



C3-Cloud

**“A Federated Collaborative Care Cure Cloud Architecture for
Addressing the Needs of Multi-morbidity
and Managing Poly-pharmacy”**

PRIORITY Objective H2020-PHC-25-2015 - Advanced ICT systems and services for integrated care

D2.11 Dissemination Plan version d

Work Package: WP2 Dissemination, Exploitation and Innovation Related Activities”

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Contributors (Beneficiary)	George Despotou, Sarah N. Lim Choi Keung, Omar Khan, Theodoros N. Arvanitis, (WARWICK) Mustafa Yuksel, Gokce B. Laleci Erturkmen, Asuman Dogac (SRDC) Pontus Lindman, Tapio Jokinen (MEDIXINE) Marie-Christine Jaulent (INSERM) Mattias Fendukly, Rong Chen (CAMBIO) Dipak Kalra, Geert Thienpont, Pascal Coorevits, Charlie McCay (EUROREC) Malte von Tottleben (empirica) Marie Beach, Chris Marguerie, Danny Roberts (SWFT) Nicolas Gonzalez, Antonio de Blas (OSAKIDETZA) Gunnar Klein (ORU) Marie Sherman, Mikael Lilja, Göran Larsson (RJH) Ane Fullaondo Zabala, Lola Verdoy, Esteban de Manuel (KG)		
Responsible Author	Dipak Kalra	Email	dipak.kalra@eurorec.org
	Beneficiary	EUROREC	

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1. EXECUTIVE SUMMARY

This final reporting period of the project has seen positive and some negative implications of the COVID-19 pandemic for our dissemination work.

On the strongly positive side, our recent emphasis has been to shift from describing what we will do, showing prototypic examples and describing piloting intentions, to demonstrating an implemented, deployed and used integrated C3-Cloud solution, with growing evidence of its practical usability for adopting healthcare providers, by multidisciplinary team users and by patients and caregivers. We have been collecting evidence of benefit, which we are now consolidating and will be able to even more powerfully disseminate post project.

Also on the positive side, we have taken on board recommendations from the last review and re-developed our website to be more appealing and easily understood by multiple stakeholders, including clinicians, patients, and health system decision-makers. We have focused our highest impact messages towards these stakeholders, who hold the trump cards in deciding whether to champion and invest in our multimorbidity and polypharmacy solutions, in contrast to previous years when we were focusing on the immediate adopting community within the ICT sector.

On the negative side, we have had many months when physical events have not been possible. We know that in-person interactions deliver much greater and more lasting impact than online events. Fortunately, we were able to schedule a large-scale event in November 2019, as a key project that was showcased through the “Joining the Dots” conference in Brussels, attended by over 150 richly multi-stakeholder participants. We were part of plenary and breakout sessions and had our own dedicated half day event during that conference. Some of the key findings we contributed to from that event were presented as policy recommendations to the eHealth Network at the end of the conference.

In 2020 we have redirected our efforts towards online workshops, conferences and publications. Our final C3-Cloud Conference on tackling multimorbidity through digital health tools was held on 28th August as an online full day event for 115 registered participants, and an interwoven agenda of external keynote speakers and components of the C3-Cloud ambition, solution and results.

Throughout this reporting period partners have contributed to conferences, written academic papers and held or contribute dot workshops. We recognise the convincing power of our final evaluation results, which have recently been compiled. We therefore intend to continue to promote the project, now that we have all of the results of our beneficial impact, in forthcoming events during 2020 - 2021.

In this deliverable we present the new look website and explain how it was redesigned in order to have greater impact on less technical stakeholders. We include chapters summarising the Joining the Dots conference, since this was the final in-person event strongly driven by C3-Cloud, and our final conference on multimorbidity. We also list, in the same format as previous years, the many dissemination activities that we have undertaken. This final year has also seen the transition between activities that are purely dissemination towards activities that lead to exploitation opportunities. Some of what we have done in the last reporting period is therefore to be found in other deliverables, especially D2.10.

Finally, it is important to emphasise that the partners are very enthusiastic about, and committed to, what we have achieved together. We really see the importance of encouraging a more proactive approach to multimorbidity management by health systems, and therefore we recognise that the opportunities for disseminating C3-Cloud must continue. The partners have therefore committed their core organisational resources to continue with dissemination activities after the project. The immediate and funded opportunity is through follow-on projects, in particular Horizon 2020 ADLIFE which is adopting and scaling up the C3-Cloud innovations for advanced chronic conditions.

This deliverable is therefore the final dissemination deliverable of the project, but it is not the final phase of our dissemination efforts and ambition.

2. KEY STAKEHOLDER MESSAGES

The following table summarises the main messages we have promoted to each of the stakeholder groups who influence decisions about adopting C3-Cloud approaches and solutions to multimorbidity and poly-pharmacy. Some stakeholder messages are the same but are delivered in appropriate language and with an appropriate level of clinical or technical detail for each group.

Stakeholder group	Main messages	Principal outreach channels
Patients, caregivers	<p>Explanation of what multi-morbidity is, and how it leads to poly-pharmacy</p> <p>Challenges in care co-ordination faced by health systems</p> <p>Benefit of harmonising clinical guidelines across diseases</p> <p>Importance of engagement in care planning</p> <p>Value of self-management and prevention, using suitable apps</p> <p>How the C3-Cloud PEP works</p> <p>Results of the C3-Cloud pilots</p> <p>Availability of C3-Cloud solutions for adoption by health systems</p>	<p>Web site</p> <p>Multi-stakeholder integrated care events</p> <p>Targeting of patient organisations for diseases commonly associated with multi-morbidity</p>
Health and care professionals	<p>The growing challenge of multi-morbidity and its implications for care co-ordination</p> <p>Why single condition guidelines are unsatisfactory, and how they can be aligned to streamline care</p> <p>How aligned guidelines may alter first line treatment choices</p> <p>The importance of patient engagement in joint decision making</p> <p>The value of empowered patients taking an active role in self-management and prevention</p> <p>The knowledge components of C3-Cloud</p> <p>The end user facing technical solutions of C3-Cloud: care planning and PEP tools</p> <p>C3-Cloud pilot evaluation results</p> <p>Availability of C3-Cloud solutions for adoption by health systems</p>	<p>Web site</p> <p>Multi-stakeholder integrated care events</p> <p>Targeting of health professional associations</p> <p>Integrated care conferences</p>

Health and social care provider organisations, healthcare payers, policymakers	<p>The growing challenge of multi-morbidity and its implications on healthcare efficiency, outcomes and costs</p> <p>How aligned guidelines may alter first line treatment and care planning choices</p> <p>The knowledge components of C3-Cloud</p> <p>The integrated care support provided by the C3-Cloud technical (interoperability) components</p> <p>C3-Cloud pilot evaluation results</p> <p>The demonstrated value to patients of the C3-Cloud empowerment platform</p> <p>Availability of C3-Cloud solutions for adoption by health systems</p>	<p>Web site</p> <p>Multi-stakeholder integrated care events</p> <p>Dedicated meetings with decision makers, mainly at national levels</p>
Health ICT sector	<p>The growing scale of multi-morbidity across Europe and its need for more integrated care</p> <p>The potential of this as a market driver for interoperability standards adoption</p> <p>Details of the C3-Cloud technical components e.g. FHIR repository, semantic interoperability tools, care plan management tools and applications, patient empowerment platform</p> <p>Approaches for integration with existing EHR systems</p> <p>Commercial relationships</p>	<p>Web site</p> <p>Multi-stakeholder integrated care events</p>
Academic organisations	<p>The importance of health data and medical knowledge integration</p> <p>C3-Cloud approaches to semantic interoperability</p> <p>C3-Cloud implementations of data standards and security standards</p> <p>Details of the C3-Cloud technical components e.g. FHIR repository, semantic interoperability tools, care plan management tools and applications, patient empowerment platform</p> <p>Outstanding areas of research</p>	<p>Web site</p> <p>Multi-stakeholder integrated care events</p> <p>Health informatics academic conferences and journals</p>

3. C3-CLOUD WEB SITE

3.1. The need for redesigning the initial C3-Cloud web site

The C3-Cloud website prior to August 2019 offered quite an extensive set of information on the project organisation, the challenges addressed and the technical solutions. In this way, it was probably a nice ‘reference book’ for project participants and insiders familiar with EU projects. However, in order to make it attractive to other stakeholders, users and beneficiaries, it was important to improve its overall design. The issues with the site as it was a year ago are highlighted here.

- Whereas the final beneficiaries should be put centre-stage, the stakeholder pages were hidden very deep down the navigation menu.
- The language used was factual, impersonal, not adapted to the knowledge level of the target group and was hardly showing empathy with the target groups’ realities. Consequently, the pages did not establish a connection with the reader and were not convincing. This factual approach also created a feeling of lack of personality on behalf of the project.
- The upper navigation menu was not helpful in offering the stakeholders a logical sequence to follow. There was no internal linking either to remedy this.
- The majority of the web pages tried to address all audiences, but therefore not succeeding in appealing to any of them because of the mix of languages (semi-scientific) and messages.
- The content pages contained rather dry information, not making full use of a variety of formats which help to increase the appeal and persuasive power of the website (infographics, images, testimonials, catch phrases, frames, colours ...).

The web site redesign that was described in D2.9 went live after project review (in June 2019) in August 2019. We moved from a simple Drupal site to WordPress with the help of website design company. This was a big redesign in itself.

3.2. Objective: personalised target group trajectories

The main objective of the new website design was to create an instant identification and interest with each of the main target groups and lead them to relevant ‘cornerstone’ pages as starting point to their ‘customer journey’ on the website.

We have differentiated three target groups and appealed to them on the homepage by showing the benefits C3-Cloud can bring to each of them. Note that we have grouped some stakeholder groups (i.e. health and care professionals + provider organisations + healthcare funders) on the basis of overlapping common pains and gains. This results in three web site trajectories / target audiences.



Clicking on one of the target groups brings the visitor to a specific cornerstone page with appropriate identification, key messages, calls to action and language. Each cornerstone page contains links to interesting subpages, which we have rewritten in function of the stakeholders' profiles to avoid a mix of technical/scientific content and lay content.

Switch from a project oriented website to a target group oriented website

3.2.1. Page structure

The cornerstone pages for each of the target groups present a logical sequence of thought to guide the website visitor to the desired conclusion and decision.

Identification → interest → acceptance/adherence → action

Identification and connection

Identification is achieved by making a strong connection with the target group, showing affinity with their realities and their pains. We have stressed this empathic approach by addressing them directly, using “you”, thus building rapport and trust. This is illustrated here for the patient or caregiver.

Possibly you, or someone close to you, suffer(s) from multiple long-term conditions, a situation referred to as 'multimorbidity'.



As a result of this, you are most likely surrounded by different teams of health care professionals,



each of them giving you a list of health instructions to follow and medication to take.



You may have multiple appointments and have to undergo several tests.

Interest

We subsequently lead the visitor from his pains to the gains C3-Cloud can offer him, in an appropriate language, relating how the C3-Cloud platform can make his everyday life better.

Your daily digital assistant

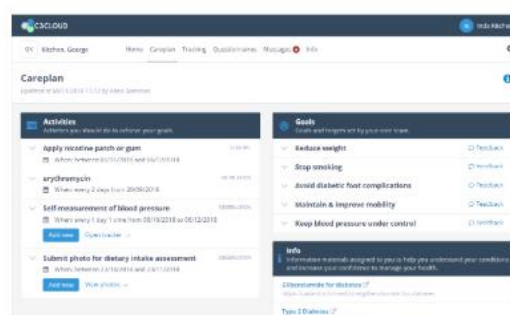
We have developed a userfriendly digital tool optimized for multimorbidity patients like you, and your informal caregivers, that will help you to better follow up on your medical instructions and allow you to communicate more easily with your health team.

Once we have explained why this solution is interesting, we enlarge on how C3-Cloud will practically help him, to subsequently lead him to the actual solutions page.

Practically, this 'Patient Empowerment Platform' provides you, in one central place, with:

- **Clarity** on the daily actions you have to undertake through reminders on medication intake, appointments with your health or care professional etc.
- The possibility to **introduce information** on your health condition, such as measurements or fill out questionnaires, so as to allow your health professional to monitoring your status closely.
- **Educational information** on your disease, your diet, the activities to help you achieve your health goals ...
- **Communication** possibilities with your health and care professionals through chat, video interview or mail

Patient Empowerment Platform



Create acceptance and adherence

In order to be more persuasive, we have used different formats to convince the reader, e.g. statistics, testimonials, storytelling. At the same time, we have tried to counter possible objections such as: is C3-Cloud difficult to use? Is it safe/GDPR-compliant? etc.

Call to action

Each cornerstone page concludes with a call to action, tailored to the stakeholder group and the status of the project.

Take positive steps for your own health

The C3-Cloud platform helps you take positive steps for your health and track your progress. This tool empowers you to contribute to the self-management of your condition. When your health care professional proposes this solution, be sure not to miss this opportunity!

3.3. Objective: make the website more convincing and attractive

Besides offering the stakeholders personalised trajectories, we needed to make the website more convincing and attractive. The above-mentioned interventions align with this second objective, which we have further enhanced through social proof, the visual page design and a variety of diverse formats.

3.3.1. Social proof

We have added (social) proof by means of

- Quotes
- Testimonials
- Statistics resulting from patient surveys and pilot site evaluations
- Statistics resulting from external studies

A patient's perspective

Göran Jönsson is one of the patients in the Region Jämtland Härjedalen participating in the C3-Cloud project. He is also testing home monitoring of blood pressure and weight in C3-Cloud. These results are automatically transferred to C3-Cloud where both he and his doctor can see the results immediately. His blood pressure readings displayed in C3-Cloud have helped him and the doctor to see that there was no need to increase the medication.



"I have perfect blood pressure at home. So, when I had an appointment with the doctor and then had an elevated blood pressure, I just informed her to look at the results in C3-Cloud. When she saw all the good blood pressure readings I had, she agreed that there was no need to increase the medication".

35 out of 36 patient-respondents think they will find it easy to become skillful at using the C3-Cloud system.

