Norwegian Centre for
E-health Research

Valkyrie:
A Distributed Service-Oriented Architecture for Coordinated Healthcare Services

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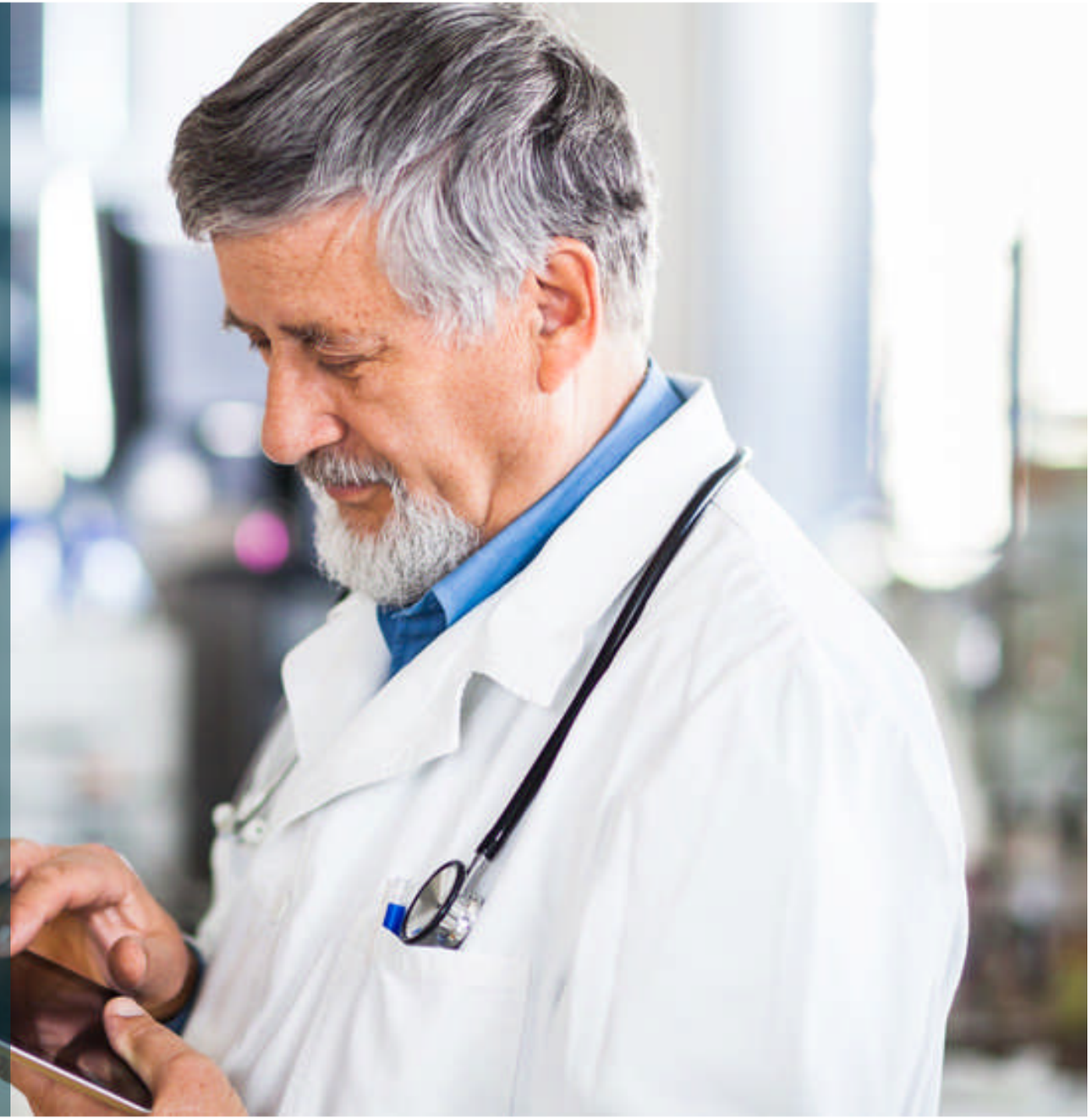
Full coordination of health care services entitles:

- Correct data is available to the right person at the right time, regardless of where the patient has previously received medical care
- Connecting multiple Healthcare Information Systems (HIS) across multiple healthcare levels



