

## Asynchronous Risk Propagationsec:asynchronous

While straightforward to specify, , is not a viable implementation for real-world application, because it is an offline algorithm that requires all individuals' recent contacts and risk scores to run. As Ayday2021 note, the centralization of health and contact data is not privacy preserving. An offline design is also computational inefficient and risks human safety. Specifically, most exposure scores may not change across invocations of , which implies communication overhead and computational redundancy. As a mitigation, Ayday2020 suggest running only once or twice daily. However, this causes substantial delay in reporting to individuals their exposure scores; and in the face of a pandemic, timely information is essential for individual and collective health.

To address the privacy limitations of , Ayday2021 propose decentralizing the factor graph such that the processing entity (e.g., mobile device or "personal cloud") associated with individual maintains the state of variable node and its neighboring factor nodes. But for real-world application, the proposal leaves key questions unanswered: enumerate

- Is message passing synchronous or asynchronous?

- How does message passing terminate?

- Are any optimizations used to reduce communication cost?

- How do processing entities exchange messages over the network?