"Yes, quality of care in past year was excellent or very good" (7)

Engaged patients

69%

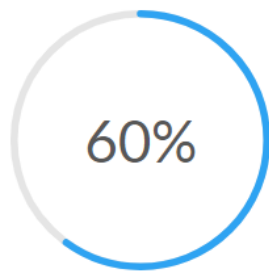
Not engaged patients

42%

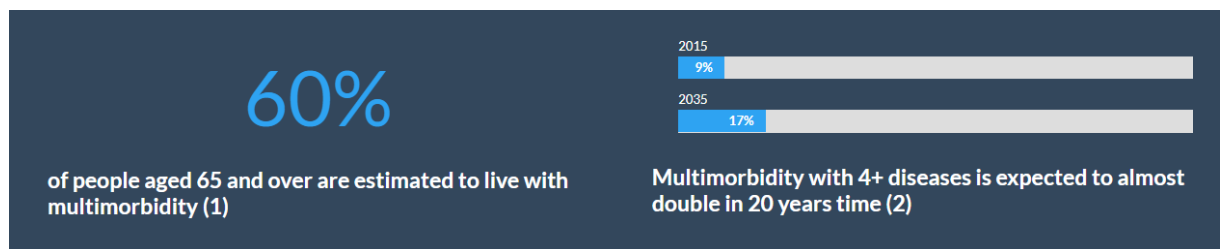
3.3.2. Visual page design

The current webpages contain more images to support the text messages, to give the site more personality and to make the site warmer, more human and more attractive to browse.

- More photos the target groups can identify with
- More coloured frames to highlight important texts such as user benefits or quotes
- Animated bar and circle counters



of people aged 65 and over are estimated to live with multimorbidity (1)



3.3.3. A variety of formats

We have introduced or reinforced a variety of formats such as

- Storytelling
- Screenshot + tutorial videos
- Catchphrases
- Subtitles and bulleted lists to make the texts more scannable

You will find an overview of the main functionalities of the Patient Empowerment Platform below or you can view the videos on the right.



General overview



Care planning for patients

Real life scenarios

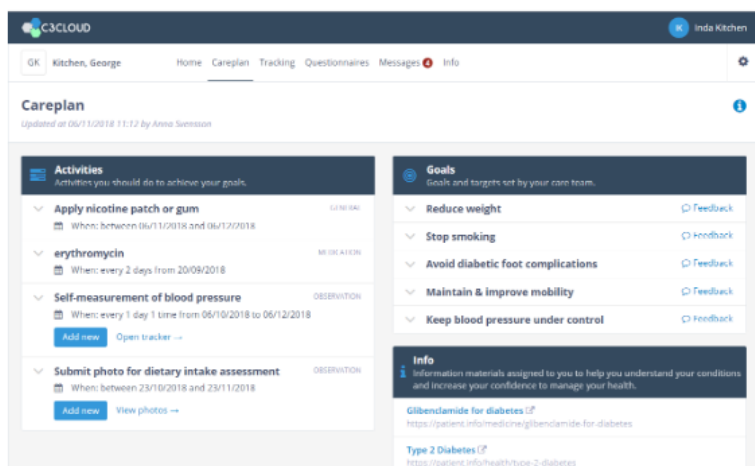
Read the stories of Mrs Jane Bee and Mrs Brenda Jones to see how C3-Cloud can support integrated care delivery.

Read the story

Mrs Jane Bee: diabetes and heart failure collide

Read the story

Mrs Brenda Jones: an example of multimorbidity in harmony



The personal care plan of the patient can be viewed and any goals, activities or informational materials that have been assigned by the healthcare team acted on.

3.3.4. New navigation and page layout

Furthermore, we have made the website more user friendly and impactful by enhancing the navigation and page layout.

The homepage, the stakeholder pages, the right page column and the upper navigation menu provide for ample possibilities for the visitor to browse through the website, amongst others via the extensive use of internal linking.

In addition, we have avoided pages with no other use than to redirect the surfer and have eliminated content that was unduly repeated on several pages.

As a result, we now have a clearer and lighter navigation structure.

3.3.5. Homepage

- We have removed the carousel on the former homepage for several reasons: competing messages that overwhelm visitors, no call to action and banner blindness to name a few. The current banner now contains a clear message about the project's mission and target groups.

- We have added easily recognisable persona blocks with title, image and practical benefits, which our different audiences can identify with to choose their corresponding trajectory.
- We have replaced the former statistic with its long accompanying text by two lighter, easier to understand statistics.


Smart solutions for management of multimorbidity

[Purpose](#)
[Solutions](#)
[Project Overview](#)
[Resources](#)
[News & Events](#)
[Contact](#)





Supporting you to better manage multiple health conditions

We provide collaboration, care coordination and follow-up tools for patients, caregivers and clinicians to achieve high quality integrated care and better health outcomes



As people are living longer, they are more likely to be living with different ongoing medical problems. Finding the best way to deal with this 'multimorbidity' can be challenging for patients, caregivers and clinicians.

C3-Cloud is developing innovative ICT systems to boost collaboration, care coordination and follow-up with the help of an online platform.

[Read more on the purpose of this EU-project.](#)

I am a patient or an informal caregiver



Get a clear overview of your treatment steps, find useful personalised info, communicate with your health professionals, take part in the management of your disease

I am a health and care professional/ manager/ funder



Benefit from care planning applications for multiprofessional teams, aligned clinical guidelines and streamlined care pathways

I am a health ICT developer



Integrate C3-Cloud as a component or as a whole solution into your EHR system

60%

of people aged 65 and over are estimated to live with multimorbidity (1)



Year	Percentage
2015	9%
2035	17%

Multimorbidity with 4+ diseases is expected to almost double in 20 years time (2)

- As a result, the list of challenges addressed by the project have moved down on the homepage.
- We have added some interesting figures about the project
- We have maintained the news, events and tweets sections

3.3.6. Right page column

Thanks to the right page column the visitor can see some other major info on the project, at a glance.



C3CLOUD
For Patients' Management of Multimorbidity

Purpose ▾ Solutions ▾ Project Overview ▾ Resources News & Events ▾ Contact

Coordinated Care for Health Sector Professionals/Managers

Due to ageing populations across Europe, we are seeing a rise of multimorbidity and polypharmacy. As a health sector professional or manager, you are undoubtedly experiencing the difficulty of managing care across diseases.




Most single condition guidelines have not been designed to be used easily alongside others, potentially leading up to patient safety risks. The increasing need for care co-ordination is hampered by a lack of information about how your patient is being managed by other healthcare professionals. This may lead to duplications of tests, multiple appointments, unnecessary treatment complexity and avoidable costs. This disjointed care threatens good health outcomes, and causes patients to lose trust and motivation.

Integrated care by a coordinated multidisciplinary team

C3-Cloud wants to fill the needs for more coordinated and personalised care planning, for multi-disease guidelines, for clinical decision support and more communication between health and care professionals, and patients. The results: better health outcomes for your patient, who will be more motivated to play an active part towards achieving his health goals.

Care plans for multiprofessional teams

C3-Cloud supports you with a Care Planning Platform which allows for:

- well aligned and easily updatable guidelines and optimised multimorbidity treatment

Care Planning Platform



Supporting patients managing multiple conditions

The C3-Cloud platform not only supports health sector professionals, it supports patients with multimorbidity, and their caregivers, with easy to use online programmes to better manage their own health in between clinic visits.

Furthermore they can introduce inputs (measurements, activities, care actions etc.) for you to monitor closely. Patients taking an active part towards their health goals.

You can find more information on this topic on our [pages meant for patients and their caregivers](#).

What is C3-Cloud?

C3-Cloud is a [European Union funded research project](#) piloted in 3 European regions in the UK, Spain and Sweden. It aims to develop personalised care plans for complex multimorbid patients, supported by ICT tools and managed by a coordinated multidisciplinary team.

Challenges

The [challenges](#) C3-Cloud is tackling:

- multimorbidity
- polypharmacy

3.3.7. Internal linking

Extensive internal linking facilitates finding the right information, including some supporting pdf

Discover more on our

- [Personalised Care Planning Support](#)
- [Clinical Decision Support Services](#)
- [Patient Empowerment Tool](#)

Health & care professionals / managers / funders

C3-Cloud wants to fill the needs for more coordinated and personalised care planning for multimorbid patients, for multidisease guidelines, for clinical decision support and more communication between health and care professionals, and patients.

This integrated care provided by a coordinated multidisciplinary team will lead to more cost-effective, safer health and better health outcomes. Patients will be more motivated to play an active part towards achieving their health goals. [More info](#)

ICT Developers will find more technical information on the Patient Empowerment Platform in this [product sheet](#) and in this [flyer](#).

documents.

3.4. Web site analytics

Comparison of active user trends over time (note that the most recent redesign went live from June 16, 2020 and it is too early for us to see differences in analytics).

Before Aug 2019 redesign (go-live) – analytics available from 1 Mar 2017

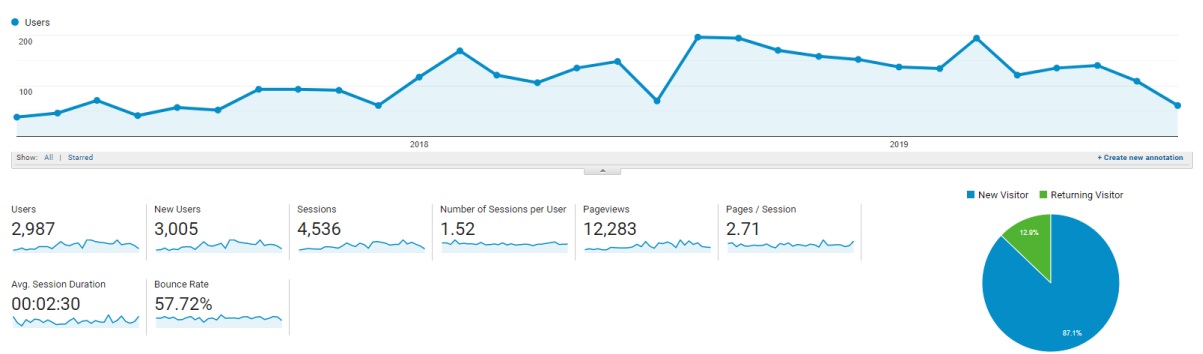
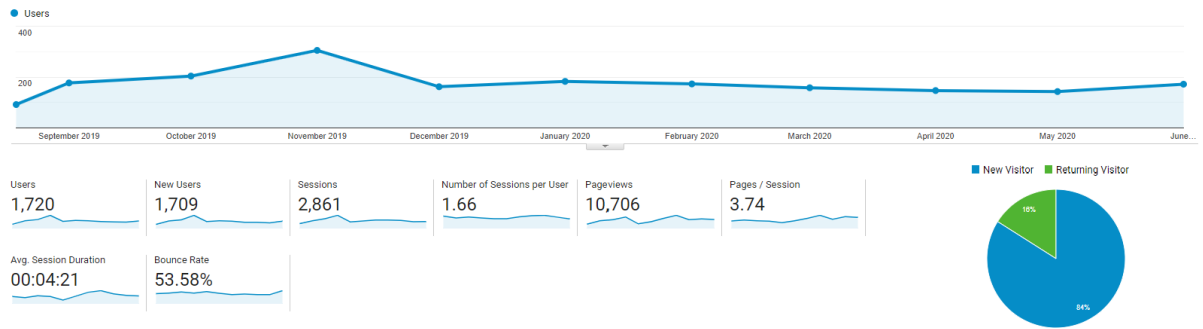


Figure 1: All users by month

After Aug 2019 redesign (go live in week starting 19 Aug 2019)



4. DISSEMINATION ACTIVITIES

The dissemination activities in this final year and a half of the project have mainly focused on presenting the project as a whole, the problems of multi morbidity that it is addressing, its method and work packages, and its anticipated results. Whilst initially face to face, in recent months this has taken place online.

4.1. Summary of dissemination activities

4.1.1. Types of dissemination activity undertaken

Our activities during this final reporting period have focused on presentations (7 conference presentations, 4 workshop presentations, 4 public C3-Cloud software demonstrations and 5 more focused presentations and demonstrations were made to key stakeholders during the past 16 months). 3 journal articles, a press release and two online articles have been published, training videos were produced and are now also on our web site. In addition to the main project web site, individual partners have promoted the project on their own web sites. Social media postings have been scaled up this year. Some examples of our dissemination outputs are included in Appendix 1.

4.1.2. Stakeholder groups reached via our dissemination activities

It is not easy to quantify the reach of our dissemination activities across stakeholder groups. Some events have been very focused and targeted just a few key persons intensely, others have reached a hundred or more within a conference plenary session or a webinar. Web site statistics do not tell us the stakeholder group of the visitors. Summing the numbers that we have therefore does not make sense. However, we do know that we have reached each of the following stakeholder groups through our activities, as indicated in the dissemination summary tables that follow.