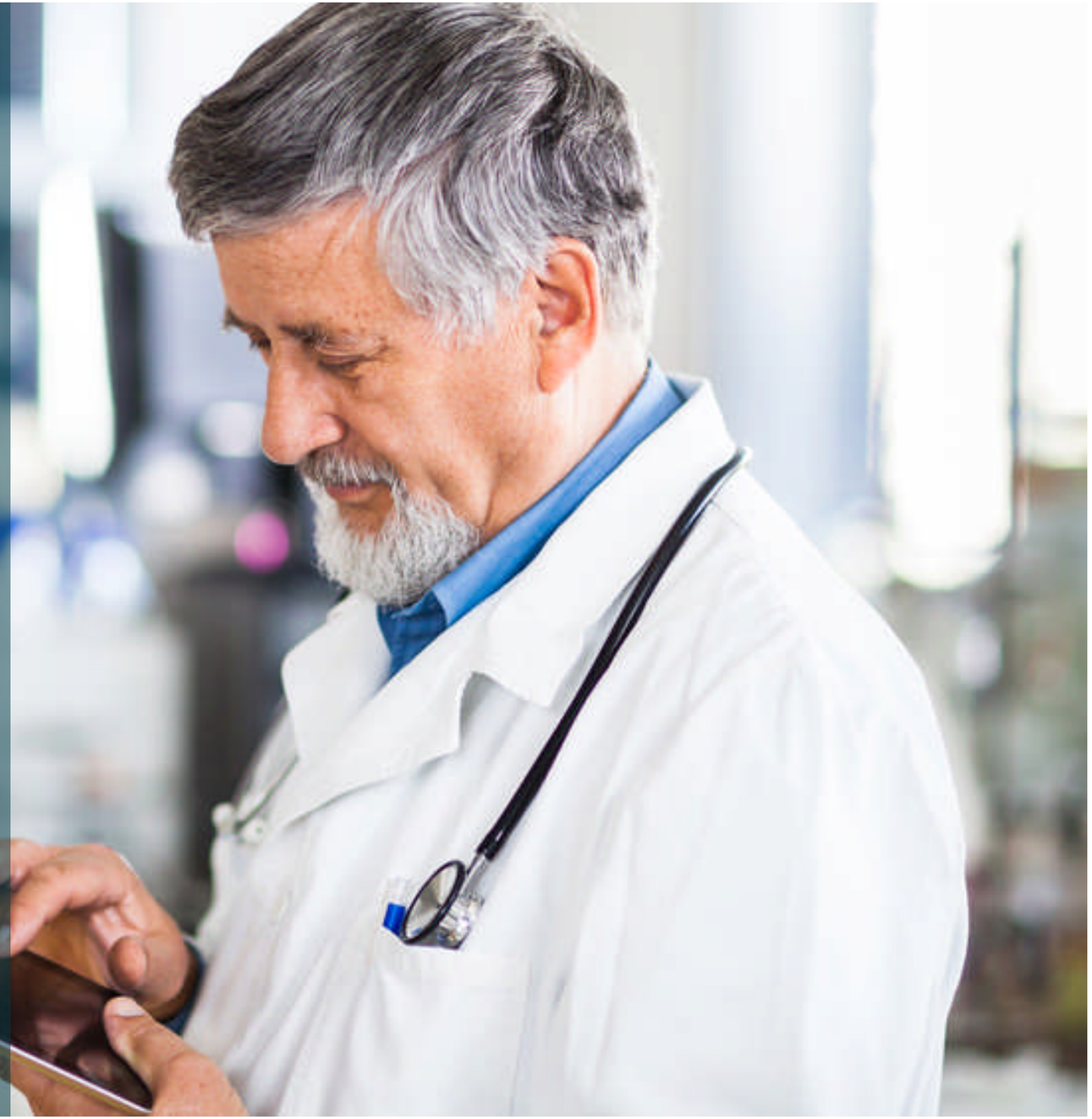
An example of a target group in contact with multiple healthcare providers

- Persons with mental disorders
  - The common use that a person with mental disorders makes of the Norwegian healthcare system is hospitalization, outpatient, and day services in specialist healthcare, as well as GP, emergency-, care-, social-, rehabilitation-, and day services from the municipality
  - GPs do not have access to electronic Patient Health Data (ePHD) from the municipality services or specialist care

- Only standardized documents are exchanged, which is insufficient for health professionals responsible for the patient.
- Medical comorbidity is expected in this target group, where the majority suffers from at least one chronic medical condition requiring somatic care
- This target group´s demand for Norwegian healthcare, makes it an excellent case study for Valkyrie

