Mama's Digital Diary: Guided Note-taking for Mothers in Antepartum Care

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Midterm Presentation

Motivation

- **Mothers in antepartum** care usually go through **regular medical sessions** that happens weekly or monthly (i.e., outpatient care).

- However, the patients experience **various symptoms, emotions, and life-impacting events** such as quitting a job.

- Although the experience of an individual patient contains rich information of the patient, they **cannot be reviewed in the regular session** due to lack of medical resources (e.g., time and place)

※ This findings are from the domain Interview with 2 doctors and 1 nurse

Diaries

- **Handwritten diaries** are the most common and widely used medium between patients and doctors

- About **1 out of 5 patients** brings **a long list of questions** in their diary app

- However, the diaries are written in ambiguous language and contain too many information to grasp in a short moment.
    - Ex) I felt pain as if my uterus was **falling out**.

※ This findings are from the direct observation of 4 outpatient care sessions (54 cases)

Proposed Idea: Guided Note-taking

1. **A patient writes a free-form diary** just as they would do with conventional diary application

2. **The app automatically recognizes** the content, **marks** important contents, and **categorizes** it into several aspects

3. **The patient either use** the automatic suggestion **or revise** it, and later utilize it as index to **efficiently navigate the diary data**.

Gathering Target Data

- We developed a simple rule-based **chatbot interface** based on the **domain medical knowledge**
- The chatbot was deployed to real patients, introduced as a **"symptom inquiry"** feature in other experiment with 100 mothers in antepartum care

Failure in the First Attempt

- Although the chatbot was deployed, **nobody used it**.
  - 11 out of 100 patients at least clicked it, and nobody made an inquiry

- Why?
  - It was introduced as an "additional feature" in the experiment that are designed with other purposes
  - The original goal of the experiment was to test the effectiveness of VR feature that visualizes fetus
  - It is highly likely that the patients did not even care about their symptoms, as they expected to use VR features to see their child(ren)

The Second Attempt: Online Community

- There are several **online communities** where patients in antepartum care share their knowledge and experiences.

- Some patients are very **active members** and use the community as their own diary

- We analyzed **the community articles as a *proxy* dataset for mothers' diaries**

Community Dataset

We crawled one major online community and gathered the following dataset

- 22 members
- 1200+ articles
- 10000+ sentences

P8	52	4	I thought it was a secretion like water.
P8	52	5	I'm putting in some vaginal ointment and the mass secretion is coming out.
P8	52	6	I'm living with a liner.
P8	52	7	I felt something coming out, so I went to the bathroom
P8	52	8	and found something wet in the middle of the liner.
P8	52	9	But I don't know if it smells or not.
P8	52	10	I heard some people leak a small amount of amniotic fluid
P8	52	11	Even if there's a small amount, does the amniotic fluid feel different
P8	52	12	and clearly smell like chlorine bleach?

Quantitative Analysis?

- Frequent words using the TF-IDF based method

  Baby, Stomach, Hospital, Pregnant, Delivery, Test, Fetal movement, Feeling, Worry, Morning sickness, Husband, Preparation, Pain, Contraction, Injection, Ultrasound, Medicine, Laundry, Menstruation, IVF/ET, Operation

- Topic Modeling with Latent Semantic Indexing (LSI) method

  Stomach + Feeling + Lower + Pain + Contraction
  Stomach - Baby
  Test Tube + Freeze + Pregnant
  Blood Test + Test Tube + Pregnant

→ Good to understand overall content of the dataset, but too coarse-grained to develop a working product

Qualitative Analysis: (1) Pilot Study

Content	Codes
Tonight!	-
I'm going to the hospital for cervical cancer screening	Plan
I just got a really small lump of blood.	Symptom, Bleeding
It's pressed like this. Then there's that part.	Symptom
I took a lot of naps ㅜㅜ I fell asleep	Daily Life
I want to check my sleep time, but I can't sleep.	Symptom, Insomnia
Construction Mat 1.9 cm 3 cm and the difference between noiselessness	-
When would be a good time to re-test for gestational diabetes?	Plan
It's so annoying today	Emotion
Sometimes I can feel it on my side.	Symptom
I didn't count the exact number of times, but I think it did decrease.	Symptom, Fetal Movement
The head size is about 2 weeks bigger than the average size. I'm sad that the baby looks like the groom.	Result
Do you all feel this kind of fetal movement?	Symptom, Question
I have a C-section scheduled for today! I'm scared of a C-section.	Plan

- Randomly sampled 200 out of 10000+ sentences, and conducted open coding process

- Constructed a **conceptual framework** from the codes that explains the types and contents mothers discuss in the community

Conceptual Framework

Contents that mothers in the online community discuss has the following three dimensions

1. Medical Protocol
    a. Plan : Where and when to do what?
    b. Examination : How is the pregnancy going? (w/ measurements as fetal weights)
2. Daily Life
    a. Events: quitting a job, husband, housework, ...
    b. Self-management: workout, medicine, ...
3. Manifestation
    a. Physical → Symptom: bleeding, contraction, accompanying disease, …
    b. Mental → Emotion: happy, sad, angry, …