- Health and social care payers and providers
 - care professionals
 - healthcare provider organisations
 - health insurers
 - health ministries
- Patient and community groups and associations
- Health ICT industry
- Standardisation bodies
- Research
 - clinical research
 - health informatics
- Education
 - health professional education
 - patient education
- Policymakers

4.2. Summaries of dissemination activities undertaken

International Journal of Integrated Care (IJIC) 2019	
Type of activity	Peer reviewed publication.
Date of activity	n/a
Title of dissemination	Facilitating coordinated Care for Multi-morbidity patients through integrated preventive Clinical Decision Support (C3-Cloud)
Description of event, publishing or hosting entity (city if applicable)	19th International Conference on Integrated Care, San Sebastian, 01-03 April 2019
Principal stakeholders	Professionals and researchers in integrated health and care.
Key messages, viewpoint and estimated impact	<p>C3-Cloud is an e-health based ICT system, offering integrated, patient-centred care, considering all aspects of multi-morbidity and creating a collaborative environment, for all involved stakeholders. The navel of the system consists of the patient care plan, a digital shared picture of the patients' needs and care regime. The care plan allows all professionals to review and understand the implications of one condition in the presence of others; this by its nature is complex, containing a considerable amount of diverse information. Navigating, understanding, and interpreting all the information can be confounding. The C3-Cloud Clinical Decision Support Service (CDS) offers an automated means of interpreting the available data. CDSS connects to the care plan repository, and continuously searches records for relevant data. The algorithms and integration of recommendations to the service were reviewed and validated by clinicians. Human computer interaction methods were employed to ensure optimal interaction between C3-Cloud and its users.</p> <p>Results: C3-Cloud offers CDSS for diabetes, renal failure, depression and congenital heart failure, with over 300 rules and checks that deliver four best practice guidelines in parallel; whilst reconciling their objectives, and monitoring their outcomes. It creates warnings or recommendations for the patient as well as for formal and informal carers.</p>
Any further links, references useful for the project (that has not already been provided for sharing publicly)	Despotou, G et al 2019 Facilitating coordinated Care for Multi-morbidity patients through integrated preventive Clinical Decision Support (C3-Cloud). International Journal of Integrated Care, 19(S1): A29, pp. 1-8, DOI: dx.doi.org/10.5334/ijic.s3029
Lead partner (if applicable)	Warwick

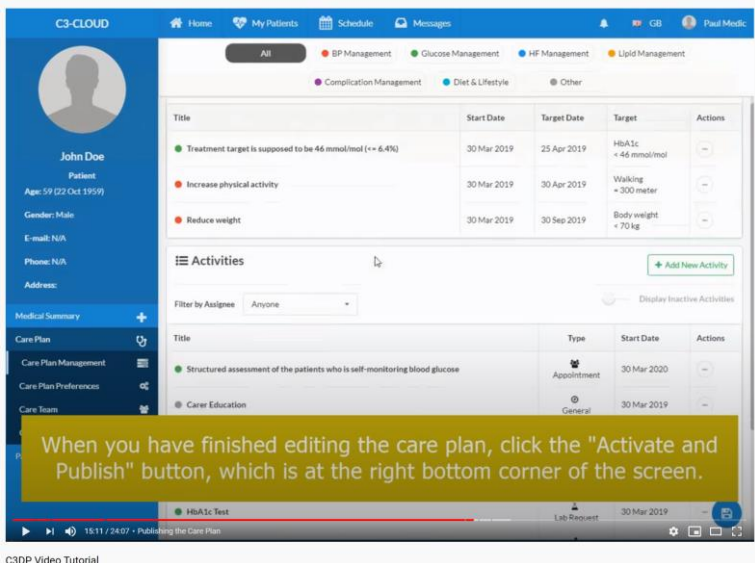
Industry engagement workshop in Sweden	
Type of activity	Participation to a Workshop
Date of activity	May 15, 2019
Title of dissemination	"Joint Way forward"
Description of event, publishing or hosting entity (city if applicable)	<p>At the eHealth Centre in Östersund, Sweden.</p> <p>Discussions from present works (internal and external) – such as the C3-Cloud project – with the mission to form a base from where the regional partners move forward in the fields of eHealth, healthcare development re primary, secondary and home care, in collaboration with stakeholders from industry and academia.</p>
Principal stakeholders	Region Jämtland Härjedalen, Municipality of Östersund, Cambio, Sigma, Tieto, Telia, Mid-Sweden University,

Provide estimated numbers for each stakeholder category where relevant (say Unknown if number not known) (the categories follow the EU reporting reporting)	
Scientific community (higher education, research)	2
Industry	10
Civil society [non-governmental, non-scientific organisations representing some sector of society e.g. patient organisations]	15
Lead partner (if applicable)	Region Jämtland Härjedalen

Vitalis 2019, Gothenburg, Sweden	
Type of activity	Participation to a Conference
Date of activity	May 22, 2019
Title of dissemination	<p>Oral presentation at the Vitalis Conference 2019</p> <p>Title of the talk was: “C3-Cloud, EU-projekt för nya former av stöd till multisjuka äldre i Region Jämtland Härjedalen” (C3-Cloud, EU-project for new ways of supporting multimorbidity in elders).</p> <p>C3-Cloud team members (Göran Larsson, Region Jämtland-Härjedalen, Mikael Lilja, Region Jämtland-Härjedalen, Gunnar O Klein and Liran Karni, Örebro University and Mattias Fendukly, Cambio Healthcare Systems AB) jointly gave the presentation.</p>
Description of event, publishing or hosting entity (city if applicable)	Vitalis in Gothenburg is the leading e-Health conference within the Nordic countries with roughly 6000 participants.
Principal stakeholders	<p>Health and social care payers and providers</p> <p>Health ICT industry</p> <p>Research</p> <p>Health sectors in the Nordic countries</p>
Key messages, viewpoint and estimated impact	Presentation of the usability of the C3-cloud platform within Swedish healthcare.
Any further links, references useful for the project (that has not already been provided for sharing publicly)	<p>https://fmbilder.svenskamassan.se/media/container/1694_Ons_F2_16.00_Gunnar%20Klein.pdf</p> <p>(slides in Swedish)</p>
Lead partner (if applicable)	<p>Region Jämtland Härjedalen</p> <p>Cambio</p> <p>Örebro University</p>

Computational and Structural Biotechnology Journal (CSBJ)	
Type of activity	Journal article
Date of activity	The article was submitted on 20 December 2018 and received a Minor Revision on 05 March 2019. A revision was submitted on 18 March 2019. It was accepted for publication on 4 June 2019 and published on 12 June 2019.
Title of dissemination	A Collaborative Platform for Management of Chronic Diseases via Guideline-Driven Individualized Care Plans
Description of event, publishing or hosting entity (city if applicable)	Computational and Structural Biotechnology Journal (CSBJ) is an online gold open access journal publishing research articles and reviews after full peer review. It has an impact factor of 6.018 https://www.journals.elsevier.com/computational-and-structural-biotechnology-journal
Principal stakeholders	Scientific community (higher education, research)
Key messages, viewpoint and estimated impact	CSBJ is a high impact journal, with an impact factor of 6.018. This paper is very detailed presentation of C3-Cloud architecture; hence we expect a high impact for the C3-Cloud project.
Any other material useful for the project (that has not been already provided for sharing publicly) (e.g. published paper versions, etc.)	The paper is open access and is publicly available at http://www.sciencedirect.com/science/article/pii/S2001037018303507
Any further links, references useful for the project (that has not already been provided for sharing publicly)	The paper is open access and is publicly available at http://www.sciencedirect.com/science/article/pii/S2001037018303507
Lead partner (if applicable)	SRDC

C3DP Video User Guide	
Type of activity	Video/Film
Date of activity	18 June 2019
Title of dissemination	C3DP Video User Guide
Description of event, publishing or hosting entity (city if applicable)	Hosted on YouTube, at first privately and now publicly.
Principal stakeholders	Scientific community (higher education, research) Industry Civil society General public Media Customers
Key messages, viewpoint and estimated impact	Primarily a training material, this video captures and explains all the functionalities provided by the C3DP in a clear way; hence is also a great dissemination material. SRDC has already shared the video instead of or in addition to bilateral demonstrations for the interested parties.

<p>Any other material useful for the project (that has not been already provided for sharing publicly)</p> <p>(e.g. published paper versions, etc.)</p>	 <p>C3-CLOUD</p> <p>John Doe Patient Age: 59 (22 Oct 1959) Gender: Male E-mail: N/A Phone: N/A Address:</p> <p>Medical Summary Care Plan Care Plan Management Care Plan Preferences Care Team</p> <p>BP Management Glucose Management HF Management Lipid Management Complication Management Diet & Lifestyle Other</p> <table><tr><th>Title</th><th>Start Date</th><th>Target Date</th><th>Target</th><th>Actions</th></tr><tr><td>Treatment target is supposed to be 46 mmol/mol ($\pm 6.4\%$)</td><td>30 Mar 2019</td><td>25 Apr 2019</td><td>HbA1c < 46 mmol/mol</td><td>...</td></tr><tr><td>Increase physical activity</td><td>30 Mar 2019</td><td>30 Apr 2019</td><td>Walking > 300 meter</td><td>...</td></tr><tr><td>Reduce weight</td><td>30 Mar 2019</td><td>30 Sep 2019</td><td>Body weight < 70 kg</td><td>...</td></tr></table> <p>Activities</p> <p>Filter by Assignee: Anyone</p> <table><tr><th>Title</th><th>Type</th><th>Start Date</th><th>Actions</th></tr><tr><td>Structured assessment of the patients who is self-monitoring blood glucose</td><td>Appointment</td><td>30 Mar 2020</td><td>...</td></tr><tr><td>Care Education</td><td>General</td><td>30 Mar 2019</td><td>...</td></tr></table> <p>When you have finished editing the care plan, click the "Activate and Publish" button, which is at the right bottom corner of the screen.</p> <p>CSDP Video Tutorial</p>	Title	Start Date	Target Date	Target	Actions	Treatment target is supposed to be 46 mmol/mol ($\pm 6.4\%$)	30 Mar 2019	25 Apr 2019	HbA1c < 46 mmol/mol	...	Increase physical activity	30 Mar 2019	30 Apr 2019	Walking > 300 meter	...	Reduce weight	30 Mar 2019	30 Sep 2019	Body weight < 70 kg	...	Title	Type	Start Date	Actions	Structured assessment of the patients who is self-monitoring blood glucose	Appointment	30 Mar 2020	...	Care Education	General	30 Mar 2019	...
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<p>Any further links, references useful for the project (that has not already been provided for sharing publicly)</p>	<p>https://www.youtube.com/watch?v=wV5I8Mj8LmQ</p>																																
<p>Lead partner (if applicable)</p>	<p>SRDC</p>																																

Meeting of the EIP on AHA - Action Group A1	
Type of activity	Participation to a Workshop
Date of activity	26.06.2019
Title of dissemination	Meeting of the European Innovation Partnership on Active and Healthy Ageing (EIP on AHA) Action Group (AG) A1 on "Adherence to prescription and medical plans",
Description of event, publishing or hosting entity (city if applicable)	<p>Christianne Lavin, empirica, Presentation of a sub-scenario based on the above scenario for Maria (Basque Country patient in the C3-Cloud project) addressing self-medicating / self-diagnosis using over the counter drugs. Other subscenario-examples included: Hypoglycaemia- insulin overdose, Blood clot- due to multiple medications, Taking over the counter pain killers,</p> <p>Poly Pharmacy- drug-drug interactions that lead to adverse drug related events and how digital solutions such as in C3-Cloud can help.</p> <p>Barcelona, Spain</p>
Lead partner (if applicable)	Empirica

ICIMTH 2019	
Type of activity	Participation to a Conference
Date of activity	5-7 July 2019

Title of dissemination	Drug Interaction Advisory Service for Clinical Decision Support of Multimorbidity Patient Centric Care Plans in the C3-Cloud System George DESPOTOU, Mustafa YUKSEL, Bunyamin SARIGUL and Theodoros N. ARVANITIS
Description of event, publishing or hosting entity (city if applicable)	ICIMTH 2019, the 17 th annual International Conference on Informatics, Management, and Technology in Healthcare was held in Athens, Greece.
Principal stakeholders	Health informaticians, clinicians, healthcare professionals and researchers.
Key messages, viewpoint and estimated impact	The Drug Interaction Advisory Service is a component of the C3-Cloud integrated care for multi-morbidity, IT infrastructure. It provides the system with over 50,000 interactions between chemical substances, in three languages. DIAS has a RESTful API and returns results in JSON, which are shown during medication changes in a patient's care plan. Future work will extend DIAS to include advisory on probability of side-effects. Multiple CIGs with patient data to manage patients with multimorbidity, using a novel execution approach as part of the MuCIGREF, is introduced. Multimorbidity case studies were created with associated CPGs and patient data. Generating personal care plans for each patient by transforming individual CIG models; resolving challenges in coordination of complex knowledge sources and their interactions through satisfying a set of constraints.
Any other material useful for the project (that has not been already provided for sharing publicly) (e.g. published paper versions, etc.)	https://www.researchgate.net/publication/334731699_Drug_Interaction_Advisory_Service_for_Clinical_Decision_Support_of_Multimorbidity_Patient_Centric_Care_Plans_in_the_C3-Cloud_System
Any further links, references useful for the project (that has not already been provided for sharing publicly)	Despotou G, Yuksel M, Sarigul B, Arvanitis TN. Drug Interaction Advisory Service for Clinical Decision Support of Multimorbidity Patient Centric Care Plans in the C3-Cloud System. Stud Health Technol Inform. 2019;262:388-391. doi:10.3233/SHTI190100
Lead partner (if applicable)	WARWICK

SKLAR Workshop	
Type of activity	Participation to a Workshop
Date of activity	August 27-28, 2019
Title of dissemination	
Description of event, publishing or hosting entity (city if applicable)	In Gothenborg, Sweden RJH one of five regions that participated in the nationwide project "Orderly introduction of digital services and products in healthcare" led by the Swedish Association of Local Authorities and Regions (SKLAR) and partly funded by the National Regional Fund Programme. As a pilot site, RJH shared its experiences and knowledge to work towards full implementation of digital services and products in healthcare. The "Flagship project" in the discussion was C3-Cloud.
Principal stakeholders	Swedish Association of Local Authorities and Regions, Regions of Jämtland Härjedalen, Norrbotten, Östergötland, Uppland and Västergötland, Stockholm County Council and Uppsala Bio.
Key messages, viewpoint and estimated impact	We focused a lot of the discussions on C3-Cloud as an exemplary project dealing with how to better the care and participation of multimorbid elderly patients with the help of new advanced digital technology. This approach is of great interest in Sweden and especially so from the implementation / exploitation point of view.
Lead partner (if applicable)	Region Jämtland Härjedalen

