Development of a Multi Matrix Multi Partner Telehealth Model in Pregnancy Care in South of Tyne and Wear, UK

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The South of Tyne and Wear Tele health Project Partnership

**Partner Organizations**

Sunderland Teaching PCT
City Hospitals Sunderland NHS Foundation Trust
Sunderland City Council
Gateshead Foundation Trust
Gateshead Council
South Tyneside Foundation Trust
South Tyneside Council
SOTW Community Nursing Services
The Multi Partner Teams

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Mrs Lesley-Kell-Shervington
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Diabetes Specialist Nurse
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Specialist Diabetes Dietician
Mrs Gillian Campbell
Diabetes Specialist Midwife
The Multi Matrix Telehealth Model Seeks to Cross the Whole Life Perspective by Proportionally Matching Telehealth Systems with the Patients Needs, Lifestyles and the Clinicians Medicine.
Using the Quality Tool Quality Function Deployment (QFD) the Needs and Wants were Matched with Functions

| Customer Needs or CCRs or Whats | Importance to Customer | Time On What | Feedback & Communication | How 3 | How 4 | How 5 | How 6 | How 7 | How 8 | How 9 | How 10 | Score |
|---------------------------------|------------------------|--------------|--------------------------|-------|-------|-------|-------|-------|-------|-------|-------|--------|-------|
| Need Quick Response from Helpdesk | 5                      | 5            | 2                        | 3     | 5     | 1     | 1     | 3     | 2     | 1     | 2      | 39    |
| Want satisfactory result from Helpdesk | 3                      | 5            | 1                        | 2     | 4     | 2     | 4     | 1     | 4     | 1     | 1      | 47    |
| What 3                          | 2                      | 5            | 1                        | 2     | 4     | 1     | 4     | 1     | 1     | 1     | 1      | 21    |
| What 4                          | 1                      | 1            | 1                        | 1     | 5     | 1     | 5     | 1     | 1     | 1     | 1      | 18    |
| What 5                          | 1                      | 2            | 2                        | 4     | 1     | 3     | 2     | 2     | 1     | 1     | 1      | 32    |
| What 6                          | 3                      | 1            | 1                        | 1     | 2     | 4     | 2     | 4     | 1     | 4     | 1      | 34    |
| What 7                          | 1                      | 1            | 1                        | 1     | 2     | 4     | 2     | 4     | 1     | 4     | 1      | 25    |
| What 8                          | 3                      | 3            | 2                        | 1     | 1     | 1     | 1     | 1     | 1     | 1     | 1      | 16    |
| What 9                          | 1                      | 2            | 4                        | 1     | 3     | 1     | 2     | 5     | 1     | 1     | 1      | 17    |
| What 10                         | 2                      | 1            | 4                        | 1     | 3     | 1     | 4     | 1     | 1     | 1     | 1      | 1     |
| Score                           | 39                     | 47           | 21                       | 18    | 32    | 34    | 25    | 16    | 17    | 1     | 1      |       |
| Current Avg Value of CTQ        | 2.5                    | 3.1          | 2.8                      | 3.6   | 0     | 1     | 2     | 7     |       |       |       |       |

The customer needs or wants are listed on the left

Needs/wants are ranked numerically in order of importance to customer

How these needs/wants can be delivered are listed

Scores are totalled, Needs plus hows, and a ranked Set of needs and how to fulfil them emerges
A Mobile Phone Based System was preferred as virtually all use mobile phones as part of their daily lives.

The NHS Simple Telehealth System Florence was identified as providing the functions required. The system could be configured to respond to incoming patient data and act upon it in compliance with the clinical pathway. Cost were between £57 and £80 per patient per year.

Clinicians needed to monitor Blood Glucose, Blood Pressure and Proteinuria. The system had to be capable of asking the patient questions and acting on the received patient data. In terms of alerts or critical breaches the system in terms of the PIH pathway, had to pass patient alerts directly to the Hospital Paging System.