Qualitative Analysis: (2) Closed Coding

1000 sentences from all articles of a single author

Further Plan: Proposed App Usage

I haven't slept since 1:30 due to fake pain. On the evening of the 1st, something like water came out. I went to the hospital at 12 p.m. from the 1st to the 2nd. I ran a amniotic fluid test. It wasn't amniotic. The birth canal was 1cm open, fetal movement was good and there was no contractions, so I came home. I had a stomachache at the hospital for a while, maybe because of the internal examination.
Two days before (yesterday Wednesday) I didn't even have fake pain. There's been a huge decline in the fetal movement. Very occasionally, less than a minute, it moves a little and then stops? I felt strangely down, so the baby might not be excited either. And then today, at about 1:40 a.m., my stomach started to hurt again. I checked the symptom using the app, and then I lay down around 3:00. It hurts and then it becomes okay, and then it hurts again. I can't get sleep. I don't think it's regular, yet. The application says I'm having a contraction.

Symptom: Contraction / Stomacheache

Symptom: Fetal Movement

Symptom: Discharge / Fluid

Emotion: Anxiety

Examination: Discharge / Fluid

Examination: BC / CL

Examination: Contraction

Management: Self-Check

Auto-tagging → Use as index

Pilot Evaluation: Auto-tagging with SVM

Using the previous coding result, we predicted labels of another author's articles

Symptom: Contraction / Stomacheache

Day 5) Stomachache like menstrual cramps.

I usually have a tummy ball when I'm awake. The belly is a rock...

I've had a stomachache like a menstrual cramps since 3 a.m. today, and my tummy mass periodically lasted about a minute every seven minutes. I didn't go to the hospital because I didn't have a strong stomachache. They say it hurts a lot more if it's a real pain.

Is this a symptom of fake pain?

Question

Is everyone like this at this time?

What kind of pads should I prepare for the baby in late May and early June?

May I prepare some handkerchiefs?

→ Although the recall was very low, the precision was fairly acceptable.

Further Plan: Proposed App Usage

1. Medical Status
Plan
I went to the hospital at 12 p.m. from the 1st to the 2nd.
Examination
I ran a amniotic fluid test. It wasn't amniotic. The birth canal was 1cm open, fetal movement was good and there was no contractions

2. Daily Life
Events
Self-management
I checked the symptom using the app, and then I lay down around 3:00. The application says I'm having a contraction.

3. Manifestation
Symptoms
#contraction I haven't slept since 1:30 due to fake pain. I had a stomachache at the hospital for a while, maybe because of the internal examination. Two days before (yesterday Wednesday) I didn't even have fake pain. And then today, at about 1:40 a.m., my stomach started to hurt again. It hurts and then it becomes okay, and then it hurts again. I don't think it's regular, yet.
#insomnia I can't get sleep.
#discharge On the evening of the 1st, something like water came out.
#fetal_movement There's been a huge decline in the fetal movement. Very occasionally, less than a minute, it moves a little and then stops?

Emotions
#depressed I felt strangely down, so the baby might not be excited either.

Automatic Restructuring → Induce users to re-organize and fill in blanks

Further Plan: Proposed App Usage

Symptom: Weight and Body Shape

PA 28wks
I feel like my stomach has gotten stiff these days.
I felt like my stomach was coming out after the mid-term.
From about 25 weeks? It's been a very different day.
Every day of the week, I feel like I'm changing.
These days, my tummy's been sticking out, I feel like I'm going to explode, and I feel like I'm going to be heavy.

PA 29wks
By the way, I thought my stomach was coming out day by day.

PA 32wks
How's the other mothers doing with the belly coming out? It's too hard.

PA 36wks
I'm tired of the big stomach, let alone annoying.

Symptom: Breathing

PA 26wks
I had rhinitis, and I got pregnant, and my rhinitis got worse. Because I can't sleep well, I get asthma when I'm tired My chest feels stuffy. It's not that I can't breathe. It's frustrating. There's a wheezing sound.

PA 32wks
I'm getting new asthma symptoms. Asthma has got worse after I got pregnant. I went to the university hospital and got an inhaler. Rhinitis is getting worse and asthma is more common than ever. I've already used six inhalers this month. ...

PA 35wks
I'm out of breath after eating again, maybe it's because my stomach is pressed. My heart was beating too fast. (I've been like this once or twice before) I'm so out of breath that when I need to fold the laundry ...

Filtered View : Efficiently explore a number of diary entries

Further Plan: Proposed App Usage

Symptom: Weight and Body Shape

PA 28wks
I feel like my stomach has gotten stiff these days.
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From about 25 weeks? It's been a very different day.
Every day of the week, I feel like I'm changing.
These days, my tummy's been sticking out, I feel like I'm
going to explode, and I feel like I'm going to be heavy.

