Remote monitoring in high risk pregnancies

Dorien Lanssens
Content

- Gestational hypertensive disorders (GHD)
- Remote monitoring (RM)
- What does already exist?
- Scoping review
- RM in pregnancies complicated with GHD
- Cost-analysis of a RM program
- Satisfaction of the users
- Future and further investigations
- Conclusions
Gestational hypertensive disorders (GHD)

An introduction
Gestational hypertensive disorders

5 – 8% of the pregnant women develops gestational hypertensive disorders (GHD)
  • Ziekenhuis Oost-Limburg (Genk): 1,918 → 140 (8.21%) with GHD
  • Flanders + UZ Brussels: 65,729 → 3,006 (4.6%) with GHD

SPE 2015:
Since the beginning of the registration, 94 maternal deaths were registered (± 1/20,500 deliveries). Most deaths were immediately associated with the delivery and were in particular: amniotic fluid embolism (n = 14), pulmonary embolism (n = 12), pre-eclampsia/HELLP (n = 10), bleeding (n = 6), sepsis (n = 8), uterus rupture (n = 6), anesthetic issues (n = 7).
Pre-eclampsia (PE)

**Definition:** PE is defined as a systolic blood pressure (BP) > 140 mmHg and diastolic BP > 90 mmHg, or a diastolic BP > 100 mmHg, which occurs after 20 weeks of pregnancy and is associated with > 300 mg proteinuria in a 24h urine collection.

**Cause:** ?

**Risk factors:** history of PE, essential hypertension, gestational hypertension, diabetes, obesity, family history, ...

**Consequences:**

<table>
<thead>
<tr>
<th></th>
<th>Fetus</th>
<th>Maternaal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Prematurity</td>
<td>- Pulmonary edema</td>
</tr>
<tr>
<td></td>
<td>- IUGR</td>
<td>- Myocardial infarction</td>
</tr>
<tr>
<td></td>
<td>- Abruptia placenta</td>
<td>- Renal failure</td>
</tr>
<tr>
<td></td>
<td>- Perinatal death</td>
<td>- Premature cardiovascular and cerebral disorders</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Eclampsia</td>
</tr>
</tbody>
</table>
Pre-eclampsia - management

Aim:
1. Safety of both the pregnant woman and the fetus
2. Delivery of a mature neonate (> 37w)

Intrapartum management:
1. Fetal observation: intra-uterine growth and cardiotocografie (CTG)
2. Maternal observation
   1. Anti-hypertensive therapy
   2. Bed rest

- > 37 w of pregnancy
  OR
  Placenta abruptio

- > 34 w of pregnancy + 1 of the following conditions:
  - SROM of unstoppable labour
  - IUGR
  - Maternal complications
  - Abnormal CTG

Birth
Problem statement

3 prenatal ultrasounds:
- 12 weeks
- 20 weeks
- 30 weeks

6 prenatal visits
- 10 weeks
- 16 weeks
- 25 weeks
- 32 weeks
- 36 weeks
- 38 weeks
There is a shortage of **intensive follow-up** for women at risk for the development of GHD, which could reduce morbidity and mortality for both mother and child as a result of this complication.
LimPrOn

Limburgs Pre-eclampsie Onderzoek

= consultation to screen and/or follow-up pregnancies at risk for GHD

→ Based on results of years of investigation

• <2009 Prof. Dr. Wilfried Gyselaers: investigation of the role of veins during pregnancy

• 2009-2013 Dr. Kathleen Tomsin: investigation to a safe methodology to perform a maternal cardiovascular profile

• 2012-2016 Dr. Anneleen Staelens: investigation to hypertensive characters in the maternal cardiovascular profile

• 2013-2017 Sharona Vonck: investigation to a cardiovascular screening tool in early pregnancy

• 2014-2018 Dorien Lanssens: investigation to the use of remote monitoring in high risk pregnancies
Who

