# Chatbot MARVIN: Development study of an Intelligent Conversational Agent to Promote HIV Patients' Engagement in Care and Management of ART Adherence Barriers

Yuanchao MA*[1,4,5], David SANMIGUEL[2,5], David LESSARD[1,5], Lévis THÉRIAULT[3], Sofiane ACHICHE[4,5], Anish ARORA[2,5], Kedar MATE[1,5], Benoît LEMIRE[6,7], Tarek HIJAL[9], Tibor SCHUSTER[2,5], John KILDEA[10], Alexandra de POKOMANDY[1,2,6], Joseph COX[1,6,8], Nadine KRONFLI[1,6], Marina KLEIN[1,6], Bertrand LEBOUCHÉ*[1,5,6]

1. Research Institute McGill University Health Centre, Montréal, QC, Canada
2. Department of Family Medicine - McGill University, Montréal, QC, Canada
3. Department of Computer Engineering and Software Engineering, Polytechnique Montréal, Université de Montréal, Montréal, QC, Canada
4. Department of Mechanical Engineering, Polytechnique Montréal, Université de Montréal, Montréal, QC, Canada
5. CIHR SPOR Mentorship Chair in Innovative Clinical Trials in HIV, Montréal, QC, Canada
6. Chronic Viral Illness Service - McGill University Health Centre, Montréal, QC, Canada
7. Department of Pharmacy - McGill University Health Centre, Montréal, QC, Canada
8. Department of Epidemiology - McGill University, Montréal, QC, Canada
9. Department of Radiation Oncology, Cedars Cancer Centre, McGill University Health Centre, Montréal, QC, Canada
10. Medical Physics Unit, Gerald Bronfman Dept of Oncology, McGill University, Montréal, QC, Canada

*If you have any questions about the project, feel free to contact us: yuanchao.ma@much.mcgill.ca or bertrand.lebouche@mcgill.ca

**Conflict of Interest Disclosure: I have no conflicts of interest.**

**This project benefits from the support of the PIHVOT, a ViiV Healthcare project.**

# Background and Objective

Intelligent conversational agents (ICA) can mimic human interaction using machine learning technology to analyze user inputs and respond appropriately using human language.

Patients play an increasingly important role in self-managing chronic conditions like HIV infection.

Lack of quick access to reliable answers to patients' questions can cause anxiety or jeopardize patients' ability to follow their treatment as prescribed.

ICAs have been shown in several studies to be cost-effective, to improve adherence-related barriers, and to promote patient empowerment, collaborative goal settings, and problem-solving skills.[1-4]

Objective: Design, develop and test MARVIN*, an ICA implemented in HIV infection to promote Patient's Engagement and self-management on perceived potential ART adherence barriers


1. Bibault J-E, Chaix B, Guillemassé A, et al. A Chatbot Versus Physicians to Provide Information for Patients With Breast Cancer: Blind, Randomized Controlled Noninferiority Trial. *Journal of medical Internet research.* 2019;21(11):e15787.
2. Chaix B, Bibault J-E, Pienkowski A, et al. When Chatbots meet patients: one-year prospective study of conversations between patients with breast cancer and a Chatbot. *JMIR cancer.* 2019;5(1):e12856.
3. Fadhil A. A conversational Interface to improve medication adherence: Towards AI support in Patient's treatment. *arXiv preprint arXiv:180309844.* 2018.
4. Xing Z, Yu F, Qanir Y, Guan T, Walker J, Song L. Intelligent Conversational Agents in Patient Self-Management: A Systematic Survey Using Multi Data Sources. *Studies in health technology and informatics.* 2019;264:18


* MARVIN: Minimal ARV Interference

# Methods

- Using a co-design methodology, a multidisciplinary group of physicians, patients, pharmacists, engineers guided the development of MARVIN:
  - Q&A Corpus development:
    - Patients and communities → Questions (Figure 1) and preferred expression of answers to ensure the understanding of user's input
    - Physicians and pharmacists → Qualified and creditable answers to guarantee MARVIN respond with the appropriate output
    - Engineers → Corpus data processing (Figure 1) to train MARVIN with Natural Language Understanding algorithm (Figure 3)
  - Decision tree development: accomplish Dialogue Management (Figure 3) by instructing MARVIN to understand how to response in the corresponding topic (Figure 2)
    - Patients' colloquial expression
    - Healthcare giver's working method
    - Software development method


