

The missing link in healthcare

Addressing the silent killer of non-adherence

Connected devices can engage patients with their treatments and drive individualised healthcare. With contributions from Bernard Vrijens, Professor, University of Liège and founder of ESPACOMP.

The future is exciting.

Ready?



Improving adherence by connecting the dots

Clinicians are constantly looking for new and better treatments for acute and chronic conditions. But what if they could have a massive impact on patient outcomes at a fraction of the cost of developing new medication? They can – by improving adherence.



Better approaches to adherence can bring the 50% of the population that are non-adherent inside.¹

Patients don't always stick to their treatments

When patients with acute or chronic illnesses don't stick to their treatment regime or take their medication as prescribed, they're reducing their chances of survival, recovery or relief from symptoms. They're also adding to the costs of care. In the US alone, poor adherence costs payers up to an estimated \$290 billion a year.² That's not surprising when you consider that, according to the UK's National Institute for Health and Care Excellence (NICE), approximately one-third to a half of all medicines prescribed for long-term conditions are not taken as recommended.³



The World Health Organisation (WHO) has said that adherence for long-term therapies for chronic illnesses, such as hypertension, cancer and HIV in developed countries is only around 50% — and even lower in developing countries.⁴

What's the answer?

Today, as part of a wider programme of adherence, most health providers rely on education and simple reminders to get people to stick to their treatments. It's true that if you provide patients with information about how important following their regimen is to the effectiveness of their treatment, you can improve adherence. And various "low tech" solutions have also proven somewhat effective: such as medication management pill boxes (labelled with days of the week, for example) and sending automated prompts by email or SMS. But providers are failing to realise the opportunities more advanced technologies offer to increase adherence, improve treatment and cut costs.

The reasons that people don't follow their treatments are complex. Traditional approaches to remedy the situation don't provide data on whether therapies, equipment or medication were actually used, taken on time and used effectively – especially important in the case of things like asthma inhalers and sleep apnoea devices. It's when this data is collected and shared with patients and healthcare professionals that it can really start to change behaviours and improve patient outcomes. We now have the technology to improve the measurement and management of adherence.

The Internet of Things (IoT) value chain

It's time for an evolution in the way medical adherence is tackled. In today's hyper-connected society, why are we still relying on 20th century techniques to try to ensure people take their drugs correctly?

Solutions like smart packaging and connected devices, which can provide an accurate measure of whether patients are following their treatment regimes, could be the answer. But they've been held back by the practicalities of capturing, storing and analysing data from thousands of remote devices. That's all changing thanks to the IoT platforms. They're helping simplify and accelerate the development of new solutions by bringing together the technical components, like devices, connectivity, hosting and analytics. This is making smarter approaches to adherence a reality.

In this paper, we cast a light on the importance of adherence and look at how it can be improved using IoT technologies – and what that could mean for the healthcare profession and patient care and wellbeing.

Why does adherence matter?

We've all forgotten to take medication at some point. But few people understand the implications of that, not just to ourselves, but to healthcare in general.

Better patient outcomes

For some treatments, there's a narrow therapeutic window and little forgiveness if patients stray from the prescribed regime. In these cases, improving adherence is vital. It's been calculated that lack of medical adherence leads to 125,000 deaths per year and accounts for 69% of all medical-related hospital admittance in the US.⁵ If patients with high blood pressure were treated to guidelines, up to 89,000 premature deaths could be prevented each year in the US.⁶ It has been estimated that there are 194,500 deaths a year in the European Union due to incorrect dosage and non-compliance of prescribed medication.⁷

With better data on adherence at clinical trials, healthcare professionals would be able to make more informed decisions on dosing. Bernard Vrijens, Professor, Department of Public Health, University of Liège, and founding member and managing director of the European Society for Patient Adherence, Compliance, and Persistence (ESPACOMP), explains that drugs are currently developed for the "average patient" to simplify prescription regimes. He says drug development is often based on finding the highest, "approximately safe" dose – but that can lead to more people experiencing side effects.⁸

With more accurate information on adherence, doses could be reduced. That, in turn, could improve adherence among those experiencing side effects. And it could provide the basis for more individualised care – with doses prescribed on the basis of a patient's likely level of adherence.

