Refining the alerting process
alertR by smartR AI

Background

The timely and effective response in the event of an emergency is fundamental to ensuring adequate help is provided. The US Department of Homeland Security (DHS) instigated research in 2018 to improve their understanding of responses and where issues arise in the communication process[1] They found that one particular thing we do not understand so well as a society is effective communication, and concluded that an integrated alert and warning ecosystem is required for the future:

" *A more cohesive and all-encompassing alert and warning system is needed that will integrate public and private communications mechanisms and sources of information, and continue to provide the necessary information for the purpose of preserving the health and safety of people, while being technologically agnostic— such that new technologies for alerts and warnings can be adopted quickly.* "
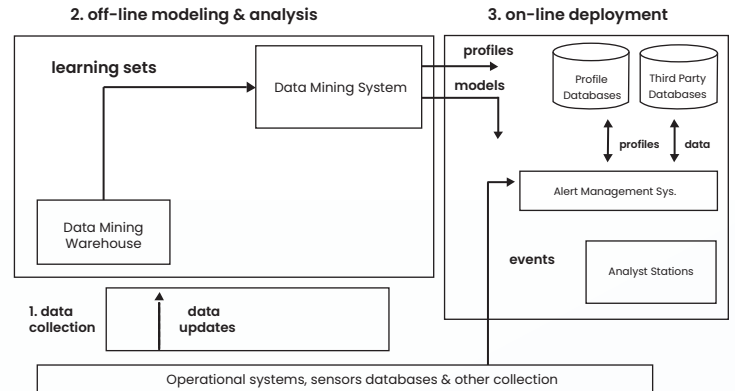
The DHS report, 2018.

Figure 1: Alert Management System

Alert system issues

An example architecture for a traditional alert system is given in Figure 1, taken from Alert Management Systems, A quick introduction[2] This highlights an issue in current approaches, where far more emphasis is placed on the decision to send an alert or not, and far less time is spent on the to whom, how, and the careful construction of an appropriate alert message. This could be seen as the most important part of the alert system; without the precise details of the situation being communicated to an individual who is able to help fast, and then actively responds, the system will fail.

Additionally, an issue has been found with the iPhone 14 crash alerting system, in the form of false alarms. Despite "a million hours of crash data, real-world driving and crash test labs" Apple's latest car crash detection feature is reportedly being triggerered by rollercoasters.[3]

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[1] Emergency Alert and Warning Systems: Current Knowledge and Future Research Directions (2018)

[2] Alert Management Systems: A Quick Introduction

[3] iPhone 14 car crash detection triggered by roller coasters

alertR: The smarter alerting system

The alertR™ engine by smartR AI is a personalized behavioral intelligence-based alert system to support and protect more vulnerable individuals, reducing risks through predictive and preventative measures.
By connecting to relevant smart devices, sensors, online applications, as well as geolocation apps data specific to the user is collected. Using AI and ML applications, the engine identifies and analyzes unique user behaviors, traits, and habits and can determine those that deviate from the individual's norm.

This leads to a series of data driven decisions to be made to efficiently and effectively despatch personalized alerts and warnings. These alerts are triggered through a dynamic system, with two distinct engines working in tandem:

1. decidR engine: Deciding if a person is in a state of distress or needs help.
This engine also works as an emotional state estimator, so that it can make predictions on the risk level of the particular situation and triggers a warning should it become apparent there is a change in behavior.

2. delivR engine: Forming an effective and personalized message, and the most efficient communication method.
When there is a trigger warning, this engine responds with personal, preventative and emergency alerts, escalating based on behavioral intelligence. It dispatches alerts at speed, in a precise and bespoke manner to the right person, at the right time, in the right way.