The QFD Tool gave a number of critical functions that were to be met in order to deliver a Telehealth Model for Outpatient Pregnancy Care.
During the South of Tyne & Wear NHS Telehealth Project We Developed the Following Multi Matrix Clinical Applications & Pathways of Telehealth. (this work now continues within NHS England Northern Senate)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Clinical Lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Failure, Angina etc.</td>
<td>FT, GP</td>
</tr>
<tr>
<td>COPD and Respiratory etc.</td>
<td>FT, GP</td>
</tr>
<tr>
<td>TB</td>
<td>FT</td>
</tr>
<tr>
<td>Hypertension</td>
<td>GP</td>
</tr>
<tr>
<td>Pregnancy Induced Hypertension</td>
<td>FT</td>
</tr>
<tr>
<td>Diabetes</td>
<td>FT, GP</td>
</tr>
<tr>
<td>Gestational Diabetes</td>
<td>FT</td>
</tr>
<tr>
<td>Parkinson’s</td>
<td>FT</td>
</tr>
<tr>
<td>Rapid Discharge</td>
<td>FT</td>
</tr>
<tr>
<td>Deprivation Medicine and Social Prescribing</td>
<td>GP and 3rd Sector</td>
</tr>
<tr>
<td>Acquired Head Injury and Stroke</td>
<td>FT, GP</td>
</tr>
<tr>
<td>Primary Care Step Up Step Down</td>
<td>GP</td>
</tr>
<tr>
<td>Care and Nursing Home</td>
<td>GP</td>
</tr>
<tr>
<td>Weight Management</td>
<td>FT, GP, LA &amp; PH</td>
</tr>
<tr>
<td>Smoking Cessation</td>
<td>LA &amp; PH</td>
</tr>
<tr>
<td>Remote Wound Dressing Monitoring</td>
<td>FT, GP</td>
</tr>
<tr>
<td>Community Matron Case Load</td>
<td>FT</td>
</tr>
<tr>
<td>Alcohol Induced Morbidity</td>
<td>FT</td>
</tr>
</tbody>
</table>

FT = Foundation Trust    GP = General Practitioner    LA & PH = Local Authority & Public Health
The application of Telehealth technology to support home monitoring in mild hypertension & gestational diabetes in pregnancy – an innovative, multidisciplinary pilot project

**Project 1**
Home monitoring for mild ‘pregnancy induced’ hypertension

**Project 2**
Home monitoring for gestational diabetes
Telehealth technology to support home monitoring in mild pregnancy-induced hypertension (PIH)

- ‘Mild PIH’ affects about 10% of pregnant women
- 2-3% of pregnant women develop ‘pre-eclampsia’
- However, ‘severe pre-eclampsia’ only affects 0.5% (1/200)
- ‘Mild PIH’ contributes a significant workload to NHS:
  - referred for outpatient ANTENATAL DAY UNIT assessment
  - subsequently, multiple home visits by COMMUNITY MIDWIFE
  - further visits to CONSULTANT HOSPITAL ANTENATAL CLINIC

Although many stay stable or resolve...
...we need to watch for development of severe pre-eclampsia
Telehealth technology to support home monitoring in mild pregnancy-induced hypertension (PIH)

- Clinical team developed safe inclusion/exclusion criteria
- SoTW Telehealth team developed the ‘Florence’ text system for the project:
  - texting information ‘to & from’ patient
  - appropriate ‘patient alerts’
  - procured necessary equipment (Supported by BHR Pharmaceuticals)
  - facilitated provision of patient information sheets (PIS)
Telehealth technology to support home monitoring in mild pregnancy-induced hypertension (PIH)

Microlife ‘WatchBPhome’
digital BP Monitor
- Cheap (~ 60 GBP)
- Portable
- Easy to use

Meditest ‘Proteinz2’
urine dipstix
(supplied by BHR Pharmaceuticals Ltd)
www.bhr.co.uk
Telehealth technology to support home monitoring in mild pregnancy-induced hypertension (PIH)