Patient-centric pathways

- Norwegian Directorate of Health National Plan for Implementation of Patient Pathways has identified challenges with the digitalization of the Norwegian healthcare sector, recognizing the need for more research to better use of ePHD
- A need has also been identified for implementing new patient pathways for mental health, which improve the coordination between primary and specialist care
- The challenges of accessing ePHD across multiple HIS, and integrating it with patient-centric solutions to form complete pathways, threaten the chances of achieving the goals for patient pathways
- Business boundaries should not hinder the sharing of health information



patient-centric care

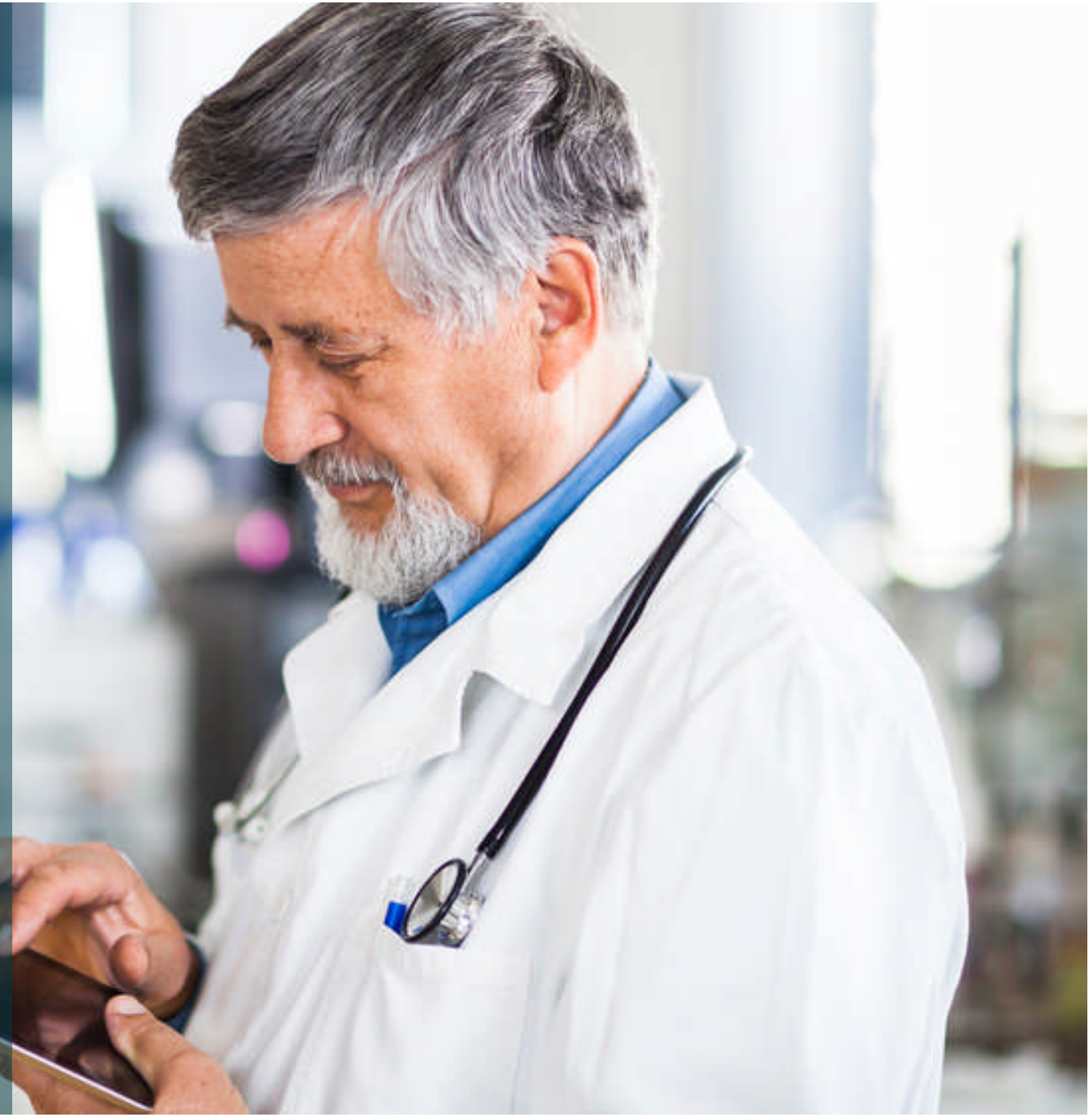
- Benefits
  - Improved quality of life
  - Increased adherence to treatment protocols
  - Reduced morbidity
- Current HIS are not designed to support integrated care delivery that spans multiple providers and settings at any health care level
- ICT play a significant role in coordinating healthcare providers who are often separated by time and space
- Introducing ICT into healthcare has proven challenging owing to the underlying complexity of healthcare processes and the number of actors involved in those processes