Figure 2: alertR Alerting Process
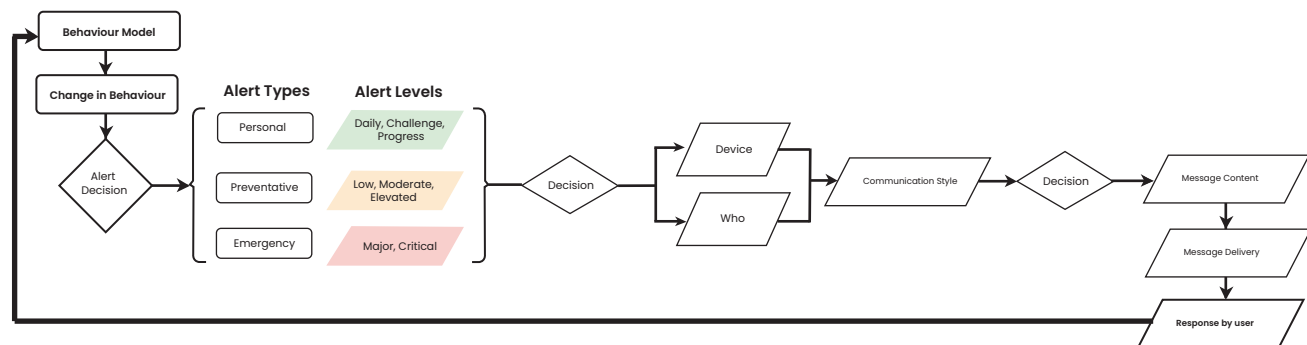
Figure 2 provides the visual context of the alertR alerting process.
In this diagram, alertR dispatches personal and low-level preventative alerts to the individual user. Preventative and emergency alerts may be sent to contacts, or emergency services, should a situation be escalated. These may be self-selected or selected by the decidR engine. For instance, alerting relevant good Samaritans in the local community who are known to assist, or emergency services.

The alertR alerting journey

As the user goes about daily life, they will be prompted with personal notifications and alerts. These aim to inform and motivate the individual about their current well-being, and act as the first stage of the alerting system, looking to prevent the need for an alert escalation cycle. These alerts include:

• **Preventative alerts;** to assist, support and keep the individual safe by warning them of potential hazards.

• **Praise notifications;** indicating where an individual has done a good job and highlighting the progress they have made.

• **Personal notifications;** such as daily and weekly status, achievements, highlights, overview of triggers, how to use the system optimally, and challenges.

alertR escalation

An alert escalation cycle is triggered by the decidR engine should the personal preventative alerts fail to change behavioral patterns that could lead to potentially risky situations. The cycle is used to efficiently alert and warn support contacts in the appropriate manner to keep the individual safe from harm.

Once the system has identified the need for intervention, the first question that must be asked is exactly what level of intervention is required. This information will be dependent on what the system wishes to alert, but may take inputs such as the individual's vital readings, weather information at the individual's given GPS location, or even video / audio streamed from a device indicating the need for intervention.
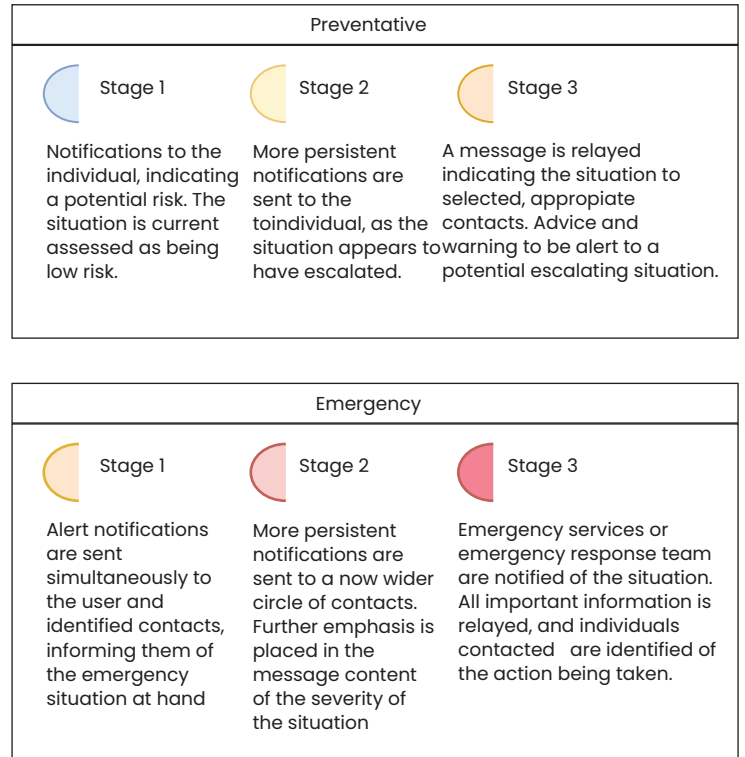
Preventative		
Stage 1	**Stage 2**	**Stage 3**
Notifications to the individual, indicating a potential risk. The situation is current assessed as being low risk.	More persistent notifications are sent to the toindividual, as the situation appears to have escalated.	A message is relayed indicating the situation to selected, appropiate contacts. Advice and warning to be alert to a potential escalating situation.