Population 1: early pregnancy
At least 1 alarm signal before the beginning, or at the start, of the pregnancy:
- History of PE or related disorders
- Familial history of PE or related disorders
- History of essential hypertension, diabetes, kidney diseases, organ transplantation, ...
- Multiple pregnancies
- Obesity (BMI > 30kg/m²)
- Auto-immune disease
- Age of pregnant woman > 40 years or < 18 years

Population 2: already pregnant
At least 1 alarm signal during pregnancy
- High BP > 140 mmHg
- Proteinuria
- Edema
- Severe throbbing headache
- Visual problems
- Weight gain > 1 kg/week
Identification of the high risk group

1) Impedance cardiografie

- Earclip (pulse)
- 2x2 electrodes
- BP
Identification of the high risk group

1) Impedence cardiografie
2) Maternal ultrasound of the veins
Identification of the high risk group

1) Impedence cardiografie
2) Maternal ultrasound of the veins
3) Bio impedance: moisture
Cardiovascular profile

- Essential hypertension
- Gestational hypertension
- PE
- Maternal PE
- Vascular PE
Advices

Report to the responsible gynaecologist

Advices:

- Start anti-hypertensive treatment
- Adjust anti-hypertensive treatment
- Excercise
- Start of RM (with weekly update of the results)
Remote monitoring
Remote monitoring

There is a shortage of **intensive follow-up** for women at risk for the development of GHD, which could reduce morbidity and mortality for both mother and child as a result of this complication.

Remote monitoring

“The use of telecommunications technologies to assist in the transmission of medical information and services between healthcare providers and patients” (Imelda et al., 2013)
There are two possible approaches:

1. **Device orientated**:
   - A tool to register physiological data via portable devices by using Bluetooth and to send those from a distance by using Wi-Fi to a server where they can be stored, controlled, and analysed.

2. **Disease orientated**:
   - 1. Curative
   - 2. Preventive
What does already exist?
Cardiology

Chronical heart failure:
- ↓ hospitalisations
- ↑ life quality

Coagulation disorders:
- ↓ bleedings and thrombo-embolic complications

Hypertension:
- ↓ uncontrollable hypertension
- Positive effect on the BP control
Pneumology, diabetes and nephrology

**Pneumology: COPD**
- ↓ sudden increase in disease symptoms
- ↓ hospitalisations

**Diabetes:**
- ↑ self-management
- Positive effect on glucose-concentrations

**Nephrology:**
- ↑ compliance
Fertility & obstetrics

Self-operated endovaginal telemonitoring (SOET):
- ↓ transport costs
- ↓ work load
- ↑ communication with the couple

Obstetrics:
???
Scoping review

Effectiveness of Telemonitoring in Obstetrics: Scoping review
**Background**

**Background:** Despite reported positive results of RM effectiveness in various health care domains, this new technology is rarely used in prenatal care.

**Objective:** an enumeration of all clinical investigations which performed an evaluation of RM in obstetrics

**Aims:**
1. Assess whether RM adds any substantial benefit to this patient population and
2. Identify research gaps in this area to suggest goals for future research.
**Search strategy**

1. **Identification**
   - 1437 records identified through electronic database searching
   - 378 duplicates removed

2. **Screening**
   - 1059 records after removal of duplications
   - 969 records excluded because of absence of the inclusion criteria

3. **Eligibility**
   - 1059 records screened through title or abstract
   - 82 full-text papers excluded
     - No clinical relevance (n=32)
     - Does not meet the definition of telemonitoring (n=21)
     - Not written in English (n=8)
     - Expert opinion (n=15)
     - (Systematic) Review (n=6)
   - 90 full-text papers assessed for eligibility

4. **Included**
   - 14 papers included

Relevant papers found within the bibliography of the selected articles and automatic updates (n=6)
Results – characteristics