Reduced costs

The benefits don't end with improved patient outcomes. Better adherence can also reduce medical costs. For severe asthma, estimates suggest that the savings produced by optimal control would be around 45% of total medical costs.⁹ Improved medication adherence among patients with diabetes could result in over 1 million avoided emergency department visits and hospitalisations in the US annually, for potential savings of \$8.3 billion each year.¹⁰ Non-compliance is estimated to cost the European Union €125 billion annually.¹¹

Payers could make significant savings from a reduced need for stepped care. For example, if patients fail to adhere to their first treatment, it's possible they'll be prescribed a higher dose. If that doesn't work, they could proceed to a third and fourth treatment. That's costly for payers. And patients may be receiving treatment they could have avoided if they'd followed their original prescription.

“ Stepped care without reliable adherence results in higher doses, unnecessary combination treatments and more expensive therapies. You'll save a lot of money and time by avoiding unnecessary combination treatments. ”

Bernard Vrijens, Professor, Department of Public Health, University of Liège, and founding member and managing director of ESPACOMP

Why don't patients follow their treatments?

The picture is complex – there are over 700 identified reasons for non-adherence.¹² That makes it difficult to develop a predictive model to suit all patients and situations. And that's why it's so important to have a means of accurately measuring and managing individual adherence.



Initiation

Across many chronic diseases 20-30% of patients don't start their treatment or collect their prescription.¹³ That can be due to cost, lack of perceived benefits, and/or concern about side effects, as well as limited availability of medicines.



Implementation

Patients can simply forget to take their medication or become overwhelmed by complex dosing regimen — some patients may need to take many medications at different times of the day.



Persistence

Many patients stop treatment early if their symptoms have abated, they're suffering side effects or they don't perceive sufficient benefit. Nearly one-third of heart-attack patients don't persist with their prescribed medications by six months.¹⁴

Finding a smarter cure for adherence

How can we change patients' behaviour so that they start their treatment and then stick to it? The Internet of Things can make a huge difference.

A better picture of adherence

IoT sensors are getting smaller, more advanced and cheaper. Connectivity is ubiquitous, and private networks are more secure than ever. Storage and computing can be scaled up easily and cost effectively thanks to the cloud. It's easier than ever before to develop new applications, with providers releasing APIs and developing IoT platforms. These technological developments are driving innovations that are transforming every industry. And they're set to transform healthcare adherence, too.

Take smart packaging. It's been around for some time, but its use has been limited. More widespread use is now becoming truly practical thanks to advances in sensors, connectivity, storage and computing. IoT sensors within a blister packet can detect when the package has been opened, and transmit that information over a secure network to a database for analysis. That's a big deal. According to Professor Bernard Vrijens, studies have found that there is a 97% correlation between how many patients open the package and how many actually take the medication.¹⁵ That means smart packaging can provide a very accurate measure of adherence.

“Smart packaging has been around for almost 25 years. But its use is still extremely limited. Connectivity has been the number one problem — getting the data from the smart packages.”

Bernard Vrijens, Professor, Department of Public Health, University of Liège, and founding member and managing director of ESPACOMP

The use of these sensors isn't limited to pill packets. Professor Bernard Vrijens expects smart inhalers to be among the first IoT-enabled devices to hit the market. As well as providing data on when they're being used, these could gather data on how effectively they're being used. Smart syringes are also being developed that can capture data on adherence and manage dosing. And smart pills can provide adherence data as well as information on patient health.