Emergency		
Stage 1	**Stage 2**	**Stage 3**
Alert notifications are sent simultaneously to the user and identified contacts, informing them of the emergency situation at hand	More persistent notifications are sent to a now wider circle of contacts. Further emphasis is placed in the message content of the severity of the situation	Emergency services or emergency response team are notified of the situation. All important information is relayed, and individuals contacted are identified of the action being taken.

Figure 3: Alert Escalation

The flow of potential warning and alert levels can be seen in Figure 3. Messages begin as preventative efforts, with notifications being sent to the individual. If the situation escalates, these notifications become more persistent and ultimately as the risk becomes increasingly elevated contacts are identified and notified of the situation.

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Situational alerting use cases

Personal preventative alert for the user

You are near a dangerous area / trigger situation for your addiction / you've been in a dangerous addiction area / trigger situation for extended period of time.

Preventative alert escalation

Notification to contact/s indicating that a potentially harmful pattern regarding an addiction has been detected, by means of internal bodily measurements (stress etc.) or periods of time in places suggested to be risky for their addiction.

Once the situation is deemed to be an emergency, alertR no longer looks for preventative methods. Emergency messages are now sent to the individual's support contacts, and the individual. At this stage escalation happens by both messaging a wider net of potential responders, and contacting more devices for these responders.

Emergency alert

Alert is sent to relevant contacts and family of an alertR user, who has been detected of having, an addictive outburst needing assistance now. Immediate advice is given on the screen (personalized to either the individual or the next closest point of contact).

Throughout this cycle alertR constantly checks the user's current status and their exact metrics to understand the gravity of the situation. This way the engine can ensure it is issuing an appropriate indication of the current state of the vulnerable individual. We also keep track of who has responded to the alert. This way we can log data regarding the contacted individuals to provide a better response in the future.

alertR responders

Speed of response from an individual's support network is critical in both preventative and emergency situations. In a study conducted in 2012 by a researcher at Colombia University, it was found that response time increasing by one minute increased the mortality by between 8-17%.[4]
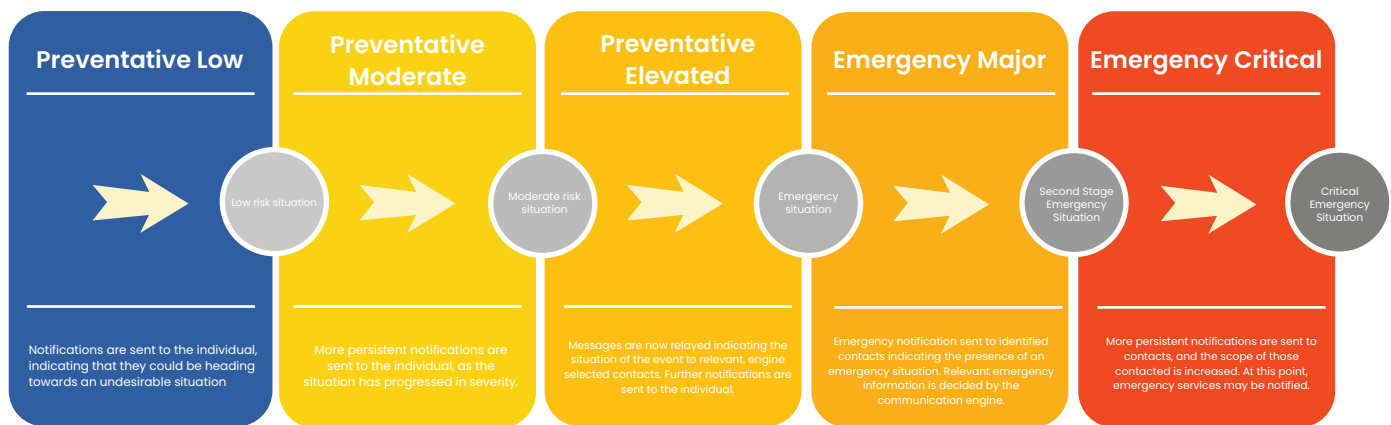
Using AI and ML to understand, interpret and predict from the vast amounts of data collected, the decidR and delivR engines ensure a fast communication process to the most relevant person close at hand.