Figure 1. Q&A Corpus example: different questions collected for sub-scenario *LATE on Atripla*

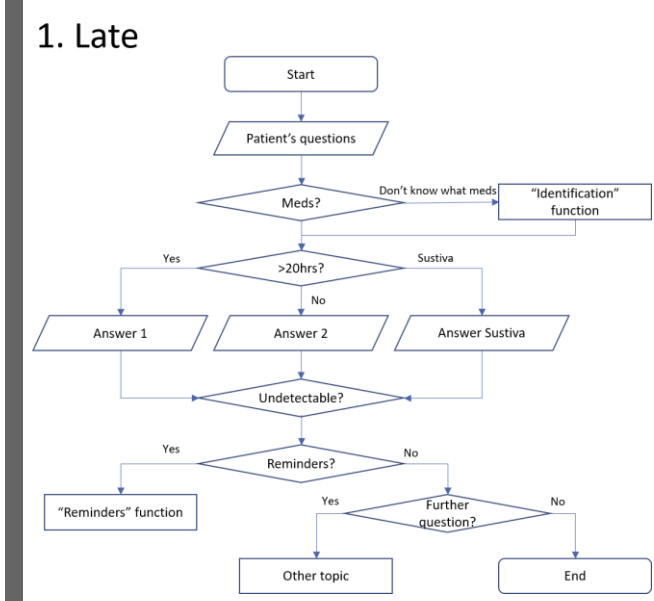


Figure 2. Decision tree example: sub-scenario *LATE*

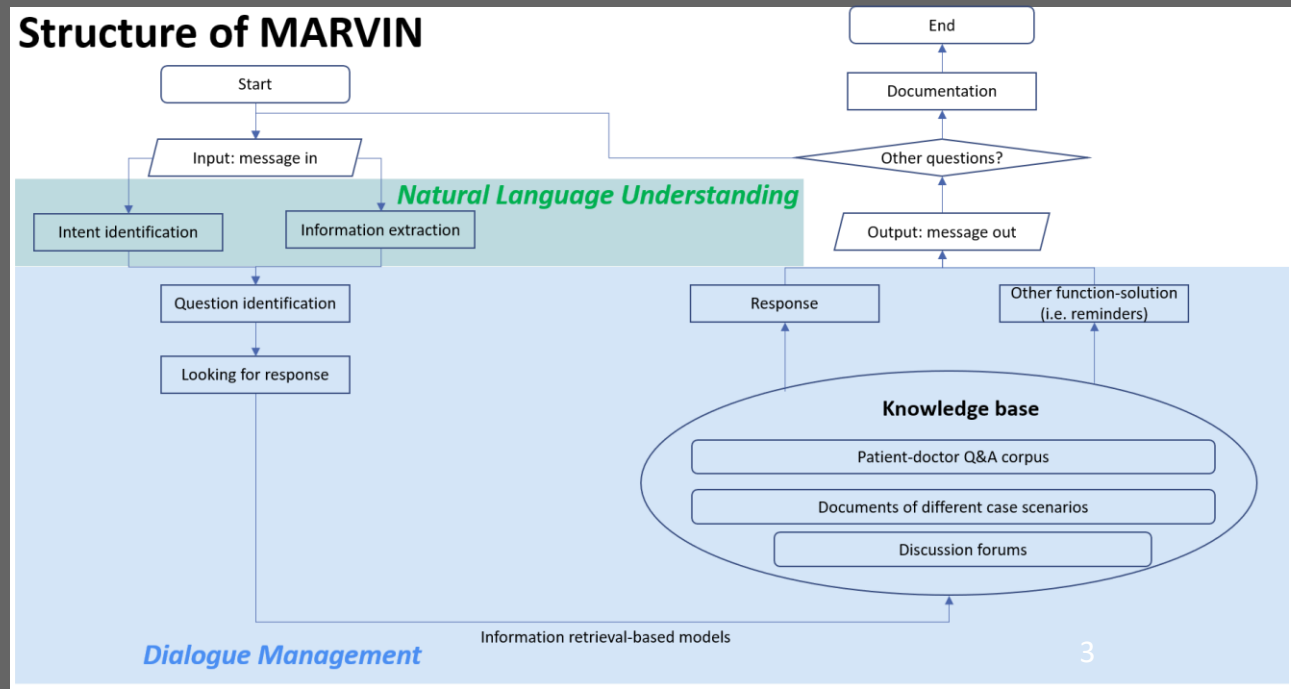


Figure 3. Structure of MARVIN

# Results

- MARVIN, a virtual assistant available in English, trained in communicating with patients by both voice and text message, 24H/7
- Perform two case scenarios considered for the first stage
  - *Advice for taking ART (time management, with or without food, difficulties with pill recognition, etc.)* (Figure 4,5 and 6)
  - *Travel with HIV (time management, country restrictions, medication packaging, etc.)* (Figure 7)
- while ensuring satisfaction such as
  - Sensitivity and confidentiality
  - Regularity and chronicity of taking medications
  - Desire for help and support