Changing patient behaviour

Once you have better information on adherence, you can start to have an immediate impact on patients' behaviour simply by sharing it with them, their relatives and healthcare providers. Data can be collected, analysed and then shared with patients via apps on their smartphones — all, potentially, in near-real time. Sharing data with patients which shows them that they're not following their treatments can provide a stronger impetus for them to improve.

As more data on adherence is collected, it may be possible to send patients increasingly personalised and compelling messages. Instead of just saying “you took eight out of ten tablets today”, clinicians may be able to say, “you reduced your chances of getting better by 20%”. This reinforces educational material and reminders, and enables clinicians to start putting more onus on patients and their families to own their treatments.



If patients get feedback about their own adherence, their compliance levels improve by nearly 20%.¹⁶

The benefits go beyond patients taking their medication at the right time and for the full term. Patients with asthma, for example, could be sent information on how to improve their inhaler technique. Patients who've taken smart pills could be sent data on the effectiveness of their medication, encouraging them to continue with their full course of treatment.



More accurate dosing

Smart adherence devices could also result in more accurate dosing. With better data on adherence levels, the healthcare industry could get a clearer picture of patient behaviour. And if they can encourage better adherence at clinical trials, they could get better results for the treatment and thus longer persistence.

Smart delivery solutions are in the pipeline that will correlate data on adherence with data from other connected devices, such as weight scales and wearable fitness trackers, to help ensure patients get the right doses at the right time.

The way forward

There's growing interest across the healthcare industry in how smart devices and other technology can help improve adherence. But the cost and complexity has tended to limit rollout to clinical trials and a handful of excellent healthcare centres that see it as a differentiator. That's about to change.

We now have all the components for an IoT-enabled adherence solution — the smart devices, connectivity and hosting needed to take smart adherence forward. There's a better chance of this working than ever before. But making it a reality requires a means of connecting the dots to deliver an end-to-end solution.

Smarter approaches to adherence



Smart packaging

Opening a bottle or carton is a reliable indicator that medication has been taken.

Sharing data with patients can improve behaviours and adherence.



Smart delivery

Sensors in devices, inhalers or syringes capture when medication is used.

For example, they provide a measure of whether the full dose was taken, which can inform patient behaviour.



Smart pills

IoT-enabled pills can show exactly when medication is taken.

These solutions can provide information on medication effectiveness.



Smart diaries

By keeping a diary, patients can become more engaged in the process of taking medication.