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[4] Do emergency medical system response times matter for health outcomes?

The message contains the right information for a speedy response such as, reliable location data, medical history, and other relevant details, appropriately to the responder and in a manner most suitable for them. This message also includes a specific response button; this is pressed by the person responding to halt the escalation chain.

Once the responder has attended to the situation, an all-clear message is sent to the individual's support network to inform them of the status. A feedback mechanism is triggered to gain valuable information from the responder(s) and those contacted in the process of the escalation. The decidR engine uses the data gleaned to better understand and future improvements.

Figure 4: The Complete Alerting Process.

Preventative Low	Preventative Moderate	Preventative Elevated	Emergency Major	Emergency Critical
Low risk situation	Moderate risk situation	Emergency situation	Second Stage Emergency Situation	Critical Emergency Situation
Notifications are sent to the individual, indicating that they could be heading towards an undesirable situation	More persistent notifications are sent to the individual, as the situation has progressed in severity.	Messages are now relayed indicating the situation of the event to relevant, engine selected contacts. Further notifications are sent to the individual.	Emergency notification sent to identified contacts indicating the presence of an emergency situation. Relevant emergency information is decided by the communication engine.	More persistent notifications are sent to contacts, and the scope of those contacted is increased. At this point, emergency services may be notified.

In summary, alertR determines:

- The required alert level to send out for the individual based on the behaviour deviation, via the decidR engine.

- The appropriate contact for the alert level stage.

- The appropriate means and type of communication for the alert level and individual to be contacted – how the message content should be written /communicated in the best manner for the recipient, via the delivR engine.

- The time to take between increasing the alert level.

- The best way of communicating user location and vital information.

- Good Samaritans, and the appropriate contacts for each stage.

- The verification process: confirms that a support contact is responding and attending to the situation, and the user becomes "not at risk", thus halting the escalation chain.

- The improvements of all the alertR modules using the data collected during the alert lifecycle.

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The alertR alerting process

Topic	Data Source	Reason
Who to contact?	Time of day	To identify when the contact may be available to help
	Social media connections	To identify who the individual talks to, and when
	Prior event database	To determine which contacts have successfully intervened in the past
	User and contact location	To determine the proximity of contacts, to understand who is close enough to respond
What device to contact?	Individual and contact device databases	To identify which connected devices the individual and contacts have
	Prior event database	To identify which device was notified in the past, and alter the device notified if required
	User feedback	To understand which devices would have been more preferable to contact for previous events
	User location	To identify the devices near the individual. For instance, altering the selected device if the chosen contact is at home, or out and about.
What should be contained in the message?	Prior event database	To identify and understand what characteristics of messages made responses successful in the past
	User preferences and feedback	To identify appropriate communication style, language, etc.
	Selected device to notify	To determine the form of the message, for instance varying if the message is to be sent to a fitness watch or a mobile phone
	Instructions to help	To inform the responder on what they can do, for the current situation. This may taken in the user's vitals, and send out information such as online resources or our own advice on what could be done.
How should the message be delivered?	Situation severity score	To understand how important a quick response is
	User and responder feedback	To identify what worked well in the past

About smartR AI

smartR AI™ is committed to developing life-changing artificial intelligence applications based on the evolution of interactions, behavior changes, and emotion detection.

Focusing on behavioral intelligence and interconnections with IoT, we use AI applications to understand, interpret, predict, and respond to complex scenarios. As intelligence moves to the edge of the network, smartR AI is all about doing things the smartest way.

To solve complex real-world problems and optimize decision-making, smartR AI uses its intelligence-based proprietary engines. These engines ensure optimal efficiency and performance, improve quality, and reduce human error. They learn faster, leverage existing and historical knowledge, provide data efficiency, and allow for connectivity, to name just a few of their attributes.

The team builds products with the latest AI techniques and knows how to help you integrate AI into your product, and our expertise and diversity of knowledge ensure clients benefit from high levels of adaptability. We listen to your ideas and turn them into reality.

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