- 14 studies included; from 1995 - now
- Outcomes
  - Maternal outcomes: 13/14
  - Fetal/neonatal outcomes: 9/14
- Sample size: 15 – 1292 pregnant women
- Risk of bias assessment (n = 9):
  - Low risk: n = 3
  - Medium risk: n = 1
  - High risk: n = 5
Results – maternal outcomes

1. Cervical dilatation/premature delivery

<table>
<thead>
<tr>
<th>Citation</th>
<th>Prolonged pregnancy survival</th>
<th>TM vs. CC</th>
<th>Experience of a preterm delivery</th>
<th>TM vs. CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown et al. (1999)</td>
<td>+</td>
<td>0.02</td>
<td>-</td>
<td>0.73</td>
</tr>
<tr>
<td>Corwin et al. (1996)</td>
<td></td>
<td>0.04</td>
<td>-</td>
<td>NS*</td>
</tr>
<tr>
<td>CHUMS Group (1995)</td>
<td>+</td>
<td>0.016</td>
<td>-</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Wapner et al. (1995)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morrison et al. (2001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

+ = more experiences in TM group vs CC group; - = less experiences in TM group vs CC group

TM group = telemonitoring group; CC = control group; NS = not significant; * = no exact value is given

2. Gestational diabetes mellitus

<table>
<thead>
<tr>
<th>Citation</th>
<th>FBS</th>
<th>TM vs. CC</th>
<th>HbA1c &lt; 5.8%</th>
<th>TM vs. CC</th>
<th>Insulin therapy</th>
<th>TM vs. CC</th>
<th>Out-patient clinic visits</th>
<th>TM vs. CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homko et al. (2007)</td>
<td>0</td>
<td>NS*</td>
<td>0.26</td>
<td>0</td>
<td>+</td>
<td>&lt; 0.05</td>
<td>-</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Homko et al. (2012)</td>
<td>0</td>
<td>NS*</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>&lt; *</td>
<td>-</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pérez-Ferre et al. (2009)</td>
<td>0</td>
<td>NS*</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>&lt; *</td>
<td>-</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pérez-Ferre et al. (2010)</td>
<td>0</td>
<td>NS*</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>&lt; *</td>
<td>-</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

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TM group = telemonitoring group; CC = control group; FBS = fasting blood sugar; NS = not significant; * = no exact value is given
Results – maternal outcomes

3. Maternal satisfaction:

<table>
<thead>
<tr>
<th>Citation</th>
<th>Result for women in TM group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homko et al. (2007)</td>
<td>More feelings of self-efficacy in women with GDM</td>
</tr>
<tr>
<td>O’Brien et al. (2013)</td>
<td>Better birth experiences resulting by induction of labour at home</td>
</tr>
<tr>
<td>Pérez-Ferre et al. (2010)</td>
<td>Higher patient satisfaction in women with GDM</td>
</tr>
<tr>
<td>Rauf et al. (2011)</td>
<td>Labour induction at home is feasible and acceptable to women</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Citation</th>
<th>Result for women in TM group vs. women in CC group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost saving</td>
<td>Average cost saving per pregnancy</td>
</tr>
<tr>
<td>Buysse et al. (2008)</td>
<td>€145,822 for 415 pregnant women</td>
</tr>
<tr>
<td>Morrison et al. (2001)</td>
<td>$867,540 for 60 pregnant women</td>
</tr>
</tbody>
</table>

TM group = telemonitoring group; GDM = gestational diabetes mellitus

4. Economical evaluation

<table>
<thead>
<tr>
<th>Citation</th>
<th>Result for women in TM group vs. women in CC group</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

TM group = telemonitoring group; CC = control group; € = euro; $ = United State dollars
## Results – fetal/neonatal results

