a greater responsibility for the identification of the optimal treatment pathways for the patients. Thus, the system has also had a knock-on educational effect, which is expected to result in further improvements in the care and treatment procedures.

A tissue viability nurse from the municipality of Aabenraa (included in the catchment area of the wound unit at the Hospital of Southern Jutland) expressed her enthusiasm towards the use of telemedicine and the new organisation of the services:

“Today there are clear guidelines for wound care via telemedicine in the municipality of Aabenraa … This is a perfect responsibility area for tissue viability nurses who benefit from the constant education and training, e-learning programmes, and networking related to the use of telemedicine. In the municipality, the use of telemedicine has led to an intensified knowledge sharing, continuous education of all groups of staff, and publication of information materials, as well as case stories shared during the coffee breaks. Telemedicine has made our daily work life more fun.”
From the perspective of the patient, the use of telemedicine has led to increased interconnection in the continuity of care, leading to an increased sense of security. Over time, we have also observed that patients have become more actively involved in their own care. Some have sent photos asking if a visit to the outpatient clinic was needed, and others have asked to be seen as an emergency due to unexpected deterioration noticed by the patient. Thus, our experience shows a tendency for the implementation of telemedicine to lead to increased quality of care via patient empowerment.

As of 2014, Sygehus Sonderjylland (Hospital of Southern Jutland) has included 2293 patients in the database, with 20-25 new patients being added monthly. A national strategy for the large-scale deployment of the system has been developed, and the process is ongoing. Figure 2 illustrates the growth in the amount of patient information held on the database at a national level.

CONCLUSION
Introducing this new, low-tech tool has changed our daily activities dramatically, to the ultimate benefit of the patients. Many routine outpatient visits have been replaced by a standard visit by the responsible nurse working in the community and a professional evaluation of the patient’s condition via a wound description and photograph, all of which are entered into the database. This leaves the outpatient clinic more time to focus on performing the examinations needed to ensure that the correct diagnosis is given, defining a treatment pathway, and promptly treating the most problematic wounds and emergency cases. In the primary healthcare setting, the use of the system has resulted in increased knowledge about wound care and faster healing of leg ulcers is indicated.

References
2 Dowsett C, Ayello E, TIME principles of chronic wound bed preparation and treatment, British Journal of Nursing. 2004;13(15), ProQuest Nursing & Allied Health Source.
4 Directive 95/46/Ec Of The European Parliament And Of The Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data
6 http://www.ikas.dk/DDKM.aspx (accessed 25.08.2014)
8 Telemedicinsk sårvurdering - En kvalitative brugerevaluering blandt patienter og sundhedsfagsligt personale i Region Hovedstaden. Brugerevaluering af telemedicinsk sårvurdering i Region H Brugerevaluering af telemedicinsk sårvurdering i Region H Februar 2013, Enheden for Brugerundersøgelser, Region Hovedstaden (in Danish)

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