Patient@home Ecosystem

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ABSTRACT
Patient@home was the largest Danish project within health and welfare technology. The aim was to support the health and care sector with innovative technologies to meet the increasing demands of an aging and more chronically ill population. The underlying hypothesis was that the increased use of technology could help minimize hospital admissions in both number and duration. New technologies enable carefully selected groups of patients to stay longer in their own homes to the benefit of both patients (and their relatives) and the health and care sectors. A unique ecosystem for the development, assessment, and testing of health and welfare technology was developed, refined and matured from 2012 to 2018. The ecosystem covered the entire value chain from research to implementation; it had a broad national coverage and an international outreach with more than 100 partners (including 66 private companies). The ecosystem provided a set of services that supported knowledge and evidence based development and assessment. Numerous contributing partners were aligned to each focus on what they do best. A “best practice” method for successful product and service development was established based on examination of successful projects in the portfolio. The ecosystem deployed specialized methods for technology assessment and smart innovation management.

Keywords
health, welfare technology, evidence based, best practice, guidelines, technology assessment, innovation management

INTRODUCTION
The health and care sectors in Denmark, as in many other countries, are challenged by increasing demand from an aging and more chronically ill population. Patient@home was established in 2012 as the national Danish Strategic Platform for Innovation and Research (SPIR) focusing on health and welfare technology.

The underlying hypothesis in Patient@home was that increased use of technology can help minimize hospital admissions in both number and duration. New technologies enable carefully selected groups of patients to stay longer in their own homes to the benefit of both patients (and their relatives) and the health and care sectors.

The Patient@home ecosystem provided a set of services that support knowledge- and
evidence-based development and assessment. Numerous contributing partners were aligned to each focus on what they do best. A “best practice” method for successful product and service development was established based on an examination of successful projects in the portfolio. The ecosystem deployed specialized methods for technology assessment (the MAST model) and smart innovation management (the SIM tool).

The goal was to create new products and services to address the great challenges of health and care and at the same time enable businesses to create new opportunities for jobs, export, and growth. Innovation Fund Denmark and the Region of Southern Denmark supported the ecosystem; the total budget exceeded 350 million DKK, covering the period from 2012 to 2018. The initiative resulted in 49 new products and services ready for market.

This paper provides a brief overview of the ecosystem and highlights the most prominent results and effects achieved through its six years of operation. See Wiil (2018) for a more detailed overview of methods, results, and effects.

ECOSYSTEM

A unique ecosystem for the development, assessment, and testing of health and welfare technology was developed, refined, and matured from 2012 to 2018. The ecosystem covers the entire value chain from research to implementation (Figure 1). The ecosystem value chain was a classical stage gate model combined with specialized tools for assessment and innovation management. Some services supported the operation of the ecosystem itself (i.e., WP 1-3, 9 in Figure 1), while other services supported specific stages in the value chain (i.e., WP 4-8 in Figure 1). The model constituted the basis behind all prototypes, products, and services developed as part of the ecosystem.

![Figure 1. Simplified overview of the Patient@home ecosystem.](image)

Projects were initiated at different stages in the value chain, but in general all projects started no later than stage 4 to ensure that each product was thoroughly tested, evaluated, and adapted to the given use context.
Assessment and innovation management tools

The ecosystem deployed three tools for assessment at various stages in the value chain:

- MAST (Model for Assessment of Telemedicine)
- SIM (Smart Innovation Management)
- Reality check

Project categories

Patient@home operated in the intersection between research and innovation. Projects fell into three overall categories: development of new products and services (category 1); adaptation (sidestepping) of products and services (category 2); and fast-track projects (category 3).

All projects that wished to be included in Patient@home were screened based on three parameters:

1. Innovation scope. What is new in the proposed product/service?
2. Business potential. What is the commercial potential in the proposed product/service?
3. Potential effect. What is the potential effect for the citizen (patient), healthcare system, and society in the proposed product/service?

Projects needed to be assessed positively in all three categories in order to be included in Patient@home.