Modelling patient-centric pathways

- Patient-centric pathway is a structured care plan that combines national guidelines with local practices and patients' wants, needs, and preferences
- Business process modeling has been used in healthcare to help represent healthcare processes so we can design systems to support those processes
- Better application of process modeling is needed to provide safe, effective, timely, and patient-centric healthcare services
- Process modeling (particularly simulation models) has helped evaluating and understanding healthcare processes at the macro-level
- Micro-level models require explicit details about the ePHD and communication flows across processes and healthcare providers

Distributed Service-Oriented Architecture

- The Service-Oriented Architecture (SOA) paradigm and its ability to connect multiple HIS across different settings is a candidate for developing integrated HIS to support healthcare services coordination across different settings
- SOA was introduced in healthcare to help break down silos and monoliths by separating the interface and services from the content and business logic and exposing it as a chain of interrelated services, feeding into expectations of better communication and interoperability between healthcare organizations and patients
- SOA and the Microservices architecture share the same ideas on exposing business processes as services
- Opposite to SOA, the Microservices architecture divides a monolithic application into multiple atomic services that run independently on distributed computing platforms, including distributed data stores



Mental health as a case-study

- Approximately 12.5% of the adult Norwegian population has a consultation in primary care related to psychological ailments, being that for specialist healthcare, the number of consultations is at 15%
- The fragmented organization of the health and social welfare services in Norway constitutes a major barrier to providing comprehensive, integrated, and coordinated services for persons in the target group
- Norwegian healthcare sector has been through several reforms that rightly have focused on reducing the overall costs of healthcare, coordinating service across the different levels of healthcare, increasing patient engagement, and equal access to health care
- Early 2019, three generic patient pathways for mental health and substance abuse were implemented
    - Later the same year, the government issued the first four specific clinical pathways