### 1. Birthweight

<table>
<thead>
<tr>
<th>Citation</th>
<th>SGA (&lt; 10&lt;sup&gt;th&lt;/sup&gt; percentile)</th>
<th>TM vs. CC</th>
<th>Mean birth weight</th>
<th>TM vs. CC</th>
<th>LGA (&gt; 90&lt;sup&gt;th&lt;/sup&gt; percentile)</th>
<th>TM vs. CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHUMS Group (1995)</td>
<td>-</td>
<td>NS*</td>
<td>+</td>
<td>NS*</td>
<td>+</td>
<td>NS*</td>
</tr>
<tr>
<td>Corwin et al. (1996)</td>
<td>-</td>
<td>0.003</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homko et al. (2007)</td>
<td>-</td>
<td></td>
<td>0</td>
<td>0.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homko et al. (2012)</td>
<td>-</td>
<td>0.001</td>
<td>+</td>
<td>&lt;0.001</td>
<td>+</td>
<td>0.70</td>
</tr>
<tr>
<td>Morrison et al. (2001)</td>
<td>-</td>
<td></td>
<td>0</td>
<td>NS*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pérez-Ferre et al. (2009)</td>
<td>-</td>
<td></td>
<td>0</td>
<td>0.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pérez-Ferre et al. (2010)</td>
<td>-</td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

+ = more experiences or higher mean in TM group vs CC group; - = less experiences or lower mean in TM group vs CC group; 0 = no differences

TM group = telemonitoring group; CC = control group; NS = not significant; * = no exact value is given

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**Table 7**: Birth weight and TM
Results – fetal/neonatal results

2. Gestational age

<table>
<thead>
<tr>
<th>Citation</th>
<th>&lt; 37 wks</th>
<th>TM vs. CC</th>
<th>&lt; 36 wks</th>
<th>TM vs. CC</th>
<th>&lt; 35 wks</th>
<th>TM vs. CC</th>
<th>&lt; 34 wks</th>
<th>TM vs. CC</th>
<th>&lt; 32 wks</th>
<th>TM vs. CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHUMS Group (1995)</td>
<td></td>
<td></td>
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<tr>
<td>Homko et al. (2007)</td>
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<tr>
<td>Morrison et al. (2001)</td>
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<tr>
<td>Kuleva et al. (2012)</td>
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TM group = telemonitoring group; CC = control group; wks = weeks; NS = not significant; * = no exact value is given

3. NICU admission

<table>
<thead>
<tr>
<th>Citation</th>
<th>Admission NICU</th>
<th>TM vs. CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHUMS Group (1995)</td>
<td>-</td>
<td>NS*</td>
</tr>
<tr>
<td>Corwin et al. (1996)</td>
<td>-</td>
<td>0.01</td>
</tr>
<tr>
<td>Homko et al. (2007)</td>
<td>+</td>
<td>NS*</td>
</tr>
<tr>
<td>Morrison et al. (2001)</td>
<td>-</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

+ = more experiences in TM group vs CC group; - = less experiences in TM group vs CC group

NICU = Neonatal Intensive Care Unit; TM group = telemonitoring group; CC = control group; NS = not significant; * = no exact value is given
But...

Risk of bias (n = 9):
- Low risk: n = 3
- Medium risk: n = 1
- High risk: n = 5

Added value of RM became less pronounced!

Only effective for transmission of uterine activity:
- ↑ pregnancy survivals
- ↓ low birth weight
- ↓ admissions to NICU
Conclusions

Aims:
1. Assess whether RM adds any substantial benefit to this patient population

RM can only be recommended by pregnant women at risk for preterm delivery

2. Identify research gaps in this area to suggest goals for future research.

- More RCT’s with a blinded protocol
- Studies investigating patient satisfaction in relation to RM
- Studies investigating economic effects in relation to RM
RM in pregnancies complicated with GHD

Remote monitoring of hypertension diseases in pregnancy

Impact of a remote monitoring program on the prenatal follow-up of women with gestational hypertensive disorders
RM in our pilot project

Measurement of blood-pressure, activity and weight

Re-evaluation of the data

Change in parameters?

