### 2.3.2 Weaknesses of literature

To-do: Review section later!

Despite recent efforts, interoperability is still an issue of IoT systems. Due to the lack of clear and concise industry standards and regulations, many manufacturers develop their own proprietary data formats and communication protocols, which hampers the integration of new resources since the systems are designed within closed ecosystems [17]. Moreover, the adoption of new systems can be often met with much objection from the clinical staff due to their mistrust of technology [24]. To facilitate the deployment of new healthcare systems in hospitals, these need to be integrated easily in existing HIS.

Fortunately, there are several international initiatives to promote the use of IoT in health in a standardized way, such as HIMSS (Healthcare Information and Management Systems Society) and the Personal Connected Health Alliance (PCHAlliance). PCHAlliance for example promotes the adoption of the Continua Design Guidelines (CDG), which facilitates the integration of personal health devices into health systems. These guidelines have been recognized by ITU (International Telecommunication Union) and the European Commission and are adopted by countries such as Denmark, Norway and the USA, among others [25]. These guidelines describe a series of e-health standards like FHIR which facilitate the exchange of information between systems, in order to ensure the implementations become truly interoperable.

## 2.4 Statement of Contributions

To-do: Complete section!

After studying the different approaches taken by researchers, and in context of the dissertation, we propose a novel fully modular IoT infrastructure that uses the FHIR standard in order to fully integrate the data in the existing HIS, Glintt GlobalCare. Other researchers in the Institute of Systems and Robotics (ISR) already developed wearable devices, designated “biostickers”, using two different networking stacks — BLE and EPC/RFID. The system must ensure reliable and secure communications with the devices for each protocol, implementing the aforementioned security features in section 2.3.2. From a hardware perspective, the system is composed of 3 different components, as seen Figure 2.5: the biostickers, that acquire the patient’s physiological signals, the “SmartBox”, which acts as a central node of the

WBAN and aggregate the data and then communicates it to the gateway, and the "Smart Gateway", which serves as a fog server in order to mitigate latency and other computing issues and acts as the gateway to the HIS.

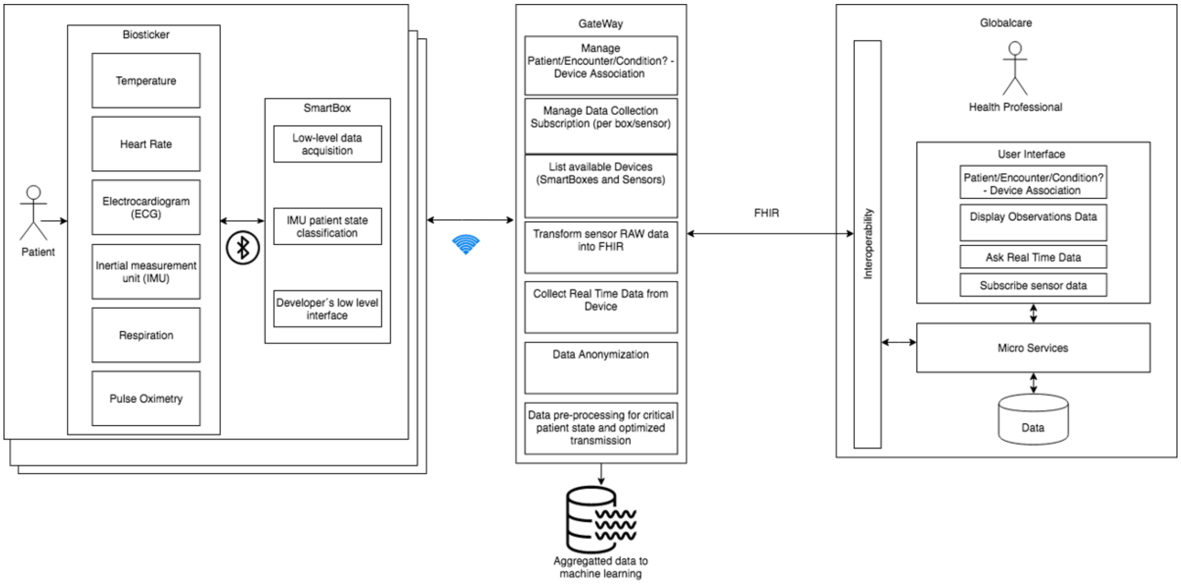


Figure 2.5: Overview of the proposed IoT-connected healthcare system.

For the work developed throughout the dissertation, we have set the following goals:

- Develop and deploy SmartBoxes embedded in hospital beds for data acquisition from biostickers attached to patients' skin via RFID:
  - Hardware evaluation of 2 different IoT kits (Raspberry Pi and Udoo Bolt).
  - Viability study of a disruptive battery-less RFID data acquisition compared to a BLE acquisition.
  - Implement reliable and secure RFID data acquisition and general communication between the biosticker and the Smart Boxes.
  - Selection of hardware components and assembly of SmartBox prototype;
- Establishment of data integration pipelines using MQTT and management of the multiple SmartBoxes in the Smart Gateway;
- Development of a FHIR API layer to integrate the proposed system in the GlobalCare HIS.
- Evaluation of the performance of the proposed system through controlled lab tests and later deployment hospital trials within the WoW project.

Adiciono também o objetivo da análise de dados? Ou até ver deixo só estes?

In the next chapter, we start with the discussion and development of the communications between the biostickers and the SmartBoxes.