The Valkyrie solution

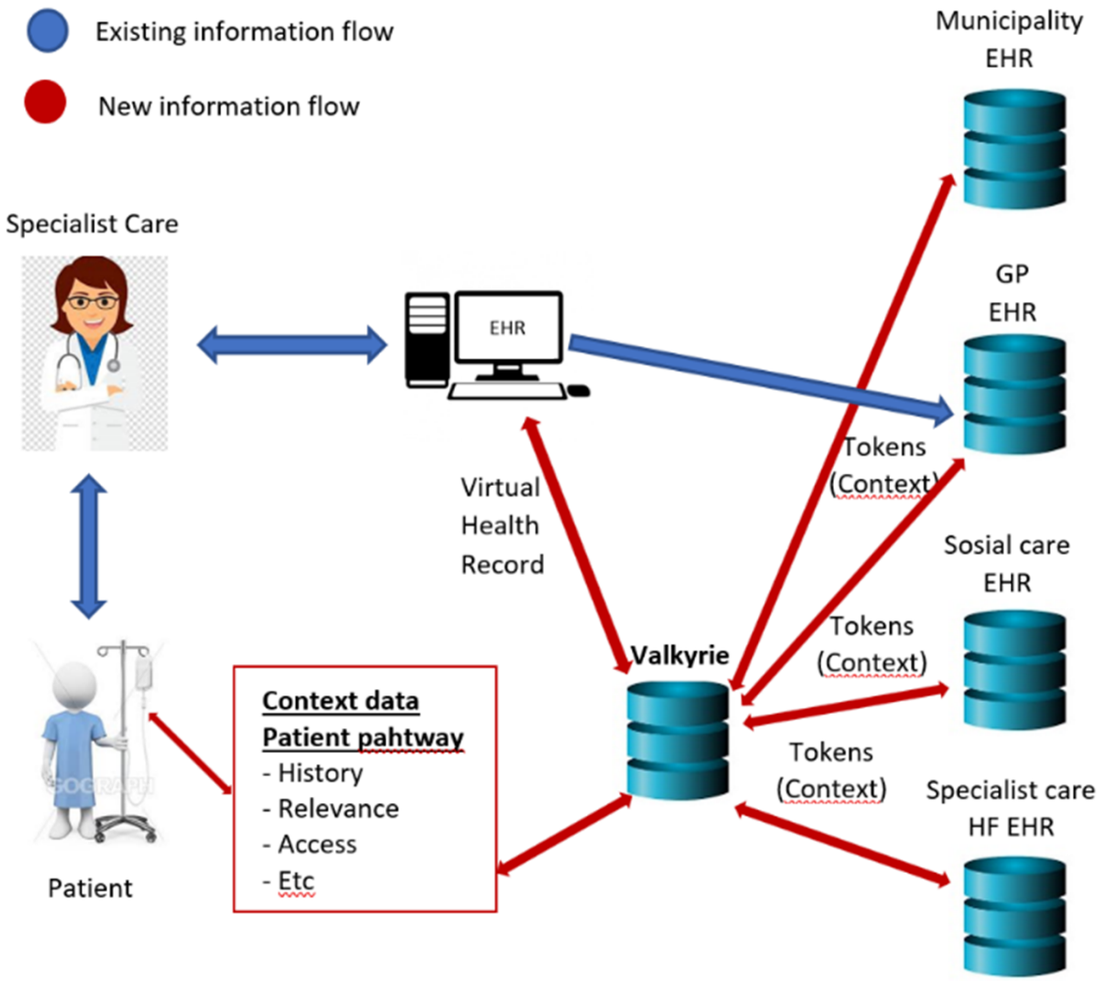
Coordination and collaboration

- To support collaboration between patients, their relatives, and health professionals, patient-centric pathways models are to be based on the Voice of the Patient (VoP) and verified information from experts explaining decisions or variances in the pathway
- Using a combination of a patient-centric design and a data-driven approach to ensure the micro-level modeling of the patient-centric pathway is derived from actual ePHD occurrences across multiple healthcare levels to achieve better coordination

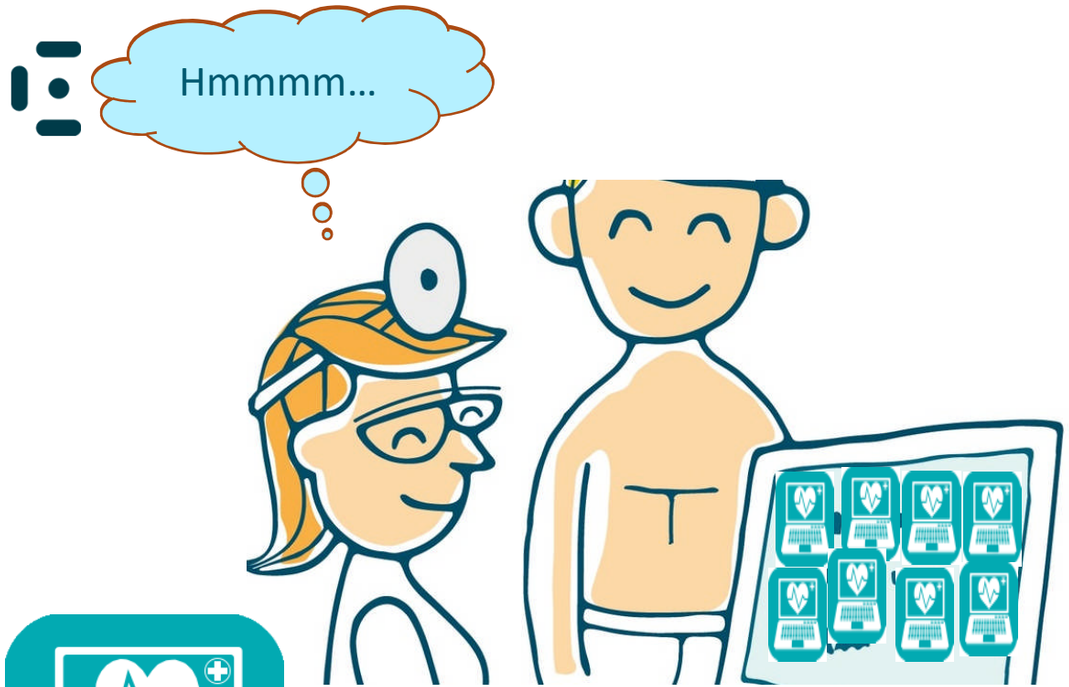
Distributed Service-Oriented Architecture

- The Valkyrie architecture supports patient centric pathways for mental health by delivering a Virtual Health Record (VHR) driven by the requirements of the pathway
- To populate the VHR, each participating HIS pushes a token, encrypted using a public key provided by Valkyrie, whenever an event is recorded in the system for any patient
- The token carries the patient identifier (unencrypted) and a small set of metadata about the event, including an identifier sufficient to locate the event in the source HIS, and the clinical coding descriptive of the event
- The encrypted tokens are transmitted to the Messaging Engine (Valkyrie), which filters the tokens based on the directory of Legitimate Relationships between Valkyrie and individual patients
- To create the Virtual Record Outline for a specific patient, Valkyrie will gather, from the Encrypted Token Store, all encrypted tokens for the patient and decrypt them using Valkyrie's private key, allowing Valkyrie to form the Virtual Record Outline as a timeline of events, some of which may be relevant to the patient-centric pathway

The Valkyrie solution: a simplified architecture



An example on how it could work?


Hmmmm…

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Thank you

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