Congreso de Salud Digital	
Type of activity	Participation to a Conference
Date of activity	12-13 September 2019
Title of dissemination	Interoperabilidad de sistemas en C3-Cloud (Interoperability in C3-Cloud)
Description of event, publishing or hosting entity (city if applicable)	Donostia (Spain) Agenda is included in appendix
Principal stakeholders	The event is open to all those who are interested in the subject, but above all we want to bring together professionals from the health field, the university, technology companies and patients. Scientific community (higher education, research) – 150 participants
Key messages, viewpoint and estimated impact	C3-Cloud helps to improve complex multimorbid patients, to empower patients, to coordinate their care. Intervention in Basque Country involves Primary care healthcare professionals (GPs and Nurses), and intervention and control multimorbid patients The end users had been trained in the use of the system according to their role in the intervention Seven Integrated healthcare organizations from Osakidetza participate in the piloting The evaluations assess the acceptability of the platforms by the end-users.
Any other material useful for the project (that has not been already provided for sharing publicly) (e.g. published paper versions, etc.)	Poster included in appendix
Lead partner (if applicable)	Kronikgune/Osakidetza

International Conference on Integrated Care (ICIC) 2020	
Type of activity	Oral Presentation in a Conference
Date of activity	16/09/2020
Title of dissemination	Implementation and validation of the C3-Cloud system: a new generation for integrated care tool developed with and for multimorbid patients. Authorships: Dolores Verdoy, Nicolás González, Marie Beach, Mikael Lilja, Mustafa Yuksel, Gokce Banu Laleci Erturkmen, Omar Khan, Lamine Traore, Konstantinos Kalliamvakos, Rong Chen, Pontus Lindman, Malte von Tottleben, Dipak Kalra, Gunnar O Klein, Sarah Lim Choi Keung, Theodoros Arvanitis and Esteban de Manuel on behalf of C3-Cloud consortium
Description of event, publishing or hosting entity (city if applicable)	Remote conference Agenda https://abbey.eventsair.com/QuickEventWebsitePortal/icic20/eventinfo/Agenda
Principal stakeholders	Researchers, clinicians and managers from around the world who are engaged in the design and delivery of integrated health and social care.
Provide estimated numbers for each stakeholder category where relevant (say Unknown if number not known) (the categories follow the EU reporting reporting)	

Scientific community (higher education, research)		1000 integrated care experts representing over 80 countries.
Key messages, viewpoint and estimated impact	<p>The contribution of end users has been crucial for the development of C3-Cloud system</p> <p>C3-Cloud intervention has been preceded by the readiness of the main organisational aspects in the sites.</p> <p>The implementation will be evaluated in terms of technology acceptance and cost-effectiveness after 5 months of piloting.</p> <p>The intervention aims to prove the improvement of the care of multimorbid patients by means of facilitating coordinated care, treatment optimizing and patient self-care.</p>	
Lead partner (if applicable)	Kronikgune/Osakidetza	

AAL Forum 2019	
Type of activity	Organisation of a Workshop
Date of activity	24.09.2019
Title of dissemination	<p>Organisation of a Workshop within the AAL Forum 2019 on Smarter practical implementation of digital solutions to enhance active and healthy living</p> <p>Workshop 8: Smart Healthy Age Friendly Environments and the Blueprint for digital transformation of Health and Care (joint session AAL/EIP on AHA)</p>
Description of event, publishing or hosting entity (city if applicable)	<p>Empirica was co-organiser and led parallel discussions on how to use the Blueprint to support policy decision makers to implement digital solutions for active and healthy ageing and addressing also informal carers' needs.</p> <p>Trieste, Italy</p>
Key messages, viewpoint and estimated impact	Particular focus on integrated care, complex patients, multi-morbidity – incl. presentation scenario on a complex patient from Basque Country developed by Esteban de Manuel Keenoy and Javier Urraca Madinabeitia (Kronikgune, Basque Country), with a contribution by Dipak Kalra (EuroRec) and empirica (Veli Stroetmann, Christianne Lavin) based on the C3Cloud project approach and solutions.
Lead partner (if applicable)	Empirica

Meeting with European Commission Unit eHealth, well-being and ageing, DG CONNECT	
Type of activity	Participation to an Event other than a Conference or a Workshop
Date of activity	04.11.2019
Title of dissemination	<p>Meeting with European Commission Unit eHealth, well-being and ageing, DG CONNECT, Luxembourg</p> <p>Discussion on support to the COM 233 priorities, with special focus on priority 3: digital tools for citizen empowerment and for person-centred care. Based on work in DigitalHealthEurope and other European projects such as C3-Cloud;</p> <p>Discussion leads from empirica: Veli Strotmann and Strahil Birov</p>

Description of event, publishing or hosting entity (city if applicable)	<p>Topics from C3-Cloud included:</p> <ul style="list-style-type: none"> • Personalisation and person-centredness: shared care planning taking into account patient preferences and ensuring goals are shared (goal-oriented planning), AI/ML enabling personalised support • Multi-morbidity: ICT supported reconciliation of clinical guidelines • Individualised health and care taking into account citizen's preferences, goals and feedback • Empowering the citizens to self-manage their own health and lifestyle • Effective interaction with health and care professionals – they need to be empowered in order to empower the citizen <p>Luxembourg, DG CONNECT, Luxembourg</p>
Lead partner (if applicable)	empirica

Industry and scientific community representatives	
Type of activity	Presentation and demonstration at a conference
Date of activity	28 November 2019
Title of dissemination	Presentation and demonstration of C3DP and onFHIR Secure Repository to industry and scientific community representatives
Description of event, publishing or hosting entity (city if applicable)	The conference was organized by i~HD in Brussels on 27-28 November 2019 with support from 6 European Commission supported projects, one of which was C3-Cloud.
Principal stakeholders	<p>Scientific community (higher education, research)</p> <p>Industry – Please see the Joining the Dots chapter in this deliverable for more information on this event</p>
Provide estimated numbers for each stakeholder category where relevant (say Unknown if number not known) (the categories follow the EU reporting reporting)	
Scientific community (higher education, research)	20
Industry	20
Key messages, viewpoint and estimated impact	Both the conference and demonstration sessions received great interest and high participation from the European scientific, industry and policy-maker community representatives. All C3-Cloud partners have made new business contacts from a community dedicated to improving person-centred health and care. This will lead to new R&D and/or industry collaborations.
Any further links, references useful for the project (that has not already been provided for sharing publicly)	<p>The web page of the conference: https://www.i-hd.eu/index.cfm/events/joining-the-dots-conference-27-28-november-brussels/</p> <p>C3DP demo version hosted at https://app.srdc.com.tr/c3dp/ was used for demonstration.</p> <p>PEP demo version hosted at https://c3clouddev.medixine.com/ was used for demonstration.</p>
Lead partner (if applicable)	SRDC, MEDIXINE

National EHR, PHR and ePrescription provider of Turkey	
Type of activity	Bilateral presentation and demonstration
Date of activity	First on 2 March 2020, followed by a few more meetings till June 2020.
Title of dissemination	Presentation and demonstration of C3DP to the National EHR, PHR and ePrescription provider of Turkey
Description of event, publishing or hosting entity (city if applicable)	Meetings first took place at the headquarters of TIGA in Ankara, Turkey and remotely after the spread of the pandemic.
Principal stakeholders	Industry
Provide estimated numbers for each stakeholder category where relevant (say Unknown if number not known) (the categories follow the EU reporting reporting)	
Industry	10
Key messages, viewpoint and estimated impact	TIGA is the long-time provider of the national EHR, PHR and ePrescription systems of Turkey. They also have other big deployments in the EMEA region. TIGA has been impressed with C3DP capabilities and the SRDC experience in personalized care plan management and chronic disease management. After a few meetings, TIGA and SRDC have agreed to be business partners in personalized care plan management and chronic disease management. TIGA also invited SRDC to be involved in an eHealth solution bid in Qatar.
Any further links, references useful for the project (that has not already been provided for sharing publicly)	TIGA Software: https://www.tiga.com.tr/en/ C3DP demo version hosted at https://app.srdc.com.tr/c3dp/ was used for demonstration.
Lead partner (if applicable)	SRDC

OLVZ hospital, Aalst, Symposium on the importance of big data	
Type of activity	Participation to a Conference
Date of activity	13 th February 2020
Title of dissemination	Using health data to power the learning health system
Description of event, publishing or hosting entity (city if applicable)	Symposium organised and hosted by the OLVZ hospital, Aalst, Belgium
Principal stakeholders	Invited presentation to almost 200 people, mainly working at the hospitals in Aalst, Belgium with invited members of many other Flemish hospitals. The audience was a mixture of healthcare professionals, patients and patient organisations, healthcare managers, academics and some governmental policymakers.
Key messages, viewpoint and estimated impact	The importance of the rising prevalence of multimorbidity The mission of C3-Cloud, some example screens from its digital solutions The challenge of aligning multiple guidelines that have been developed for single diseases The importance of focusing on patient health outcomes and the importance of recognising the patients will be an important future source of data An update on the innovations taking place across Europe in learning from health data
Lead partner (if applicable)	EuroRec

Lecture to the Institute for Interdisciplinary Innovation in healthcare	
Type of activity	Invited lecture
Date of activity	6 th March 2020
Title of dissemination	Data science, cornerstone of innovation
Description of event, publishing or hosting entity (city if applicable)	Lecture to the Institute for Interdisciplinary Innovation in healthcare (I3h), on its Interdisciplinary Program in Healthcare Innovation. Brussels, Belgium.
Principal stakeholders	Invited lecture on this interdisciplinary program, to approximately 200 people, mostly active in life sciences research and in digital innovation.
Key messages, viewpoint and estimated impact	<p>The importance of the rising prevalence of multimorbidity</p> <p>The mission of C3-Cloud, some example screens from its digital solutions</p> <p>The challenge of aligning multiple guidelines that have been developed for single diseases</p> <p>The importance of focusing on patient health outcomes and the importance of recognising the patients will be an important future source of data</p> <p>The ambition of hospitals to learn more from their health data, to improve care as well as to undertake more research</p> <p>A deep dive into the European project landscape scaling up the re-use of health data, and an examination of the success factors for large-scale eHealth and research infrastructures across Europe</p>
Lead partner (if applicable)	EuroRec

MIE 2020	
Type of activity	<p>Participation to a Conference</p> <p>Paper accepted and published as proceedings.</p>
Date of activity	<p>Planned for April 2020 but cancelled.</p> <p>Conference proceedings published</p>
Title of dissemination	Localisation, Personalisation and Delivery of Best Practice Guidelines on an Integrated Care and Cure Cloud Architecture: the C3-Cloud Approach to Managing Multimorbidity
Description of event, publishing or hosting entity (city if applicable)	MIE2020 was scheduled to be held in April 2020 in Switzerland (cancelled)
Principal stakeholders	Medical and health informaticians and clinicians with interest in digital health and informatics.
Provide estimated numbers for each stakeholder category where relevant (say Unknown if number not known) (the categories follow the EU reporting reporting)	
Other	Over a 1000 integrated care experts expected to attend, from over 80 countries
Key messages, viewpoint and estimated impact	C3-Cloud had deployed collated and reconciled guidelines on multimorbidity in three European pilot sites. Achieving this required a co-production process involving the pilot site clinical teams, the C3-Cloud clinical reference group, the pilot site technical teams, and the C3-Cloud technical team. The process resulted in over 60 clinical scenarios, 300 CDS rules and over 380 design requirements.
Any other material useful for the project (that has not been already provided for sharing publicly)	<p>Open access paper: http://ebooks.iospress.nl/volumearticle/54237</p> <p>Despotou G. et al. Localisation, Personalisation and Delivery of Best Practice Guidelines on an Integrated Care and Cure Cloud Architecture: The C3-Cloud</p>

(e.g. published paper versions, etc.)	Approach to Managing Multimorbidity. Studies in Health Technology and Informatics, Volume 270: Digital Personalized Health and Medicine, pp 623-627, 2020. DOI: 10.3233/SHTI200235
Any further links, references useful for the project (that has not already been provided for sharing publicly)	Conference website: https://mie2020.org/en/
Lead partner (if applicable)	WARWICK

To German industry and scientific community representatives	
Type of activity	Bilateral presentation and demonstration
Date of activity	27 April 2020
Title of dissemination	Presentation and demonstration of C3DP and onFHIR Secure Repository to German industry and scientific community representatives
Description of event, publishing or hosting entity (city if applicable)	The session was held online.
Principal stakeholders	Scientific community (higher education, research) Industry
Provide estimated numbers for each stakeholder category where relevant (say Unknown if number not known) (the categories follow the EU reporting reporting)	
Scientific community (higher education, research)	2
Industry	1
Key messages, viewpoint and estimated impact	Ruslan David and his colleagues stated that they are impressed with the demonstrated solutions. They are investigating how C3DP and the onFHIR.io FHIR Repository can be re-used in their own project PANOS, which is a regional research project in Sachsen / Germany.
Any further links, references useful for the project (that has not already been provided for sharing publicly)	C3DP demo version hosted at https://app.srdc.com.tr/c3dp/ was used for demonstration.
Lead partner (if applicable)	SRDC

PEP training video	
Type of activity	Training Video/Film
Date of activity	Openly accessible from June 2020
Title of dissemination	Patient Empowerment Platform training videos (in English)
Principal stakeholders	C3-Cloud study participants (patients, informal caregivers, health professionals)
Any further links, references useful for the project (that has not already been provided for sharing publicly)	C3-Cloud System Overview: https://youtu.be/sXaTXYkayLA C3-Cloud System Tutorial: https://youtu.be/x3XwF_kQVp4
Lead partner (if applicable)	WARWICK (produced the videos), MEDIXINE (PEP component lead)

News article in e-Pulse (SWFTs weekly newsletter)		
Type of activity	Internal Electronic Newsletter	
Date of activity	15 July 2020	
Title of dissemination	C3-Cloud Research Study	
Description of event, publishing or hosting entity (city if applicable)	Article in e-Pulse (SWFTs weekly newsletter)	
Principal stakeholders	SWFT employees	
Provide estimated numbers for each stakeholder category where relevant (say Unknown if number not known) (the categories follow the EU reporting reporting)		
Other – SWFT staff		~4,000
Key messages, viewpoint and estimated impact	<ul style="list-style-type: none">• Reminder of the background to the study• Description of, and outcome of the C3-Cloud trial, including the impact of COVID-19 on the trial• Suggestion of the future potential of the system with further development• Handover of the project to ADLIFE	
Any other material useful for the project (that has not been already provided for sharing publicly) (e.g. published paper versions, etc.)	Newsletter article in appendix	
Lead partner (if applicable)	SWFT	