Best practice guidelines

More than 100 projects involving over 100 partners (66 companies) were initiated as part of Patient@home; an overview of activities is available (Patient@home, 2016 and 2018). An effort was made to gather experiences from finished and ongoing projects. This resulted in the adoption of a “best practice” method for new projects a few years into the lifespan of the ecosystem. New projects should:

- address a relevant health and care problem
- follow a research- (evidence-) based approach
- be interdisciplinary in nature
- have a dedicated “flow master” to ensure successful progress along the ecosystem value chain
- have a clear commercial focus and involve companies in the development of the solution
- involve relevant health and care professionals, patients/relatives in the design and testing of the solution
- deploy systematic methods to assess solutions
- deploy systematic methods to involve users
Our experience clearly demonstrated that projects that complied with the above guiding principles were more successful.

RESULTS
Two prominent results will be shared in this section. One relates to the success rate of the 106 started projects. The other relates to the ability to attract new funds. Together, they demonstrate the high level of activity in the ecosystem and the ability to move products and services all the way along the ecosystem value chain to implementation in order to make the most of the invested funds.

The success rate for projects in Patient@home was high compared to usual “innovation standards”. At the end of 2016 a study examined the first 22 finished products and services. Table 1 summarizes the results.

Table 1. Status of the first 22 products.

<table>
<thead>
<tr>
<th>Number</th>
<th>Percentage</th>
<th>Current product status</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>64%</td>
<td>In use in the health and care sector</td>
</tr>
<tr>
<td>2</td>
<td>9%</td>
<td>Sold to large international company (BioTelemetry Inc.)</td>
</tr>
<tr>
<td>2</td>
<td>9%</td>
<td>Led to new projects based on experiences gained</td>
</tr>
<tr>
<td>4</td>
<td>18%</td>
<td>Currently not in use</td>
</tr>
</tbody>
</table>

Hence, 73% of the earlier products (2012–2016) have had a positive outcome so far.

The status of the recently completed projects (2017–2018) is still under investigation (27 in total), but so far, we know that:

• 11 products are already in use (41%)

We expect that many more will end up being in use when the products fully enter the market. Hence, so far, 27 of 49 products have had a positive outcome and more are expected to follow from the recently finished products. In summary, the Patient@home ecosystem has had very positive results from its product development activities:

• High success rates for projects: 46% (49/106) ended up as finished products
• High success rates for finished products: 55% (27/49) of them are so far in use in the health and care sectors (or have been sold)

The ecosystem managed to attract more than 128 million DKK in external funding for research and development from private and public funding agencies in Denmark and Europe. The participating 66 private companies invested more than 114 million DKK (in kind) in product development as part of their involvement in Patient@home. The interest and engagement of companies was steady throughout the six years of operation.
EFFECTS
Patient@home has led to effects in at least three different ways:

- The health and care sectors have found ways to shorten the stays and have avoided readmissions for carefully selected groups of patients. This frees up resources for those patients that really need to be at the hospital.
- Certain categories of patients (and their relatives) have experienced ways to stay longer in their own home and avoid unnecessary admissions to hospital.
- The companies involved have experienced growth in sales and employees.

A report from the Region of Southern Denmark (one of five regions in Denmark) stated that 200 new full-time jobs were created in the region from 2012 to 2015 within health and welfare innovation (Region of Southern Denmark, 2017). The new jobs were created by companies that participated in initiatives funded by the region from 2010 to 2012; Patient@home was by far the largest initiative supported in that period. The participating companies have also experienced a growth in sales of 280 million DKK from 2012 to 2015.

The effects within the above three mentioned categories are likely to increase as time passes and more products are implemented and sold.

CONCLUSION
The primary contribution of Patient@home is the development of a unique ecosystem for the development, assessment, and testing of health and welfare technology. The ecosystem was developed, refined, and matured from 2012 to 2018. As many as 46% of all started activities resulted in finished products and services – and 55% of the finished products and services led to positive results and effects within three overall categories – bringing benefits to the Danish health and care system, to Danish patients and their relatives, and to Danish companies.

Despite its success, Patient@home is no longer in operation in its original form. However, the core ecosystem partners in the Region of Southern Denmark continue to collaborate and have used the experiences gained from the ecosystem as part of new national and international health and welfare technology innovation initiatives.

REFERENCES