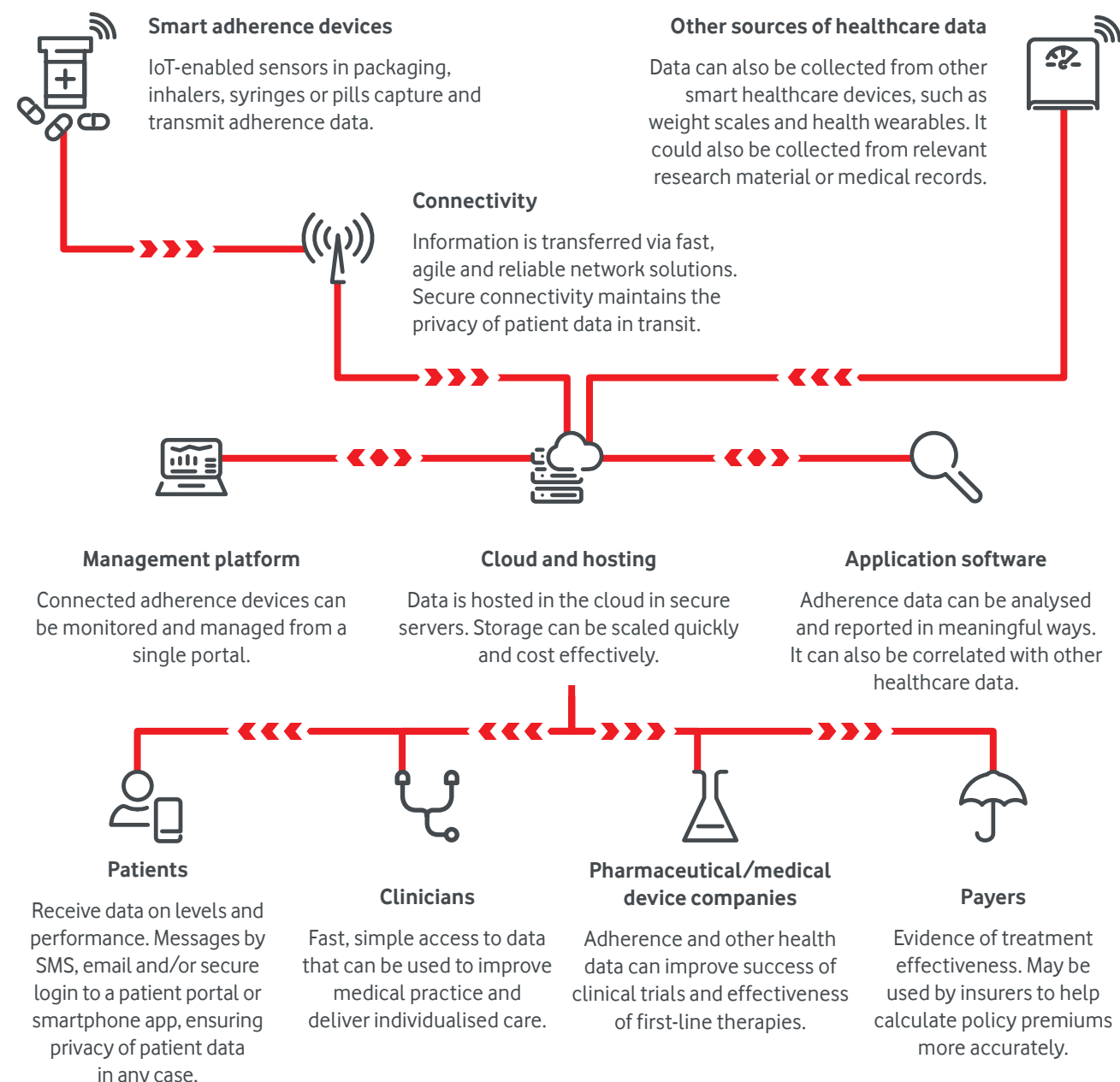
Patients share information on how they're feeling with their doctor.

The Internet of Things: providing a platform for change

The technology is here to make smarter adherence a reality and deliver better patient outcomes. Here's how it works.

Communication service providers, like Vodafone, offer a managed IoT platform that provides the secure and reliable connectivity, storage and compute to handle data from vast numbers of devices and scale up to much larger entities. And they provide management portals that give oversight of all connected assets. That means smart adherence programmes can be rolled out securely, reliably and cost-effectively for IoT projects of any size.

IoT-enabled adherence solution



Delivering individualised healthcare

What do IoT-enabled adherence solutions mean for the future of healthcare?

More independence for patients

For patients, better adherence will mean better outcomes. They'll be more likely to live longer. They'll be less likely to suffer side effects from unnecessarily high doses. And with greater access to data on their own adherence and health, they'll be in a better position to take charge of their own health and live more independent lives. As data analytics becomes more sophisticated, it's possible that prescriptions could be changed automatically without the need for a clinical appointment.

“Healthcare providers currently monitor four main vital signs: body temperature, pulse rate, respiration rate and blood pressure. IoT means they'll soon be able to measure a fifth – medical adherence.”