Open Source release of C3-Cloud components		
Type of activity	Other – Dissemination of software components through release as OpenSource on a public repository	
Date of activity	July 2020	
Title of dissemination	C3-Cloud GitHub organisation	
Description of event, publishing or hosting entity (city if applicable)	<p>C3-Cloud components have been released on GitHub (the most popular repository of open source software projects worldwide), these include:</p> <ul style="list-style-type: none"> • GDL guideline examples from Cambio • Semantic Mapper client from Inserm • Technology Interoperability Suite from Warwick (in progress) • AuditEvent viewer and onFHIR repository from SRDC <p>These are publicly available and accessible and allow the general public, in particular developers, to reuse code in their own work subject to the terms of the open source licenses used (Apache or GNU GPL per component)</p>	
Principal stakeholders	<p>Development community (general public)</p> <p>Health ICT industry</p> <p>Research</p>	
Key messages, viewpoint and estimated impact	<p>Impact will be monitored via clones of repositories made by other GitHub users and visits to the repository pages.</p> <p>The released components are configured to use standardized languages, architectures and healthcare focused coding systems and communication protocols to facilitate reuse of the code within other projects.</p>	

Any further links, references useful for the project (that has not already been provided for sharing publicly)	Links to the individual component repositories, to be forked to the C3-Cloud GitHub organization in WP8 https://github.com/gdl-lang/common-clinical-models https://github.com/mikaeldusenno/c3cloud-semanticmapper-client https://gitlab.com/c3-cloud-warwick/tis-source-code https://github.com/srdc/audit-event-viewer https://github.com/srdc/onfhir
Lead partner (if applicable)	WARWICK (T8.3 Lead) and KRONIGUNE (WP8 Lead)

Digital Health News	
Type of activity	Non-scientific and non-peer-reviewed publication
Date of activity	27 th August 2020
Title of dissemination	C3-Cloud: the digital coordinated care platform of the future
Description of event, publishing or hosting entity (city if applicable)	News article in Digital Health News EU
Principal stakeholders	Digital health, healthcare, policymakers, ICT
Key messages, viewpoint and estimated impact	A feature article summary about the C3-Cloud project
Any other material useful for the project (that has not been already provided for sharing publicly)	Screenshot of the article included in the appendix
Any further links, references useful for the project (that has not already been provided for sharing publicly)	https://www.digitalhealthnews.eu/development/6228-c3-cloud-the-digital-coordinated-care-platform-of-the-future
Lead partner (if applicable)	WARWICK

Warwick management Group press release	
Type of activity	Press release
Date of activity	27 th August 2020
Title of dissemination	C3-Cloud: the digital coordinated care platform of the future
Description of event, publishing or hosting entity (city if applicable)	Press release from Warwick Management Group
Principal stakeholders	Digital health, healthcare, policymakers, ICT
Key messages, viewpoint and estimated impact	A feature article summary about the C3-Cloud project
Any other material useful for the project (that has not been already provided for sharing publicly)	Screenshot of the article included in the appendix, plus a larger font extract of the content.
Any further links, references useful for the project (that has not already been provided for sharing publicly)	https://warwick.ac.uk/newsandevents/pressreleases/c3-cloud_the_digital
Lead partner (if applicable)	WARWICK

4.3. Future dissemination activities and opportunities

Warwick MSc HOM	
Type of activity	Education/training
Date of activity	n/a
Principal stakeholders	Postgraduate students with multiple backgrounds.
Key messages, viewpoint and estimated impact	Overview of C3-Cloud capabilities and impact.
Lead partner (if applicable)	WARWICK

ICIC2020	
Type of activity	Participation to a Conference Oral presentation in Session 4I - Digital platforms supporting an ageing society
Date of activity	16 September 2020
Title of dissemination	The C3-Cloud Approach to Clinical and Technical Co-production of a Multi-morbidity Integrated Care Information Technology Infrastructure
Description of event, publishing or hosting entity (city if applicable)	ICIC20 Virtual Conference – 20th International Conference on Integrated Care 9 th , 16 th , 23 rd and 30 th September 2020
Principal stakeholders	Integrated care experts Patients and carers
Provide estimated numbers for each stakeholder category where relevant (say Unknown if number not known) (the categories follow the EU reporting reporting)	
Other	Over a 1000 integrated care experts expected to attend, from over 80 countries
Key messages, viewpoint and estimated impact	C3-Cloud adopted a through-life co-production approach. From conceptual design to deployment, a well-defined process has allowed the validation and verification of the integrated care system offered, from a number of stakeholder perspectives. Clinical and technical reviewers, as well as potential users, continuously reviewed the validity of the resulting solution. A rigorous requirements management process provided very detailed traceability, amongst local clinical scenarios, clinical practice guidelines, technical requirements, system implementation and testing.
Any further links, references useful for the project (that has not already been provided for sharing publicly)	Conference website: https://integratedcarefoundation.org/events/icic20-20th-international-conference-on-integrated-care
Lead partner (if applicable)	WARWICK

EHMA Annual Conference	
Type of activity	Presentation in a Conference
Date of activity	17-19/11/2020
Title of dissemination	C3-Cloud system: an innovative digital integrated care tool developed with and for multimorbid patients
Description of event, publishing or hosting entity (city if applicable)	Agenda https://ehmaconference.org/ehma-2020-conference-programme/
Principal stakeholders	Educators, researchers, managers, and health professionals from Europe and beyond
Key messages, viewpoint and estimated impact	<p>The contribution of end users has been crucial for the development of C3-Cloud system</p> <p>C3-Cloud intervention has been preceded by the readiness of the main organisational aspects in the sites.</p> <p>The implementation will be evaluated in terms of technology acceptance and cost-effectiveness after 5 months of piloting.</p> <p>The intervention aims to prove the improvement of the care of multimorbid patients by means of facilitating coordinated care, treatment optimizing and patient self-care.</p>
Any other material useful for the project (that has not been already provided for sharing publicly) (e.g. published paper versions, etc.)	(The oral presentation slides will be available later)
Lead partner (if applicable)	Kronikgune/Osakidetza

5. JOINING THE DOTS CONFERENCE

During the early years of the project the C3-Cloud partners progressively understood that the future adoption of our solution critically requires raising the profile of multimorbidity itself as a European health issue, and to stress the need to leverage integrated and person-centred digital health solutions to tackle it. In developing the C3-Cloud technology, the partners also recognised that the issues we have been tackling such as interoperability and data quality, patient empowerment, integrated care, computerised representation of guidelines and organisational change are also to some extent being tackled by other European projects.

C3-Cloud therefore was pleased to play a strong role in a multi-stakeholder and multi-project event called Joining the Dots, organised by the European Institute for Innovation through Health Data. Its President, Dipak Kalra, is also the lead for partner EuroRec, the WP2 lead, and so intimately involved in C3-Cloud dissemination, exploitation and industry engagement. This event combined C3-Cloud with other European projects that have been tackling some of the same challenges and brought the projects jointly into contact with a wide range of (mainly European) stakeholders.



Dipak Kalra (i~HD, EuroRec) opening Join the Dots, and Theo Arvanitis (WARWICK) introducing the audience to C3-Cloud

Joining the Dots explored several key socio-technical and technical challenges in detail. The event, strongly supported by C3-Cloud alongside other projects such as Digital Health Europe, was held in November 2019 in Brussels. It attracted over 150 different stakeholder participants. In addition to being one of the main projects showcased through the event, C3-Cloud organised, along with the International Foundation for Integrated Care (IFIC), a specific challenge session on multimorbidity, and partners also contributed to sessions on interoperability and patient empowerment.

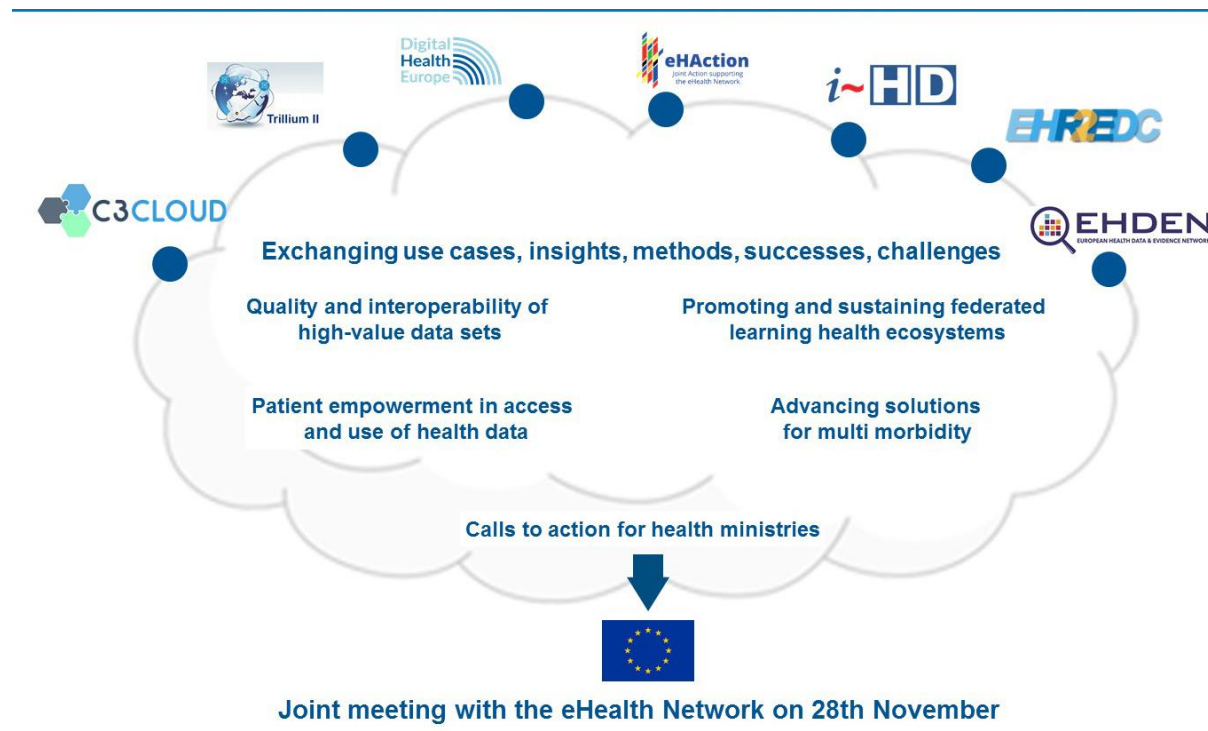
Joining the Dots, especially through the challenge sessions, co-created recommendations to policymakers and decision-makers, which Dipak Kalra was invited to present on behalf of the conference to a parallel meeting of the eHealth Network in Brussels on 28th November.

On the second day of Joining the Dots, C3-Cloud held a Vendor Forum, which was a multi-stakeholder event which vendors were especially invited to attend. It started with a dedicated lunchtime demonstration session of the different modules making up our solution. We held a deep dive session on the second afternoon to present and demonstrate the project in detail, and to discuss with the audience the best approaches that we should take to sustain and scale up adoption of our multimorbidity solutions. This part of the conference is reported in Deliverable 2.14.

The rest of this chapter of the deliverable summarises the Joining the Dots event and the challenge sessions that were tackled. It presents the conference programme including the C3-Cloud second day afternoon and presents the multi morbidity session in more detail. The final recommendations that were developed and presented to the eHealth Network are included. Appendix 2 provides the C3-Cloud information pack that was given to all 150+ delegates. Much of that material has now been incorporated into our web site.

Joining the Dots Conference

Ensuring better data for person-centred health and care,
optimised research and Learning Health Systems
Brussels, 27 and 28 November 2019



This conference brought together seven European initiatives that are developing innovations to advanced digital health and to accelerate clinical research. These initiatives are complementary to each other, and collectively are tackling most of the critical success factors for leveraging at scale the potential from health data, data infrastructures and digital innovations to transform the health and care landscape.

Rather than project specific sessions, the projects are working together to share use cases, insights, methods, success factors and outstanding issues under six crosscutting “key challenges”. After a brief introduction to the initiatives at the start of the conference, most of the time was spent in parallel breakout challenge sessions. Conference delegates were able to participate in three of the six sessions (see challenges below). These sessions were led by European thought leaders, from these initiatives, who exchange use cases, insights, success and outstanding obstacles.

The final sessions on Thursday 28th was led by C3-Cloud. It focused on how EHR systems can be adapted to guide clinicians and patients to manage multimorbidity, starting with lunch-time demonstrations of the C3-Cloud project’s clinician and patient solutions.

The tangible final goal we wanted to achieve, thanks to each attendee’s input, was to finalise a list of forceful calls to action for European Health Ministries to be presented to the nearby eHealth Network meeting during the second day of our conference.

The projects contributing to Joining the Dots (= ‘the Dots’)

- [C3-Cloud](#) aims to develop personalised care plans for complex multimorbid patients, supported by ICT tools and managed by a coordinated multidisciplinary team, that promotes integrated care and the involvement of the patient and/or caregiver.
- The [Trillium II](#) project is coordinating and supporting efforts towards an interoperable international patient summary.
- [DigitalHealthEurope](#) undertakes a number of actions to boost innovation and advance the Digital Single Market priorities for the digital transformation of health and care: citizens’ secure access to and sharing of health data across borders; better data to advance research, disease prevention and personalised health and care; digital tools for citizen empowerment and person-centred care.
- The main objective [eHAction](#) wants to address works together with a common vision at EU Level, Country and Regional level to promote and strengthen the use of ICT in health development, from applications in the field to EU governance and strategies implementation.
- The [European Institute for Innovation through Health Data](#), in short i~HD, aims to improve healthcare and to accelerate research through more trustworthy reuse of health data. It is a membership-based organisation with members from pharma, healthcare providers, academic organisations, and works closely with patient organisations, healthcare payers, the health ICT sector and standards development organisations.
- The [EHR2EDC](#) project (from Electronic Health Records to Electronic Data Capture systems) is developing solutions to enable routinely collected hospital EHR data to be directly reused within the conduct of clinical trials, if trial subjects have given their consent for this.
- [EHDEN](#) (European Health Data & Evidence Network) was launched to address the current challenges in generating insights and evidence from real-world clinical data at scale, to support patients, clinicians, payers, regulators, governments, and the pharmaceutical industry in understanding wellbeing, disease, treatments, outcomes and new therapeutics and devices.