PA 29wks
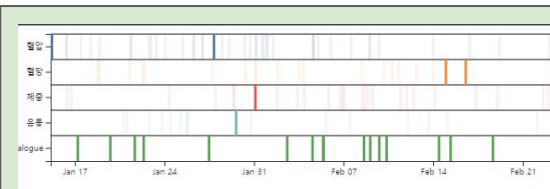By the way, I thought my stomach was coming out day by
day.

PA 32wks
How's the other mothers doing with the belly coming out?
It's too hard.

PA 36wks
I'm tired of the big stomach, let alone annoying.

Summary Report for Doctors
*(i.e., a patient directly shows
it in the outpatient session)*

Dedicated Visualization

Join with other field
*(e.g., mood change,
body weight)*

Project Timeline

		3/23	3/30	4/5	4/12	4/19	4/26	5/3	5/10	5/17	5/24	5/31	6/7
Domain Research	Proposal Presentation (Milestone 1)	■											
	Domain expert Interview (@Regular Meetings)	■	■										
	Define Problem Situations (Outpatient Observation)					■	■						
	Define Target User & Goals (@Regular Meetings)						■						
	Mid-Presentation (Milestone 2)							■					
Design	Brainstorming / Searching (w/ Pair Programming Sessions)				■	■	■						
	Chatbot Prototype							■					
	Iterative Design Process								■	■			
Implementation	Standardization Logic											■	■
	Interface									■	■		
	Dashboard									■	■		
	Community Dataset												
Evaluation	Chatbot Deployement & Debugging								■	■			
	Quantitative Analysis										■		
	Qualitative Analysis										■		
	Pilot Evaluation										■	■	
	Final Presentation (Milestone 3)												■(red)

Roles and Contribution

All
- Domain Study
- Design Process
- Brainstorming, Searching, Evaluation
- Qualitative Analysis

Seokweon Jung
- Data Preprocessing
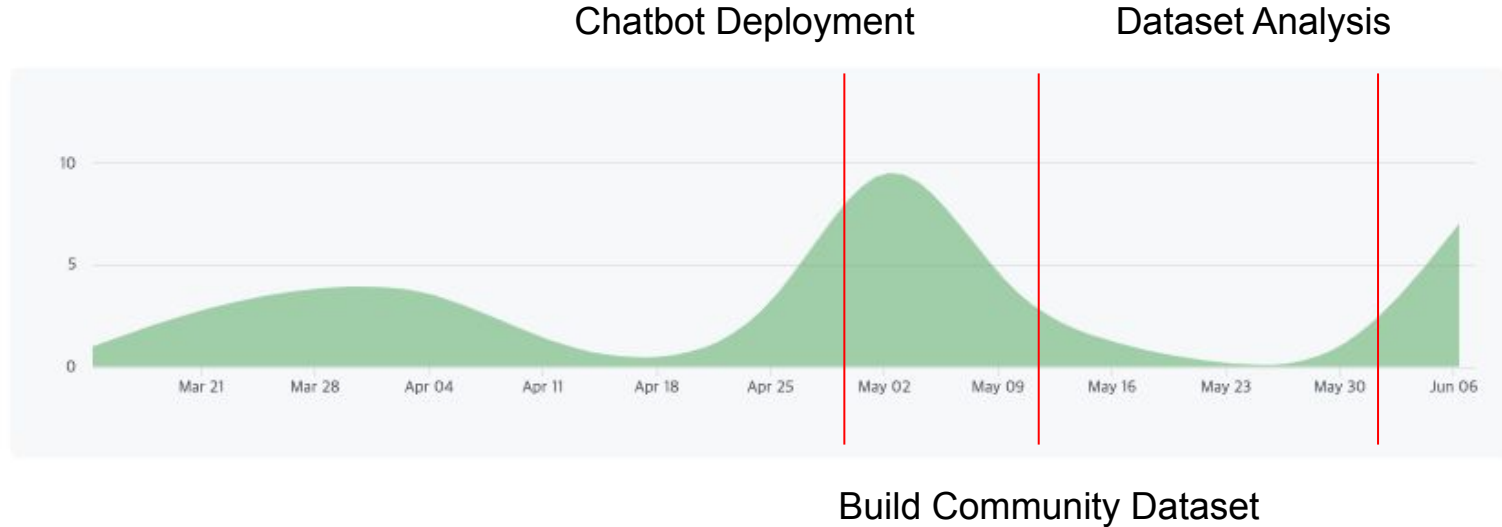- Dashboard prototyping
- Auto-tagging Pilot Evaluation

Kiroong Choe
- Chatbot Implementation & Deployment
- Quantitative Analysis
- Target Application Formulation

Aeri Cho
- Data Preprocessing
- Data Collection
- Usage Scenario Articulation

Project management - Git Status

Discussion

- Contribution
  - Domain research with several trial and errors
  - Conducted qualitative analysis and formulated the target application
  - Pilot quantitative analysis and prediction

- Limitation
  - Absence of implementation
  - Low prediction performance
  - Qualitative evaluation needs more iteration

- Opportunities
  - Found that a simple TF-IDF based auto-tagging method could work with further sophistication
  - Our proposed app can be adopted in real-world medical protocol without additional effort of patients or doctors