

A Conversational Dialogue Agent to Improve Outcomes in Healthcare

Medication Reconciliation and Adherence

Patients are unable to fully utilize care provided by the healthcare industry due to poor management of medication regimens. By providing healthcare data management tools, we seek to empower patients and reduce the burden of medication reconciliation and medication adherence on providers.

Despite medication reconciliation being identified as a patient safety quality measure of care by The Joint Commission, patient medication history is often incomplete and inaccurate (Patient 19). Medication reconciliation proves a difficult and tedious task, especially for patients who see several providers whose electronic medical record systems lack interoperability (Rose 2017). Clinicians may not be able to access a patient's complete pre-admission medication lists, or may be unaware of recent medication changes, that may lead to inadvertently omitting needed medications, unnecessarily duplicating existing therapies, or propagating incorrect dosages. These inconsistencies increase patient risk for adverse drug events, and stifle the quality of care (Patient 19).

Chronic illnesses commonly require long-term use of pharmacotherapy for treatment. The WHO finds that despite medications being effective in combating disease, their full benefits are often not realized because approximately 50% of patients do not take their medications as prescribed. The reasons for poor adherence include forgetfulness, poor health literacy, misunderstanding complex drug regimens, prescription refill logistical limitations, limited office visit time and access to care, lack of health information technology, adverse drug effect's mismanagement and ineffective communication about adverse effects, as well as cost (Brown 2011). Hospital programs with discharge services including medication adherence and reconciliation have shown to have decreased rehospitalization rates (Jack 2009).

An artificially intelligent conversational dialogue system that shares the burden of medication reconciliation and adherence with patients and providers would substantially improve patient outcomes. Applications of chatbots to healthcare is an area of high interest, due to benefits a chatbots provides; anonymity, asynchronicity, personalization, scalability, authentication, and consumability (Pereira 2019).

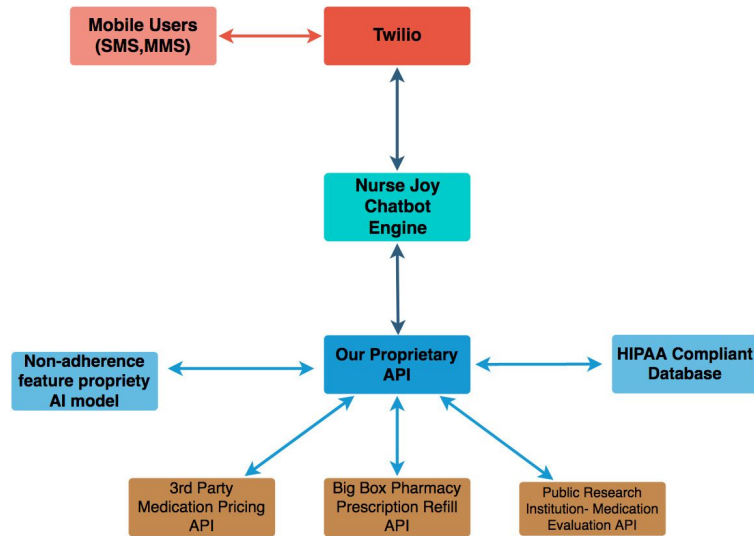
Chatbots are also available for patients who don't have smart phones and cannot use mobile applications based medication adherence solutions. Fadhil proposes the architecture and design of a diagnostic and decision support chatbot to assist in patient medication adherence (Fadhil 2018). Roberto Chatbot's functionality includes reminders for medication adherence and doctor's appointments, a chat interface with healthcare providers, scheduling appointments, data collection on sleep, mood, diet, physical activity, healthcare provider recommendations, access to specific disease health information, and health tips.

While feature rich, Roberto does not address the core issue of influencing patient behavior over time, in an engaging and sustainable manner. Preset medication reminders, while initially aid in patient adherence, become predictable and start to be ignored over time, losing patient interaction, thus decreasing adherence (Backman 2017).

Our Solution

We are launching Nurse Joy, a conversational medication adherence and reconciliation tool that is designed to address some of the problems outlined above.

Nurse Joy is built on an intent-entity relation engine, and leverages state of the art natural language processing technology. The bot design and functionality are oriented around managing the complex data needed for medication reconciliation, while providing patient specific medication adherence recommendations learned from patient behavior.



Users are able to quickly set up patient medication adherence reminders over SMS. Medication adherence is logged when the user answers prompted feedback requests, reporting their ability to adhere. This adherence log can be securely compiled into a shareable report for physicians or family.

Nurse Joy securely stores an accurate historical log of medication regimens, which can be accessed at any time, and shared with physicians and family. This allows for a faster, more accurate medication reconciliation across multiple health care providers. Upon entry, medications are validated by requesting the RxNorm API from National Library of Medicine to ensure medication and dosage accuracy.

When the bot detects non-adherence (either through specific prompts or through lack of responses), the bot attempts to intercept and return the patient to adherence through a set of interventions. The bot tracks number of doses dispensed, and is able to assist in obtaining refills at local pharmacies. If the root cause of non-adherence is medication side effects or adverse events, the bot sets up an escalation to the health care provider, thus enabling faster response to potential adverse reactions. If reasons for non-adherence are financial, is able to provide information about drug prices in the patient's region and compare costs across pharmacies, or recommending financial assistance programs tailored to patient demographics and medication regimen. Finally, the bot can serve important educational content that can help address patients' health literacy increase the user's knowledge about their medication regimen.