Challenge 1. Promoting the capture, interoperability and quality of high value data sets across Europe: cross standards alignment, data quality, cross-border access for care and research. This included the international patient summary experience from Trillium II, mapping approaches by the EHR2EDC project between eHealth and CDISC standards to exchange data between EHRs and EDC systems, the core data sets and rules C3-Cloud has used for multimorbidity guidelines and the data set rules needed by i~HD to benchmark data quality.

Challenge 2. Educating and empowering patients across a spectrum from self-care, care pathway decision-making, health system priority-setting, to clinical trials and the reuse of data for research. The session explored, with patient representatives from Digital Health Europe and C3-Cloud, how we can focus data collection and sharing on what matters most to patients and enable patients to have access to enough information for shared decision-making along their care pathway. Participants learned how patient preferences can best be reflected in decisions about how health data is used for research.

Challenge 3. Scaling up federated data networks to deliver big data insights for clinical research, personalised medicine and healthcare quality improvement. This challenge embraced issues like the mapping of diverse registries and EHRs to a common data model for research addressed by EHDEN and how the research reuse of health data should be governed. Participants learned from EHR2EDC how GDPR compliance is essential to win hospital trust in connecting to a federated reach network. The session explored how all stakeholders can promote and reward more shareable and reusable (FAIRer) data.

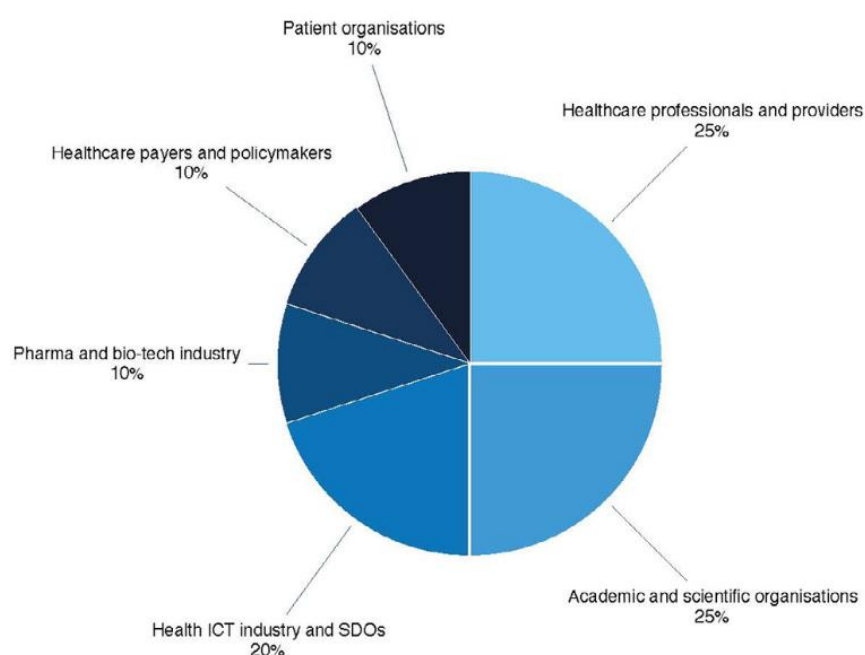
Challenge 4. The societal challenges of multimorbidity and polypharmacy that are having the greatest impact on health systems from an ageing society and increase complexity of care, as addressed by C3-Cloud. Multimorbidity is the strongest driver for urgently adopting interoperability standards. This challenge is also being addressed by eHealth Action by prioritising the knowledge gaps that research needs to deal with as

well as the information flows and service delivery transformations that are needed to meet ageing patient needs. How should health systems be designed for better multimorbidity solutions?

Challenge 5. Addressing the legal and ethical challenges of digital health. Digital health is fuelled by data exchange, which demands trust in the integrity of the data and confidence that privacy can be assured. Using data demands that traditional legal concepts of data ownership, stewardship and responsibility were re-examined to ensure that law supports digital health and allows appropriate data flow. Participants shared experiences with DigitalHealthEurope experts to identify the most pressing legal challenges of using data in digital health and how they can be addressed.

Challenge 6. Boosting digital transformation of health and care: scaling up and evaluation. Digital solutions for health and care can increase the well-being of millions of citizens and radically change the way health and care services are delivered to patients, if designed purposefully and implemented in a cost-effective way. This session examined the main traits of the present EU market of digital solutions for person-centred care, analyse good practices, key drivers and inhibitors for large scale deployment. Participants learned how twinning actions can support scaling up of innovative solutions. They explored how different evaluation approaches can optimise decision making and boost investments in digital health and care.

Conference attendance



153 attendees	22 nationalities	13 sessions
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CONFERENCE PROGRAMME

Wednesday 27th November			
08.30	Registration, coffee		
09.00	<p>Welcome, conference objectives and project co-ordinators</p> <p>Facilitator: Dipak Kalra, i~HD</p> <ul style="list-style-type: none"> - C3-Cloud: Theo Arvanitis, University of Warwick - Trillium II: Catherine Chronaki, HL7 Europe - Digital Health Europe: Veli Stroetmann, empirica - eHealth Action: Henrique Martins, SPMS - EHR2EDC: Nadir Ammour, Sanofi - EHDEN: Nigel Hughes, Janssen 		
10.00	<p>Parallel sessions 1 and 2 (with mid-point coffee break)</p> <p>Please indicate the session you wish to attend on the registration form</p> <table> <tr> <td> <p>Parallel session 1</p> <p>Promoting the capture, interoperability and quality of high value data sets across Europe: cross standards alignment, data quality, cross-border access for care and research</p> <p>Facilitators:</p> <ul style="list-style-type: none"> - Christel Daniel, AP-HP - Catherine Chronaki, HL7 Europe </td><td> <p>Parallel session 2</p> <p>Educating and empowering patients about access and use of health data in self-care, prevention and for research</p> <p>Facilitators:</p> <ul style="list-style-type: none"> - Lyudmil Ninov, EPF - Nhu Tram, AGE-PLATFORM </td></tr> </table>	<p>Parallel session 1</p> <p>Promoting the capture, interoperability and quality of high value data sets across Europe: cross standards alignment, data quality, cross-border access for care and research</p> <p>Facilitators:</p> <ul style="list-style-type: none"> - Christel Daniel, AP-HP - Catherine Chronaki, HL7 Europe 	<p>Parallel session 2</p> <p>Educating and empowering patients about access and use of health data in self-care, prevention and for research</p> <p>Facilitators:</p> <ul style="list-style-type: none"> - Lyudmil Ninov, EPF - Nhu Tram, AGE-PLATFORM
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12.30	Lunch and networking		
13.30	<p>Parallel sessions 3 and 4 (with mid-point coffee break)</p> <p>Please indicate the session you wish to attend on the registration form</p> <table> <tr> <td> <p>Parallel session 3</p> <p>Federated data networks for scaling up research and healthcare quality improvement</p> <p>Facilitators:</p> <ul style="list-style-type: none"> - Nigel Hughes, Scientific Director, Janssen Clinical Innovation – Patient Data for Research - Nadir Ammour, Sanofi </td><td> <p>Parallel session 4</p> <p>The societal challenges of multimorbidity and polypharmacy, harmonising guidelines, personalising care and refocusing research</p> <p>Facilitators:</p> <ul style="list-style-type: none"> - Theo Arvanitis, University of Warwick - Sonja Müller, empirica - Leo Lewis, IFIC </td></tr> </table>	<p>Parallel session 3</p> <p>Federated data networks for scaling up research and healthcare quality improvement</p> <p>Facilitators:</p> <ul style="list-style-type: none"> - Nigel Hughes, Scientific Director, Janssen Clinical Innovation – Patient Data for Research - Nadir Ammour, Sanofi 	<p>Parallel session 4</p> <p>The societal challenges of multimorbidity and polypharmacy, harmonising guidelines, personalising care and refocusing research</p> <p>Facilitators:</p> <ul style="list-style-type: none"> - Theo Arvanitis, University of Warwick - Sonja Müller, empirica - Leo Lewis, IFIC
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16.00	<p>Plenary review of each group's recommendations</p> <p>Facilitator: Dipak Kalra, i~HD</p>		

17.00	Finalising the calls to action for the eHealth Network Facilitator: Henrique Martins , Chair of the eHealth Network	
17.30	Time to freshen up at your hotel	
19.00	Conference dinner	
Thursday 28th November		
08.30	Registration, coffee	
09.00	Parallel sessions 5 and 6 (with mid-point coffee break) Please indicate the session you wish to attend on the registration form	
	Parallel session 5 Addressing the legal and ethical challenges of digital health Facilitators: - Petra Wilson , Health Connect Partners, DigitalHealthEurope legal expert - Ava Lloyd , FTI - Zoi Kolitsi , DigitalHealthEurope - Diane Whitehouse , EHTEL, DigitalHealthEurope - Nick Schneider , Federal Ministry of Health, Germany	Parallel session 6 Boosting digital transformation of health and care: scaling up and evaluation Facilitators: - Veli Stroetmann , empirica, DigitalHealthEurope - Jose Usero , Funka - Valentina Tageo , ECHalliance - Strahil Birov , empirica - Francisco Lupiañez , Open Evidence - Jordi Piera Jiménez , AHIMA - Franco Mercalli , MultiMed Engineers
11.50	Reflection on the outcomes of these sessions Birgit Morlion , eHealth, Well Being and Ageing, DG Connect, European Commission	
12.00	Rolling lunch	More about the C3-Cloud session.
	<div>12.30 and 13.30: two identical C3-Cloud presentations on multimorbidity-ready EHR's, to attend at choice</div>	
14.00	C3-Cloud spotlight on multimorbidity-ready EHR's - Discussion of the business drivers for health system investments in better multimorbidity solutions - Discussion of how the solution and its components can be adopted by EHR system vendors Facilitator: Theo Arvanitis , University of Warwick	

15.00	<p>Coffee break</p> <p>Report back from the eHealth Network: responses to our calls to action</p>
15.30	<p>Continuation of C3-Cloud spotlight on multimorbidity-ready EHR's</p> <ul style="list-style-type: none"> - Discussion of the business drivers for health system investments in better multimorbidity solutions - Discussion of how the solution and its components can be adopted by EHR system vendors <p>Facilitator: Theo Arvanitis, University of Warwick</p>
16.00	<p>Close</p>

Report of Challenge 4

The societal challenges of multi-morbidity and polypharmacy, harmonising guidelines, personalising care and refocusing research

Topic facilitators: Theo Arvanitis, University of Warwick and Leo Lewis, IFIC

Multimorbidity has perhaps the greatest impact on health systems from an ageing society. It not only adds to the volume of healthcare need per ageing person, but greatly adds to its delivery complexity. It is the strongest driver for adopting interoperability standards, since care delivery to patients with multiple illnesses cannot be isolated within a single speciality or care provider. It also challenges our traditional hierarchies of evidence since our pyramids of knowledge, often expressed as treatment guidelines, are mostly built on findings from single disease RCTs and lead to single disease care pathways. Reimbursement systems poorly recognise multi-morbidity, and most clinical trials still screen out patients with complicating diseases to focus on only one. Polypharmacy and iatrogenic complications are just one illustration of what can easily go wrong, but considerable duplication and wastage of health system effort and considerable disruption to patients are other consequences.

More clinical research is urgently needed into the interactions between diseases and their treatments, and how to optimise multiple care pathways. Personalised medicine in the future needs not only to be more precise for a single disease, but more holistic to an individual's disease profile. Pharma needs to find incentives and methodologies to develop more detailed product labels that specify how to handle commonly occurring drug combinations. Pharma needs to drivers to conduct more research in multi-morbidity contexts.

This breakout group examined how each Joining the Dots project has touched on this topic, and what learning and approaches each project has built up that can be applied or re-applied to this problem. By enlisting input from audience members, which included healthcare professionals, clinical research and ICT companies, this session prioritised the specific knowledge gaps that research needs to address and the information flows and service delivery transformations that are needed to meet patient needs. The session also examined how health systems can be more strongly motivated (incentivised) to invest in better multi-morbidity solutions. Progress towards good multi-morbidity care needs action and change from multiple stakeholders, and this group developed calls to action and identified the incentives that are needed for each stakeholder to respond. These were presented to the eHealth Network, with special attention to the role that health ministries can play in creating the necessary success conditions.

Mini-Hackathon exercise within this session

The aim of the Mini-Hackathon was to put participants' heads together to come up with some inspiring approaches or solutions to overcome the main hurdles in managing multimorbidity and to help with defining recommendations based on these discussions.

Preparatory slides included a description of challenges/problem statements that are currently the most pressing and for which the leads wanted to identify solutions and approaches as a group, so that they can be raised as a call to action to the eHealth Network. These preparatory slides are below.

To connect the mini-hackathon's challenges to "real-life" and concrete examples, participants were each asked to pick one that was particularly relevant in their context/project and to speak to it briefly during the introduction to the exercise.