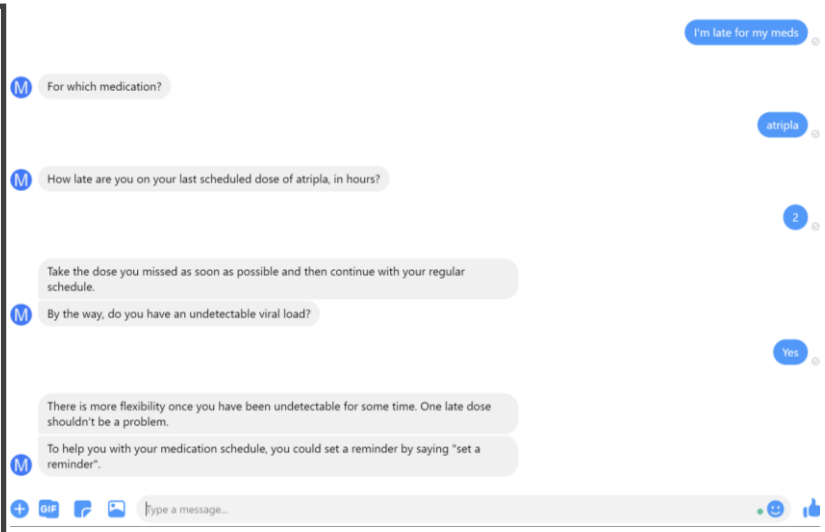


Figure 4. Conversation example: sub-scenario *LATE*

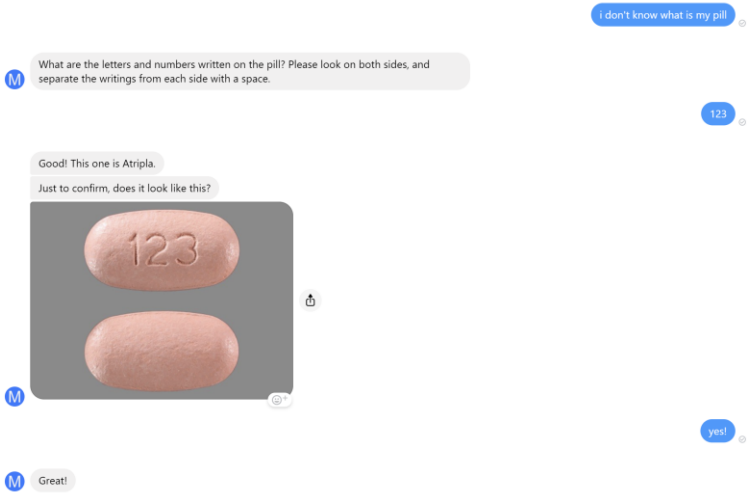


Figure 5. Conversation example: sub-scenario *IDENTIFICATION*

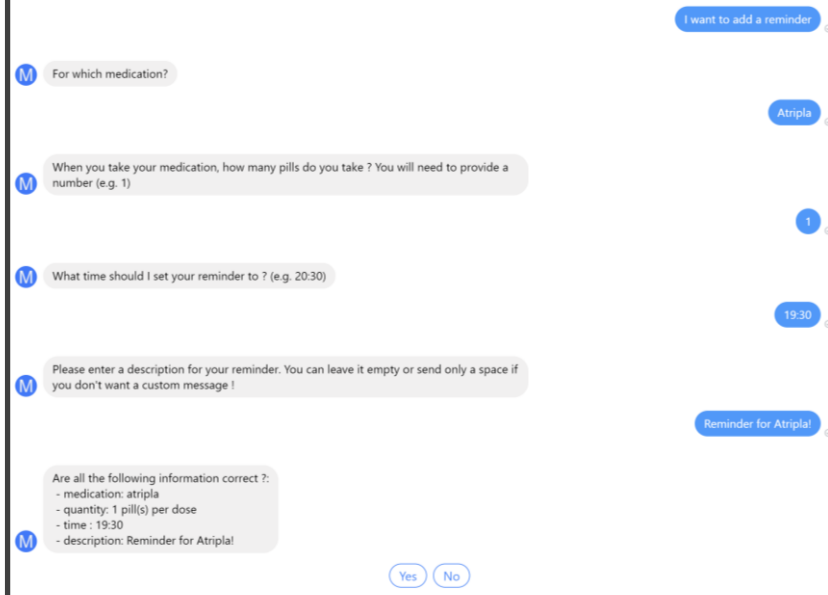


Figure 6. Conversation example: sub-scenario *REMINDER*

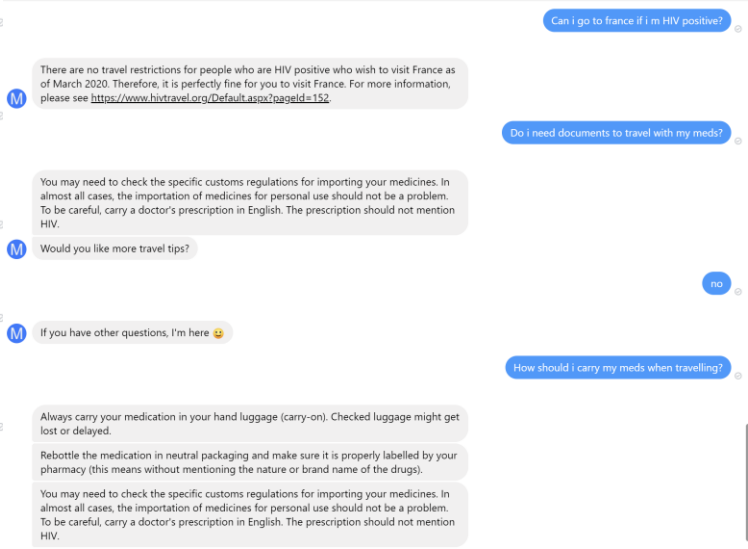


Figure 7. Conversation example: Scenario *Travel with HIV*

# Conclusions

## Strengths

- Patient-centered care by increasing the patients' involvement
- Automating functions that previously required face-to-face interaction
- Provide personalized medicine
- Data collection for ICA improvement and research study (e.g., ICA training with conversation histories, identification of new barriers with users' questions)

## Limitations

- Scenario *Side effects* not considered due to potential medico-legal issues
- Require large datasets for ICA training
- Does not always recognize or respond appropriately (Figure 8)
- More features and functions to be added (medication interactions, support information, French version, etc.)

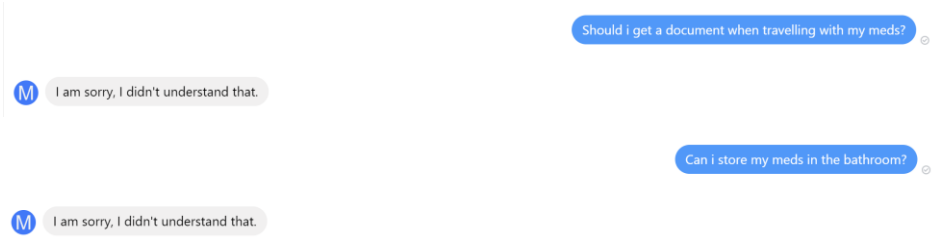


Figure 8 Examples of incomprehensible questions