Going past the information gathering and pre-set reminder based approach proposed by others in this field(Fadhil 2018), we create patient specific behavioral models learned from responses to non-adherence and implement smart adherence support tools. By continually evaluating patient behavior and proactively assisting to maintain adherence, we have created a more robust and fatigue-resistant solution.

Nurse Joy's empowers patients to implement self-care practices and gives them control of their health data, all while helping them shoulder the responsibility of continuing a pharmacotherapy regimen successfully. Currently Nurse Joy is in closed beta.

References

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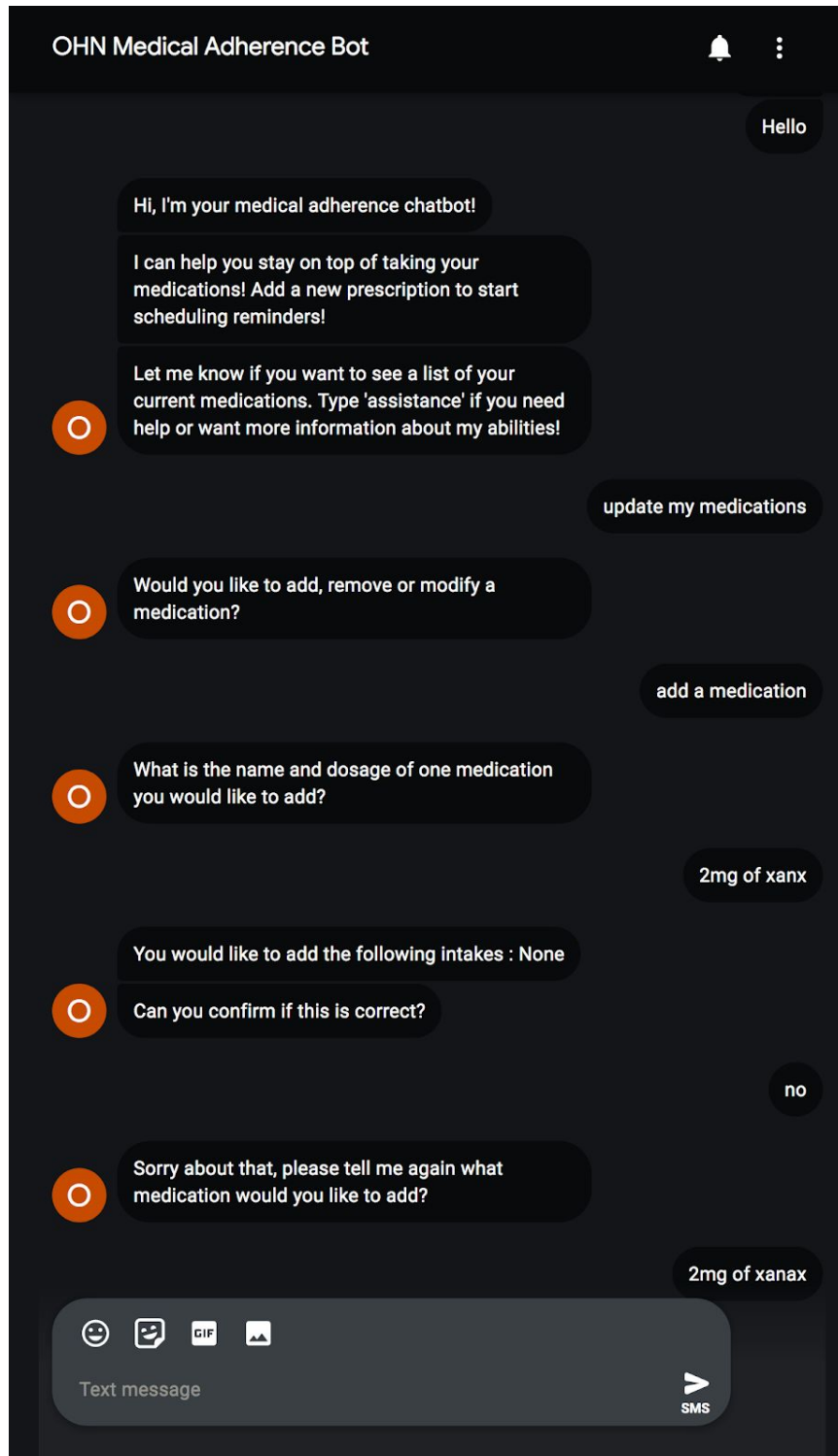
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Appendix

A1. Adding a new prescription



A2 .Collecting prescription information and setting reminders

The screenshot shows a chat interface with a dark background. At the top, the chat is titled "OHN Medical Adherence Bot" with a notification bell icon and a menu icon. The conversation consists of several messages from the bot and user responses:

- Bot:** "You would like to add the following intakes : Alprazolam 2 MG [Xanax]"
- User:** "Can you confirm if this is correct?"
- Bot:** "Thanks for confirming. How often are you supposed to take this medication? You can let me know of specific time restrictions here..."
- User:** "once a day"
- Bot:** "I'll record your medication frequency as once a day."
- Bot:** "And how long are you expected to take this medication?"
- User:** "about 4 months"
- Bot:** "Medication duration will be logged as about 4 months."
- Bot:** "Would you like to be sent medication reminders?"
- User:** "yes"
- Bot:** "When you would like to recieve a notification about taking your medication?"
- User:** "weekdays at 6:31 am est"
- Bot:** "I'll schedule a reminder for weekdays at 6:31 am"

A3. Optional prescription refill reminder