The structure of the Mini Hackathon was:

- Introduction

- Scene setting presentation

- The facilitators will ask you to 'pitch' the problem you are facing, as an example of the challenge to solve

- Participants will be split into groups of no more than 10 people (mixed backgrounds). The challenges will be 'distributed' to the groups so that every group focuses on solving one challenge (each group solves a different one). Solutions / approaches should be concrete and

hands-on group exercise, followed by reporting back to plenary and summary/ reflections from facilitators

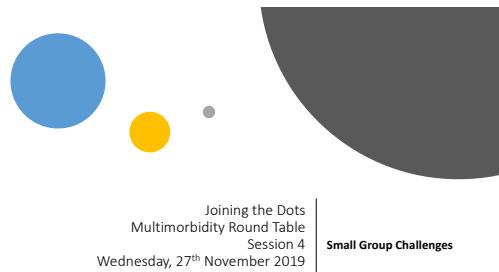
Participants solve a second challenge in groups following the same format (depending on the final number of challenges and participants, these will either be new or repeated)

A plenary discussion and close

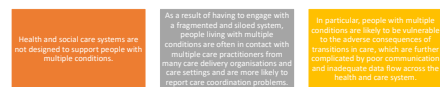


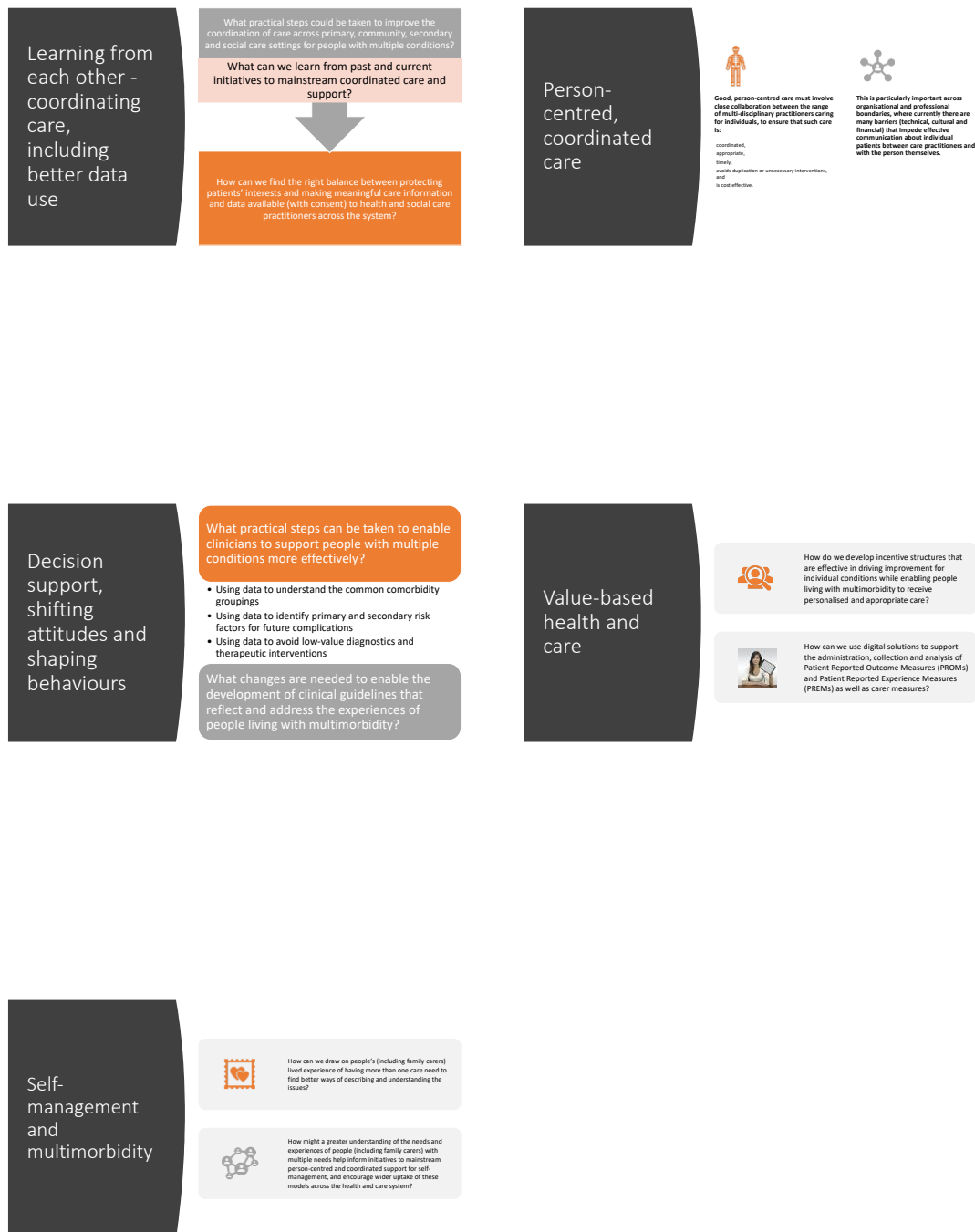
Photographs taken during the Mini-Hackathon

Slides presented during the multimorbidity session



Key issues – a fragmented care system





The C3-Cloud Vendor Forum demonstration and presentation session

This second afternoon of Joining the Dots was a C3-Cloud dedicated session with a demonstration of the solution followed by an interactive presentation with audience discussion. This Vendor Forum is reported in Deliverable 2.14, focusing on industry liaison.



Photographs taken during the C3-Cloud Vendor Forum session: Theo Arvanitis (WARWICK), Lola Verdoy Berastegui (KONIGRUNE), Mustafa Yuksel (SRDC)

Joining the Dots - Final Stakeholder Recommendations

At the conclusion of the six multi-stakeholder challenge sessions, the session leaders generated a number of recommendations. These were endorsed by around 150 conference participants before being presented formally to the eHealth Network¹, which was meeting at the same time. These recommendations are reproduced below.

Quality and interoperability of high-value data sets

- The EU and MS should specify how and by whom high-value data sets should be endorsed and certified in order to be promoted and adopted at national and EU levels
- The definition of a high-value dataset should include the definition of the high-value services that the dataset will underpin
- The EC should invest in big synthetic high-value data sets to support the development of high-value data services, enable developers to run simulation scenarios and training, and pave the way towards use of the European Health Data Space
- Evidence derived from high-quality data conforming to a high-quality data set needs to be valued by policymakers and regulators in order to be prioritised by other stakeholders.

¹ The eHealth Network, set up under the so-called Cross Border Healthcare Directive 2011/24/EU, connects national authorities responsible for eHealth in the EU. In this forum, eHealth developments are coordinated between MS, for instance in strategic decision-making on interoperability and standardisation.

Promoting and sustaining federated learning health ecosystems

- Enable running European projects to support the European Health Data Space by focusing supplementary funds on a common catalogue of project outputs (e.g. deliverables, resources, and tools), managed by i~HD ²
- The EC should enforce this deposition of project outputs that are reusable for future projects, with an emphasis on interoperability and collaboration to avoid redundancy and repetition and ensure the timeliness of accessibility
- The EU clinical and research communities, and MS/regions need assistance and guidance to make sure that they use existing standards and deliverables from programmes that are delivering today. The EC should provide resources for expert guidance to facilitate this.
- The EC should promote educational curriculum development for the public, and the medical and research community, for a 21st century EU model of healthcare and research.

Boosting digital transformation

- More in-depth analysis is needed of the person-centricity characteristics of the existing digital solutions for health and care, as well as their key drivers and inhibitors, in order to drive the market faster and provoke the desired market disruption in this business area
- It is important to identify relevant successful innovative solutions and to establish the conditions for transferability and scaling-up of those solutions and guide their transfer across regions and countries
- It is essential to provide relevant evidence and know-how to health authorities, health providers, and field researchers, in order to increase their capacity to prepare investment strategies and access financing
- The analysis and implementation of different evaluation approaches can optimise decision-making and boost investments in digital health and care, that will ultimately facilitate the desired provision of innovative cost-effective health care solutions.

Patient empowerment

- Digital health literacy education is important for avoiding (yet another) source of health inequality. MS should scale up investments in literacy programmes that begin in school and continue throughout the life course. This should include education about the available tools and platforms for illness prevention and self-management.
- Today, the legal framework for accessing health data and data sets is proving to be too limiting, a consequence of looking only at the privacy risks and not taking into account the benefits to patients and society. Develop and deploy scalable solutions for ensuring citizens' trust when they agree to share health data collected by themselves and/or by professionals for a diversity of secondary use purposes.
- Promote the wider-scale collection of patient-defined outcome measures, and their use for individual patient care decisions, for health and care service planning, and for research.

Advancing solutions for multi-morbidity

- Healthcare practitioners must be up-skilled and further educated on multimorbidity and the associated complexity of conditions, while promoting a culture of multidisciplinary teamwork. Education of patients and the public is also essential
- There is a need for co-ordinated efforts to understand multimorbidity implications better for health and care at local, regional, national and European levels. We recommend consensus efforts for both policy and practice for this challenge

² <http://www.i-hd.eu>

- Europe must move towards data-driven guideline development for multi-morbid conditions (beyond traditional evidence-based approaches with the use of dynamic data, different level of abstractions in the definition of the conditions and the use of data from Patient Reported Outcome Measures and Patient Experience Measures (PROMs and PREMs)).
- Europe must investigate the use of patient-defined PROMs (co-produced with health and care professionals and negotiated based on patient choices).

Legal and ethical challenges

- MS and stakeholders to collaborate at European level to develop a code of conduct for using data for research
 - Based on GDPR Article 40
 - Designed for pan-European acceptance, focussed at national level
 - Endorsed by the European Data Protection Board (EDPB), implemented and supported at MS level
- Use the capacity of the Professional Qualifications Directive 3 (or other relevant legislation) to promote Continuing Professional Education to develop an understanding of the GDPR across medical and legal communities
- EDPB to develop guidance on harmonised interpretation of the GDPR for health research and care, based on the perspective of facilitating data-sharing, founded on the lived experience of clinicians, researchers, data protection officers, patients and other relevant stakeholders.

All three of these legal and ethical targets require **funded and supported systems to ensure that the voices of the stakeholders are heard** in order that stakeholder voices may be fed into the policy and legislation development process at every level.

These recommendations now have to be championed and elaborated into more concrete and stakeholder targeted actions. It was agreed amongst the Dots projects that this would be driven by the Digital Health Europe (DHE) project⁴, a Support Action co-ordinated by one of the C3-Cloud partners (empirica) and involving other C3-Cloud partners. The C3-Cloud perspective will therefore continue to be promoted at decision maker level.

³ Directive 2005/36/EC on the recognition of professional qualifications; <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32005L0036>

⁴ <https://www.digitalhealtheurope.eu>

6. C3-CLOUD FINAL CONFERENCE ON MULTIMORBIDITY

This conference was held as a full day, online, conference marking the closing finale of the C3-Cloud project. It was held on Friday 28th August. The conference objective was to showcase how the C3-Cloud digital health tools can enable health systems to respond to the escalating challenge of multimorbidity through providing more personalised and empowering care.

C3-Cloud promoted this conference to present and demonstrate how it has designed, implemented and evaluated an innovative ICT solution that aligns multiple single disease guidelines within clinical decision support and care planning tools, linking this to a standardised representation of each patient's electronic health record information. We wanted to show how, through C3-Cloud, patients can access their own care plan via a mobile patient empowerment platform, contribute self-management information and share this with their multi-professional care team for monitoring and joint decision making. The conference was designed to explain and demonstrate the solution that had been piloted and evaluated in three healthcare environments in Spain, Sweden and the UK, and is now ready to be sustained through a number of pathways that were presented.

The programme of the conference was structured to interweave invited keynote talks with presentations and demonstrations of the project results. The conference covered the following topics: multimorbidity, polypharmacy, integrated care, patient empowerment,

interoperability standards and EHRs, clinical decision support, data protection, organisational change management and the sustainability of digital health innovations including C3-Cloud sustainability.

The following pages show how the conference was announced on our website, and the conference programme. Participation was free, but registration was essential in order to operate the GoToWebinar meeting facility. Promotional emails were sent to the contact networks of all of the partners, plus all of the people who attended the November 2019 Joining the Dots conference who will have had an earlier introduction to the project. The other “Dots” participating projects were also invited to cascade the invitation to their consortium members and networks, which most of them did despite this being the holiday season.

The conference had 115 registered participants, of whom around 85 were external to the consortium. All of the project partners had at least one representative, and some had their whole teams participating. Many of the partners contributed to presentation preparation and delivery. The external participants included health informatics experts including the coordinators of other relevant European projects, people from academic organisations, European not-for-profit institutions active in digital health and integrated care, healthcare professionals, healthcare provider representatives, the ICT sector, health ministries, patient organisations and our project officer from the European Commission who was also a speaker. Attendees came from all over Europe, and the US.

C3-Cloud Grand Finale Conference

Jul 17, 2020 | Events

Friday 28th August 2020
Virtual full day conference

Discover how digital health tools can enable health systems to respond to the escalating challenge of multimorbidity through providing more personalised and empowering care.

Registration is free but compulsory. [Click here to register.](#)

Objectives

During this grand finale of the EU sponsored C3-Cloud project you will learn how the innovative C3-Cloud ICT solution assists

Multidisciplinary healthcare teams in defining integrated and optimised multimorbidity treatments through

- well aligned multi-disease guidelines
- several clinical decision support services
- the creation of personalised care plans, linking to data of each patient's electronic health record.