Bernard Vrijens, Professor, Department of Public Health, University of Liège, and founding member and managing director of ESPACOMP

More effective diagnosis and monitoring

But healthcare IoT technology doesn't mean patients are left alone. It will give clinicians access to data that will help them make more effective diagnoses and prescribe the best possible treatments for individuals. That data won't just be on adherence. They'll also have access to real-time data from connected health monitoring devices as well as medical trials. With this, they'll be able to aggregate data to develop stronger education programmes. And they'll be able to correlate adherence data with research results to help, for example, tackle the issue of antimicrobial resistance. Artificial intelligence (AI), machine learning and advanced data analytics could provide valuable new insights.

Better drug development

In research and development, the healthcare IoT value chain will mean access to more accurate information when running clinical trials and developing drugs. With better adherence data, there will be a greater likelihood of a clinical trial completing successfully. And by using smart devices to manage the delivery of medication, they'll be able to boost the success rate of their treatments.

Lower healthcare costs

For payers, better patient outcomes will mean lower costs. And the use of smart devices to improve adherence and measure health could prove a particularly attractive proposition for payers and health providers by helping avoid the need for stepped care.

We're making this happen now

In this paper, we've evidenced the importance of adherence and how it can be improved using IoT technologies. And we've also set out what that could mean for the healthcare profession, patient care and wellbeing.

Providers like Vodafone can help design IoT-enabled adherence solutions to meet the individual needs of patients and healthcare professionals by integrating devices, software and managed connectivity.

The technology is here to make smarter adherence a reality and deliver better patient outcomes.

Now is the time to act.

Please visit vodafone.com/iothealth or email iot@vodafone.com

References

1. Adherence to long-term therapies, WHO, 2003, p 156
2. Thinking Outside the Pillbox: A System-wide Approach to Improving Patient Medication Adherence for Chronic Disease, New England Healthcare Institute, 2009. p 1
3. Medicines adherence: Involving patients in decisions about prescribed medicines and supporting adherence, National Institute for Health and Care Excellence (NICE), Clinical Guideline 76, 2009. p 4
4. Adherence to long-term therapies, WHO, 2003, p XIII
5. <https://www.healthcarepackaging.com/article/package-feature/safety/patient-non-adherence-costs-underestimated>
6. <https://www.healthcarepackaging.com/article/package-feature/safety/patient-non-adherence-costs-underestimated>
7. http://cordis.europa.eu/project/rcn/75025_en.html
8. Poor medication adherence in clinical trials: consequences and solutions, Breckenridge et al, 2017, p 1
9. Adherence to long-term therapies, WHO, 2003, p 13
10. Greater Adherence to Diabetes Drugs is Linked to Less Hospital Use and Could Save Nearly \$5 Billion Annually, A. Jha, Health Affairs 31, no. 8, 2012, p 1836
http://cordis.europa.eu/project/rcn/75025_en.html
12. Determinants of patient adherence: a review of systematic reviews, Kardas et al, 2013, p 1
13. <https://link.springer.com/article/10.1007%2Fs11606-010-1253-9>
14. <http://managingyourmeds.org/adherence-facts/>
15. Methods for Measuring, Enhancing, and Accounting for Medication Adherence in Clinical Trials, B. Vrijens, Clin Pharmacol Ther, 95:6, 2014. p 6
16. Identification and Assessment of Adherence-Enhancing Interventions in Studies Assessing Medication Adherence Through Electronically Compiled Drug Dosing Histories: A Systematic Literature review and Meta-Analysis, Demonceau et al, Drugs, 2013, p 546

vodafone.com/business/iot/health

Vodafone Group 2017. This document is issued by Vodafone in confidence and is not to be reproduced in whole or in part without the express, prior written permission of Vodafone. Vodafone and the Vodafone logos are trademarks of the Vodafone Group. Other product and company names mentioned herein may be the trademark of their respective owners. The information contained in this publication is correct at the time of going to print. Any reliance on the information shall be at the recipient's risk. No member of the Vodafone Group shall have any liability in respect of the use made of the information. The information may be subject to change. Services may be modified, supplemented or withdrawn by Vodafone without prior notice. All services are subject to terms and conditions, copies of which may be provided on request.