Disruptive Innovation for Sustainable Healthcare

Enabling Technologies for Portable Ultrasound Devices

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Appleby, J. (2013), Spending on health and social care over the next 50 years. The King’s Fund. London
Cost of medical technology key factor in the growth of healthcare spending

Appleby, J. (2013), Spending on health and social care over the next 50 years. The King’s Fund. London
Technology moved healthcare away from patients ...
... into hospitals as temples of technology
Challenges

- Shift healthcare to the community
- Integrated healthcare

Position technology innovation at start of patient journey and medical process:
- Increase assessment & diagnostic capability in primary care
- Develop easy to use and affordable technology
Portable ultrasound as Trojan horse ...
Ultrasound imaging in low-resource settings

Requirements
• Portability
• Affordability

Lacks adoption and diffusion
• SKILLS
• PRACTICAL IMPLEMENTATION / SYSTEM CHANGE
Two prototype apps

1. Decision-support-system for clinicians with little experience of ultrasound to use portable device for specific conditions e.g. gall stones
2. Cost/benefit analysis of alternative pathways

Using integrated innovation framework and co-design and service design approach
Overview App 1

Scenario selection

Comparison of actual image and reference library

Documentation

Test

Solution with explanation

Overview - Guidance

Taking the image

Report

Figure 7: Overview of finalised App
Guidance

Gallstones

Definition

Gallstones are small stones, usually made of cholesterol, that form in the gallbladder.

Steps

1. Briefing
2. Find organ, perform ultrasound and capture images
3. Sample images
4. Result
5. Suggested next steps (Pathway app)

Briefing

This is the briefing video for gallstones which explains the procedure.

Important

- Switch off the lights before performing ultrasound
- Make sure you scan the whole organ rather than just a small slice
- Rotate the probe in order to scan the organ longitudinal and cross-section
- The patient has to fast for 4h prior to the exam
- Gallstones usually cause a shadow on the ultrasound. If there is no shadow it might be a polyp or cancer
Reference images

Select age and gender:

Gender  Male

Age  Adult (17+ years)

Relevant sample images are shown below.
Swipe through the images (tablet) or click on the arrows below (PC) to navigate.
Relevant cases are shown for both normal and pathologic gallbladder.
Click on the link to jump to the relevant picture directly.

Normal gallbladder

Relevant images:

1. No gallstones
2. No inflammation and normal gallbladder wall
3. Normal gallbladder contracted

No gallstones
Documentation:

Data:
25-06-2013 18:42:07

Patient name:
Florian Sibraccher

Ultrasound Image:
- EXAM: 379
- 13/Aug/2013
- 12:58:10
- Abdominal
- Mt: 0.8
- Tt: 0.1

Ultrasound image of Gallbladder exam

Comments:
None.

Observation:
- No gallstones
App 2 Cost / benefit analysis of alternative pathways
Cost / benefit simulation

Annual savings (1st year)
- Maximum: £9,111.00
- Average: £6,735.52
- Minimum: £4,433.33

Average waiting time
- 30 days: 28 days
- 20 days: 14 days

Maximum AS-IS costs
- £11,788.00 (17%)
- £7,550.00 (17%)

Average AS-IS costs
- £10,579.00 (17%)
- £5,193.60 (17%)

Minimum AS-IS costs
- £9,414.00 (16%)
- £4,783.00 (16%)

Maximum TO-BE costs
- £5,000.00
- £5,000.00

Average TO-BE costs
- £5,000.00
- £5,000.00

Minimum TO-BE costs
- £5,000.00
- £5,000.00

Number of patients requiring ultrasound scanning per day:
- Typical: 5
- Minimum: 0
- Maximum: 8

No. of GPs doing scans: 1
Setup cost per GP (£): 5000
Working days in a year: 240

Start simulation
Save results
Reset defaults
Patients’ experience

Patient’s pathway selection

Have you used the portable diagnostic device (PDD) to scan the patient?

YES

NO

Start over
## Monitoring

<table>
<thead>
<tr>
<th>Number of patients requiring scan:</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients scanned by GP:</td>
<td>11</td>
</tr>
<tr>
<td>Diagnosed by GP:</td>
<td>5</td>
</tr>
<tr>
<td>Treatment in primary care:</td>
<td>2</td>
</tr>
<tr>
<td>Treatment in secondary care:</td>
<td>2</td>
</tr>
<tr>
<td>No treatment needed:</td>
<td>1</td>
</tr>
<tr>
<td>Not diagnosed by GP:</td>
<td>6</td>
</tr>
<tr>
<td>Images/videos sent to specialist:</td>
<td>4</td>
</tr>
<tr>
<td>Diagnosed by specialist:</td>
<td>4</td>
</tr>
<tr>
<td>Treatment in primary care:</td>
<td>1</td>
</tr>
<tr>
<td>Treatment in secondary care:</td>
<td>2</td>
</tr>
<tr>
<td>No treatment needed:</td>
<td>1</td>
</tr>
<tr>
<td>Not diagnosed by specialist:</td>
<td>0</td>
</tr>
</tbody>
</table>

**Number of referrals:**

| Hospital:                        | 1  |
| Community:                       | 3  |
| Visiting Sonographer:            | 2  |
| Mobile Sonographer:              | 1  |

**PDD use:**

- 69% patients

**PDD success rate:**

- GP: 45%
- Overall: 82%

**Outcomes of PDD use:**

- Referral for another scan: 18%
- Treatment in primary care: 27%
- Treatment in secondary care: 36%
- No treatment needed: 18%

**Patient statistics**

- **Show data from:**
  - May 2011
  - June 2012
  - July 2013
  - August 2014
  - September 2015

- **To:**
  - June 2011
  - July 2012
  - August 2013
  - September 2014
  - October 2015

[Save results] [Clear all statistics]
Application
Initial validation

• "Fantastic! I want that!"
• "Great potential of revolutionising the way healthcare works"
  o "by cutting down the number of unnecessary referrals dramatically"
  o "very logical and user friendly"
• "Could be useful for GPs and nurses"

Source: Data supplied by sample of Bedfordshire GPs
Conclusions

• Portable ultrasound in primary care is a potential disruptive innovation that
  o enables integrated pathways
  o reduces healthcare cost
  o increases patients’ experience
• It requires enabling technologies to reduce training and provide cost/benefits for implementation
• Effective methods for disruptive innovation
Next steps

• Further validation
• Commercialisation
• Application to other conditions and diagnostic technologies
Acknowledgements

- European Commission - grant agreement 262044 VISIONAIR

- NHS

http://www.infra-visionair.eu/
Cost of medical technology key factor in the growth of healthcare spending

Figure 3  Two estimates of causal factors accounting for growth in real per capita US health care spending, 1940–90

Appleby, J. (2013), Spending on health and social care over the next 50 years. The King’s Fund