Performing interventions

Intervention

Data transfer via Wi-Fi and Bluetooth to an online platform

Pregnant woman

Midwife

Gynaecologist

Data interpretation and counseling

Performing interventions

Re-evaluation of the data
Study design

**Aim:** evaluation of the role of remote monitoring (RM) in the obstetrical care for pregnant women at risk for GHD

**Design:** retrospective pilot project

**Endpoints:** prenatal follow-up and maternal & neonatal outcomes

**Period:** 1st of January 2015 – 31st of December 2015
Methoden

Figure 1: population diagnosed with GHD flow chart (n, number of cases; ZOL, Ziekenhuis Oost-Limburg; GHD, gestational hypertensive disorder; RMG, remote monitoring group; RG, reference group)
## Results - demographics

### Table 1: maternal demographics and characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>RM Group (n = 48)</th>
<th>CC Group (n = 98)</th>
<th>Statistical significance (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal age (year)</td>
<td>31.69 (± 4.25)</td>
<td>31.94 (± 4.77)</td>
<td><em>P</em> = 0.73</td>
</tr>
<tr>
<td>Pre pregnancy weight (kg)</td>
<td>72.00 (± 17.99)</td>
<td>76.80 (± 19.74)</td>
<td><em>P</em> = 0.11</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>166.00 (± 6.94)</td>
<td>167.08 (± 6.86)</td>
<td><em>P</em> = 0.38</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.54 (± 5.58)</td>
<td>27.08 (± 6.92)</td>
<td><em>P</em> = 0.32</td>
</tr>
<tr>
<td>Primigravidity (%)</td>
<td>41.66% (n = 20)</td>
<td>66.32% (n = 65)</td>
<td><em>P</em> = 0.005</td>
</tr>
<tr>
<td>Concomitant diseases (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Cardiovascular disorders (%)</td>
<td>0% (n = 0)</td>
<td>1.02% (n = 1)</td>
<td><em>P</em> = 0.48</td>
</tr>
<tr>
<td>- Blood coagulation disorder (%)</td>
<td>2.08% (n = 1)</td>
<td>1.02% (n = 1)</td>
<td><em>P</em> = 0.61</td>
</tr>
<tr>
<td>- Endocrine disorders (%)</td>
<td>4.16% (n = 2)</td>
<td>5.10% (n = 5)</td>
<td><em>P</em> = 0.81</td>
</tr>
<tr>
<td>- Immunological disorders (%)</td>
<td>2.08% (n = 1)</td>
<td>2.04% (n = 2)</td>
<td><em>P</em> = 0.99</td>
</tr>
<tr>
<td>Smoking (%)</td>
<td>0% (n = 0)</td>
<td>10.20% (n = 10)</td>
<td><em>P</em> = 0.02</td>
</tr>
<tr>
<td>GA first visit (week)</td>
<td>10.10 (± 5.36)</td>
<td>11.21 (± 7.60)</td>
<td><em>P</em> = 0.66</td>
</tr>
</tbody>
</table>

RM = remote monitoring, CC = conventional care, GA = gestational age; Data are mean (± SD) or percentage (number).
### Results – prenatal follow-up

<table>
<thead>
<tr>
<th>Table 2: Prenatal follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Total number prenatal visits</td>
</tr>
<tr>
<td>(no.)</td>
</tr>
<tr>
<td>CTG’s (no.)</td>
</tr>
<tr>
<td>Echo’s (no.)</td>
</tr>
<tr>
<td>Prenatal admission (%)</td>
</tr>
<tr>
<td>Days hospitalized (no.)</td>
</tr>
<tr>
<td>Prenatal admission until</td>
</tr>
<tr>
<td>delivery (%)</td>
</tr>
<tr>
<td>Gestational outcome (%)</td>
</tr>
<tr>
<td>- Essential hypertension</td>
</tr>
<tr>
<td>- Gestational hypertension</td>
</tr>
<tr>
<td>- Pre-eclampsia</td>
</tr>
<tr>
<td>- HELLP</td>
</tr>
</tbody>
</table>