- **Inclusion criteria:**
  - 28 to 38 weeks pregnant
  - no symptoms (eg headache, flashing lights etc)
  - normal blood results
  - Proteinuria

- **Exclusion criteria:**
  - symptomatic or BP raised (see table):

<table>
<thead>
<tr>
<th>Level of Proteinuria</th>
<th>Systolic</th>
<th>Diastolic</th>
<th>Upper limit for inclusion to Telehealth</th>
</tr>
</thead>
<tbody>
<tr>
<td>No proteinuria</td>
<td>140-150</td>
<td>90-100</td>
<td>149/99 with no protein</td>
</tr>
<tr>
<td>+ proteinuria</td>
<td>&lt;146</td>
<td>&lt;96</td>
<td>145/95 with + protein</td>
</tr>
<tr>
<td>++/+++ proteinuria</td>
<td>&lt;140</td>
<td>&lt;90</td>
<td>139/89 with ++/+++ protein</td>
</tr>
</tbody>
</table>

All women who develop any symptoms will be informed by Florence text to: contact ANDU or Delivery suite the same day for 1:1 discussion and management irrespective of BP and urine measurement.
Telehealth technology to support home monitoring in mild pregnancy-induced hypertension (PIH)

- Suitable women registered on ‘Florence’ SMS text system
- BP/urine monitoring on days 2/4/6 (patient reminded by SMS)

### Uneventful monitoring
- Review in ANTENATAL DAY UNIT on day 7 (equipment return)
- Further management decided at review

### Develops symptoms / ↑BP or proteinuria (above defined levels)
- Appropriate SMS alert to patient & unit notified
- Review on unit (same or next day)
Telehealth technology to support home monitoring in mild pregnancy-induced hypertension (PIH)
Patient demographics (n=22)

- Was this the patient’s First Baby:
  - No
  - Yes

- Point of Telehealth Commencement:
  - 0-10 weeks
  - 11-20 weeks
  - 21-30 weeks
  - 31-40+ weeks

- Outcomes:
  - Clinical decision to include patients with mild ↑ BP at ‘booking’
  - 22 patients included in analysis – first 4 months
  - No adverse outcomes
  - One patient admitted via SMS alert due to trigger (↑ BP) – induced next day safely & delivered
**Patient Control & Satisfaction (n=22)**

### Level of Control Before Telehealth
- **36%** Not at all in control
- **23%** A little bit in control
- **23%** In control - enough for me
- **18%** Completely in control

### Level of Control After Telehealth
- **63%** Not at all in control
- **14%** A little bit in control
- **23%** In control - enough for me
- **0%** Completely in control

### Patients' Opinion of the Florence System
- **68%** Poor
- **32%** Reasonable
Definition:
First presentation of high blood glucose levels in pregnancy

When?
Usually detected between 24 – 28 weeks but can be earlier

How?
Fasting glucose level > 5.6mmol/l or Oral Glucose Tolerance Test Fasting > 5.6mmol/l or 2hr > 7.8mmol/l

Risk factor screening – previous GDM – test earlier
### National Prevalence

<table>
<thead>
<tr>
<th>Condition</th>
<th>National Prevalence</th>
<th>Number of Pregnancies in England</th>
<th>Number of Pregnancies in City Hospitals Sunderland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total singleton pregnancies</td>
<td></td>
<td>600,200</td>
<td>4000</td>
</tr>
<tr>
<td>Type 1 Diabetes</td>
<td>0.3%</td>
<td>1,800</td>
<td>20</td>
</tr>
<tr>
<td>Type 2 Diabetes</td>
<td>0.2%</td>
<td>1,200</td>
<td>20</td>
</tr>
<tr>
<td>Gestational Diabetes</td>
<td>3.5%</td>
<td>20,400</td>
<td>160</td>
</tr>
<tr>
<td>Total diabetes in Pregnancy</td>
<td></td>
<td>23,400</td>
<td>200</td>
</tr>
</tbody>
</table>
Aims of Simple Tele Health

Aims:

- Test the feasibility of Simple Tele Health in women with Gestational Diabetes
- Assess patients’ treatment satisfaction with this novel method of monitoring (DTSQ*)
- Evaluate the economic benefit of enrolling onto this system in conjunction with routine antenatal diabetes care

Methods:

- A prospective pilot into the effectiveness of incorporating “Simple Telehealth”.
- Consecutive patients with gestational diabetes were offered enrolment along with usual antenatal diabetes care.
- Outcomes were evaluated and the potential economic benefit from a reduction in frequency of out patient attendance whilst maintaining a high degree of safety.
Gestation Diabetes Pathway

Management of Gestational Diabetes:

1: Blood Glucose Testing  
   - Pre and Post Meals

2: Life style Changes  
   - Healthy Eating Plan  
   - Weight Management

3: Oral Medication  
   - Metformin

4: Subcutaneous Insulin  
   - Regimes vary in degrees of complexity once a day to 4 times

- Dating Scan
- 16 week Scan
- 20 week Anomaly Scan
- 24 - 28 week OGTT
- 26 week Scan
- 30 week Growth Scan
- 34 – 38 weeks Weekly Growth Scans +/- Bio Physical Profile

Intervention Points with Simple Tele Health
The Process

- Information Leaflet – at 1st visit
- Enrolment – in clinic
- Consent attained & Communication to GP
- Supportive Test Messaging Service & Alerts
- Blood Glucose Testing Pre and post meals
- Targets and alert thresholds pre-determined
  - Pre Meal < 6mmol & 2 Hr Post Meal < 8mmol/l
- Fortnightly weight recorded via SMS
- DTSQ at 4 weeks and post natal.
Results

* Average recruitment: 5 patients per month.
* Mean duration of ‘Simple Telehealth’ use was 12 weeks (range 6 – 18).
* Patient Treatment:
  
  40% Diet only, 40% Diet + Metformin, 20% Diet + Metformin + Insulin.
* DTSQ results showed high figures for satisfaction, convenience, flexibility with treatment and enhanced understanding of diabetes with all patients.

<table>
<thead>
<tr>
<th>Very satisfied</th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>Very dissatisfied</th>
<th>Average Satisfaction Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: How satisfied are you with your current treatment?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very dissatisfied</td>
<td>6</td>
</tr>
<tr>
<td>2: How often have you felt that your blood sugars have been unacceptably high recently?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very dissatisfied</td>
<td>1.3</td>
</tr>
<tr>
<td>3: How often have you felt that your blood sugars have been unacceptably low recently?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very dissatisfied</td>
<td>0.7</td>
</tr>
<tr>
<td>4: How convenient have you been finding your treatment to be recently?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very dissatisfied</td>
<td>5.9</td>
</tr>
<tr>
<td>5: How flexible have you been finding your treatment to be recently?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very dissatisfied</td>
<td>5.8</td>
</tr>
<tr>
<td>6: How satisfied are you with your understanding of your diabetes?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very dissatisfied</td>
<td>5.2</td>
</tr>
<tr>
<td>7: Would you recommend this form of treatment to someone else with your kind of diabetes?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very dissatisfied</td>
<td>6</td>
</tr>
<tr>
<td>8: How satisfied would you be to continue with your present form treatment?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Very dissatisfied</td>
<td>6</td>
</tr>
</tbody>
</table>
Results

* There were no adverse outcomes reported during the pilot to mother or baby.

* Cost saving attained:
  
  Total cost of ‘Simple Telehealth’ £80/patient/yr.
  
  Average number of hospital visits prevented per patient 3.2 during a single pregnancy.
  
  Assuming a single attendance costs £80/visit giving total saving of £1,024/pt/yr.
Conclusion

* Patient-delivered home monitoring for mild PIH & Gestational Diabetes using tele health technology is deliverable.

* Pregnant women find the technology easy to use and the concept highly acceptable.

* Initial data suggest the approach is safe & there may be cost-benefits to the NHS.

* Assessment of safety, economic benefit & patient acceptability is required within a randomised controlled trial against standard management.