CI = Confidence interval, RM = remote monitoring, CC = conventional care, HELLP = Hemolysis Elevated Liver enzymes and Low Platelets. Univariate analysis: Data are mean (± SD) or percentage (number).
## Results – maternal outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Univariate analysis</th>
<th>Multivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RM group (n = 48)</td>
<td>CC group (n = 98)</td>
</tr>
<tr>
<td>GA delivery (week)</td>
<td>37.49 (± 2.52)</td>
<td>37.20 (± 3.20)</td>
</tr>
<tr>
<td>Start birth process (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Spontaneous</td>
<td>60.42% (n = 29)</td>
<td>31.63% (n = 31)</td>
</tr>
<tr>
<td>- Induction</td>
<td>25.00% (n = 12)</td>
<td>48.98% (n = 48)</td>
</tr>
<tr>
<td>- Primary cesarean section</td>
<td>14.54% (n = 7)</td>
<td>19.39% (n = 19)</td>
</tr>
<tr>
<td>Mode of delivery (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Vaginal</td>
<td>66.67% (n = 32)</td>
<td>59.18% (n = 58)</td>
</tr>
<tr>
<td>- Instrumental</td>
<td>8.33% (n = 4)</td>
<td>8.16% (n = 8)</td>
</tr>
<tr>
<td>- Primary cesarean section</td>
<td>14.54% (n = 7)</td>
<td>19.39% (n = 19)</td>
</tr>
<tr>
<td>- Secondary cesarean section</td>
<td>10.42% (n = 5)</td>
<td>13.27% (n = 13)</td>
</tr>
</tbody>
</table>
# Results – neonatal outcomes

<table>
<thead>
<tr>
<th></th>
<th>Mean (± SD)</th>
<th>p-value</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birthweight (g)</td>
<td>3058.54 (± 692.60)</td>
<td>0.36</td>
<td>-162.71 – 535.33</td>
<td>0.29</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>49.53 (± 2.85)</td>
<td>0.07</td>
<td>0.02 – 3.45</td>
<td><strong>0.05</strong></td>
</tr>
<tr>
<td>Apgar 1’</td>
<td>8.11 (± 1.20)</td>
<td>0.86</td>
<td>-0.38 – 0.88</td>
<td>0.43</td>
</tr>
<tr>
<td>Apgar 5’</td>
<td>9.13 (± 0.80)</td>
<td>1.00</td>
<td>-0.37 – 0.65</td>
<td>0.59</td>
</tr>
<tr>
<td>Admission NIC (%)</td>
<td>10.42% (n = 5)</td>
<td><strong>0.02</strong></td>
<td>0.10 – 1.14</td>
<td>0.08</td>
</tr>
</tbody>
</table>

CI = Confidence interval, RM = remote monitoring, CC = conventional care, GA = gestational age, NIC = Neonatal Intensive Care.

Univariate analysis: Data are mean (± SD) or percentage (number).
Conclusions

RM = promising tool
- ↑ gestational hypertension and less PE
  - Multivariate analysis
- ↓ prenatal hospitalisations (until moment of the delivery)
  - Univariate analysis
- ↑ spontaneous births & ↓ inductions
  - Multivariate analysis
- ↓ NICU admissions
  - Univariate analysis
Cause of the difference

Productivity

Mastery

Learning

Productivity Dip

Productivity with old technology

Time

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Future and further investigations
Future investigations

Other applications in obstetrics?
- Preterm contractions
- Diabetes
- Fetal movements
- Obesity
Opportunity for further improvement of perinatal outcome
Cost allocation
How we work
Conclusions
... the future of midwives

"A boat doesn't go forward if each one is rowing their own way."

Source: Unknown
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