Patients to contribute to the self-management of their condition through

- access to their own care plan via a (mobile) patient empowerment platform
- sharing current health data with their multi-professional care team for monitoring
- joint decision making

6.1. Conference Programme

C3-Cloud Conference Schedule – 28 August 2020		
09:00 CET	20mins total	Welcome (Chair: Prof Theo Arvanitis)
09:00	10mins	<ul style="list-style-type: none"> Theo Arvanitis, C3-Cloud Coordinator
09:10	10mins	<ul style="list-style-type: none"> Orestis Kalliantzidis, Policy and Programme Officer, European Commission
09:20	65mins total	Societal challenge of multimorbidity and polypharmacy (Chair: Prof Theo Arvanitis)
09:20	15mins	<ul style="list-style-type: none"> Theo Arvanitis, University of Warwick C3-Cloud mission and high-level achievements in the area of multimorbidity
09:35	15mins	<ul style="list-style-type: none"> Robert Vander Stichele, Prof. of Clinical Pharmacology, University Ghent Polypharmacy from a clinical perspective
09:50	10mins	<ul style="list-style-type: none"> Chris Marguerie, South Warwickshire NHS Foundation Trust Clinical perspective and challenges of multiple guidelines
10:00	10mins	<ul style="list-style-type: none"> George Despotou, University of Warwick Drug-drug interaction service in C3-Cloud
10:10	15mins	<ul style="list-style-type: none"> Discussion
10:25	45mins total	C3-Cloud solution demonstration (Chair: Dr Sarah Lim Choi Keung)
10:25	10mins	<ul style="list-style-type: none"> Sarah Lim Choi Keung, University of Warwick Introduction to digitally-enhanced integrated care
10:35	25mins	<ul style="list-style-type: none"> Mustafa Yüksel, SRDC, and Pontus Lindman, MEDIXINE C3-Cloud demonstration

11:00	10mins	<ul style="list-style-type: none"> Discussion
11:10	15mins	BREAK
11:25	40mins total	Interoperability of systems (Chair: Dr Sarah Lim Choi Keung)
11:25	15mins	<ul style="list-style-type: none"> Catherine Chronaki, Secretary General, HL7 International Foundation International Patient Summary standards connected to EHRs: Lessons learned in Trillium II project
11:40	15mins	<ul style="list-style-type: none"> Gokce Banu Laleci Erturkmen, SRDC C3-Cloud architecture and technical solution
11:55	10mins	<ul style="list-style-type: none"> Discussion
12:05	40mins total	Clinical decision support (Chair: Dr Sarah Lim Choi Keung)
12:05	15mins	<ul style="list-style-type: none"> Thomas Beale, Chief Architect, openEHR Foundation Success factors for guideline and clinical decision support in task planning and EHRs
12:20	15mins	<ul style="list-style-type: none"> Rong Chen, CEO, Cambio CDS Clinical decision support with GDL in C3-Cloud
12:35	10mins	<ul style="list-style-type: none"> Discussion
12:45	45mins	LUNCH BREAK
13:30	40mins total	Patient empowerment and self-management (Chair: Dr Sarah Lim Choi Keung)
13:30	15mins	<ul style="list-style-type: none"> Nhu Tram, Research Project Officer, AGE Platform Europe Self-management and empowerment through technology: enablers and barriers for older adults

13:45	15mins	<ul style="list-style-type: none"> Pontus Lindman, MEDIXINE Benefits and challenges of patient empowerment platforms
14:00	10mins	<ul style="list-style-type: none"> Discussion
14:10	50mins total	Information sharing and change management (Chair: Prof Theo Arvanitis)
14:10	25mins	<ul style="list-style-type: none"> Nathan Lea, Senior Research Associate, University College London, & Gunnar Klein, Prof. of Health Informatics, Örebro University and chairperson of the C3-Cloud Ethics Committee Protecting patient data: in conversation with Nathan Lea and Gunnar Klein
14:35	15mins	<ul style="list-style-type: none"> Tim Robbins, Academic Medical Registrar, University Hospitals Coventry & Warwickshire NHS Trust Digitally integrated diabetes care
14:50	5mins	<ul style="list-style-type: none"> Dipak Kalra, EuroRec Organisational changes to get the best out of C3-Cloud
14:55	5mins	<ul style="list-style-type: none"> Discussion
15:00	60mins total	What's Next? (Chair: Prof Theo Arvanitis)
15:00	15mins	<ul style="list-style-type: none"> Malte von Tottleben, empirica Evaluating C3-Cloud to plan for future development
15:15	10mins	<ul style="list-style-type: none"> C3-Cloud pilot sites Healthcare management and sustainability
15:25	15mins	<ul style="list-style-type: none"> Theo Arvanitis, University of Warwick C3-Cloud business and exploitation plans
15:40	10mins	<ul style="list-style-type: none"> Esteban de Manuel, KRONIKGUNE ADLIFE project
16:50	10mins	<ul style="list-style-type: none"> Discussion
16:00	15mins total	Closing (Chair: Prof Theo Arvanitis)

16:00	15mins	<ul style="list-style-type: none"> Closing remarks Theo Arvanitis, University of Warwick
16:15		END

6.2. Conference summary

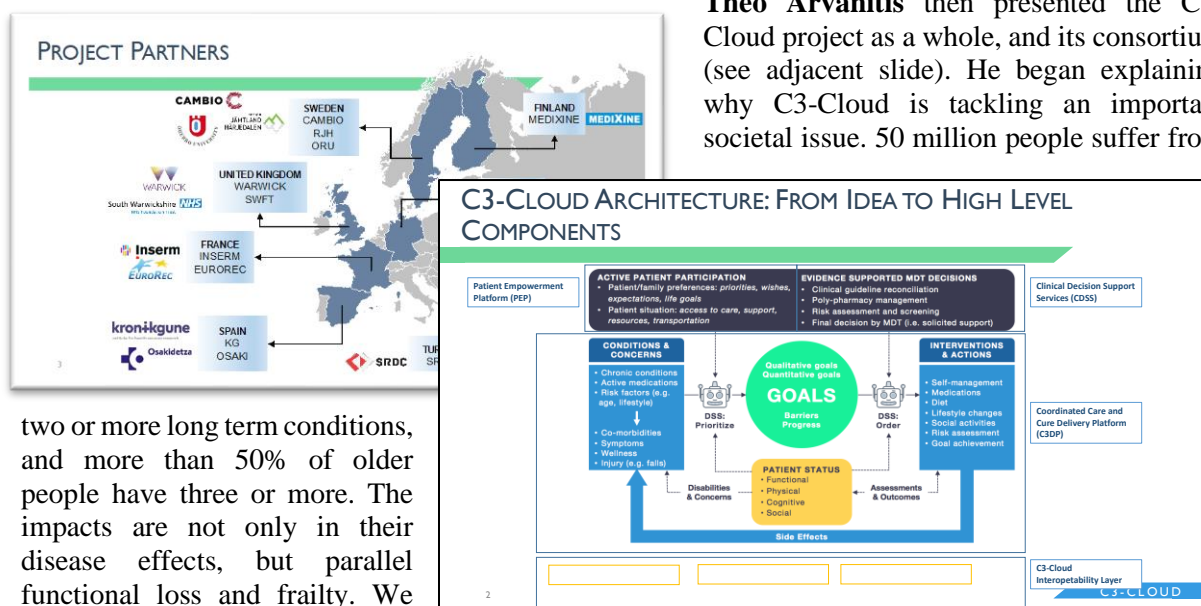
6.2.1. Welcome addresses

Theo Arvanitis, the C3-Cloud project co-ordinator from the University of Warwick, welcomed participants, explained the virtual meeting logistics for the day and outlined the agenda and speakers. He briefly introduced C3-Cloud, its mission and the main achievements that would be explained through the conference, interwoven with our invited keynote speakers.

Orestis Kalliantzidis, on behalf of the European Commission, explained the rationale behind the call text to which C3-Cloud responded. He explained how the growing challenge of ageing and multimorbidity impacts on health and care services across Europe, on individuals and on society. These impacts include increased burden on hospitals, such as prolonged length of inpatient stays, and on community health and social care teams. C3-Cloud is one of six projects funded in this call, which are all complementary. C3-Cloud has especially focussed on improved care pathways and patient empowerment. Orestis highlighted the success of C3-Cloud in achieving four innovations that have scored highly in the European Commission's Innovation Radar. He hopes for future success of C3-Cloud in the ICT market, but also recognised the importance of embedding C3-Cloud into new EC sponsored projects. He summarised the new seven-year funding cycle, and its main frameworks including Digital Europe, which will include relevant topics for the C3 cloud partners to participate in.

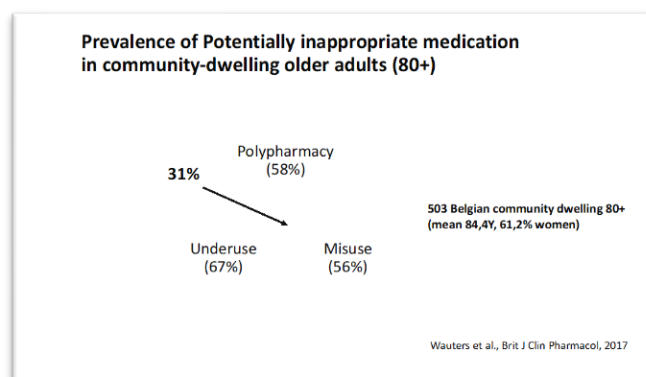
6.2.2. Societal challenge of multimorbidity and polypharmacy

Theo Arvanitis then presented the C3-Cloud project as a whole, and its consortium (see adjacent slide). He began explaining why C3-Cloud is tackling an important societal issue. 50 million people suffer from



also know that clinical knowledge is not sufficient in multimorbidity care, especially the management of polypharmacy and how to optimise a multi-condition care plan. C3-Cloud set itself very ambitious objectives, to connect multiple members of a care team who may be on different sites, enable them to share a well-designed multimorbidity care plan and enable patients and caregivers to be fully informed and engaged. C3-Cloud has leveraged interoperability standards and advanced digital tools to achieve this. One of our challenges was to shift from treating single diseases to combined disease strategies, which we delivered to clinicians through computerised decision support. We have focused on four major diseases: type 2 diabetes, renal failure, heart failure and depression. These often co-occur and so represent a significant multimorbidity care burden in Europe. C3-Cloud needed to define over 500 decision support rules that navigate across these four single-disease guidelines in a clinically defined, holistic way. Theo closed by emphasising the relevance of solutions like C3-Cloud in supporting greater patient self-driven care with digital remote clinician support, in the post-COVID-19 era when in person contacts need to be minimised.

Robert Vander Stichele spoke about the clinical perspective on polypharmacy, and in particular how to detect potentially inappropriate medications. In the developed world 15-20% of people are aged 65 or over, and many of these take more than one long term medication. 80% of very old persons have both multimorbidity and polypharmacy. Polypharmacy is usually defined in terms of the number of medicines with a systemic action (usually 5 or more). He stressed that polypharmacy is not inherently bad, as multiple medicines may be required for multiple conditions. Likewise, a patient on four medicines, which is not formally classified as polypharmacy, might not have an appropriate drug combination. If every patient is treated “by the book” for each single condition the number of medicines can escalate. Rationalisation is needed. A Belgian survey of ~500 nursing home residents (see adjacent slide) found a high percentage of polypharmacy, underuse and misuse of medicines. There are published evidence-based decision rules to identify potentially inappropriate prescribing, guiding prescribers to review the patient’s medication list. To run these rules, it is essential to have access to a complete EHR or at least a well populated patient summary, in a computable form. The published rules also have to be expressed in a computable way. Computable solutions then need to deliver the decision rule alerts to multidisciplinary teams, so they can de-prescribe or change a medication item as needed. Robert



Take home messages

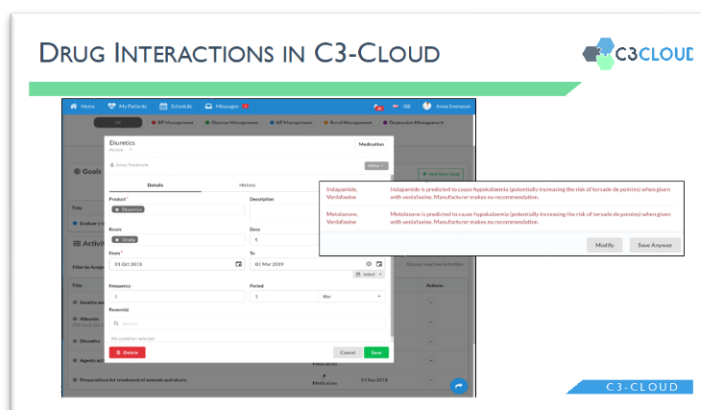
- Complex morbidity patterns and polypharmacy are the fate of many older adults, whether residing in nursing homes or community-dwelling.
- These are vulnerable patients, often with insufficient clinical documentation
- A current Patient Summary with a reliable medication list is enough to unleash the power of ICT supported medication review.
- Good clinical data and ICT-Support will increase the efficiency of medication review, prevent alert fatigue, and facilitate interprofessional cooperation.
- Better quality of prescribing could make this vulnerable population more resilient to pandemics and may reduce pharmacodynamic interactions with impact on Quality of Life. The latter statement needs more evidence.

explained the scope of the published rule collections, and the kinds of risks they can identify. Studies of the use of these rules show that they can lead to reduced mortality and reduced hospitalisation. His take home messages (see adjacent slide) stressed that many vulnerable patients have insufficient clinical documentation, but that a well-filled patient summary with a reliable medication list is more than enough to enable the use of digital tools to enable safer prescribing and to improve patient resilience to pandemics.

Chris Marguerie spoke about the clinical challenge of multiple clinical guidelines. The development of guidelines has transformed the ability of clinicians to apply evidence into their clinical practice.

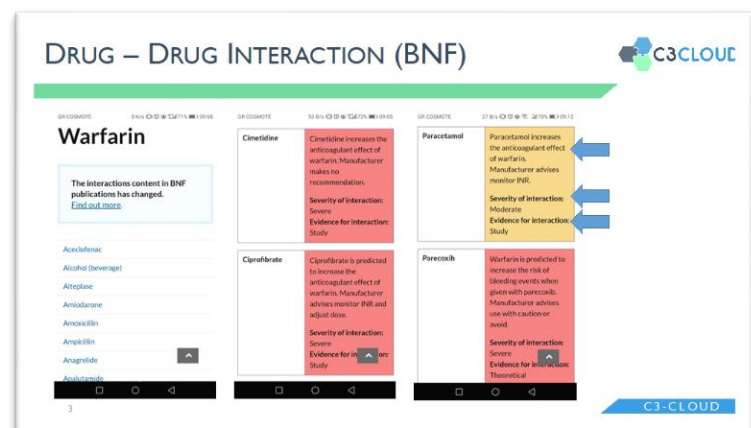
However, the studies underpinning the guidelines have almost always been based on patients with the single disease being focussed on. Even in trials including some patients with a comorbidity, the other conditions are not often included in the analysis. NICE published a multimorbidity guideline in 2016, which sets out principles but no disease specifics. Even taking just the four conditions adopted by C3-Cloud led to over 500 decision rules derived from the guidelines. These had to take into account that patients with multimorbidity not only have multiple conditions but are frail, have poor physiological reserve and therefore the treatment indicated for a single condition might not be appropriate. If a patient has a complex disease, possibly compromising immunity or treated with a biological agent, this adds to the complexity. The C3-Cloud solution offers a platform that supports the reconciliation of multiple guidelines and reconciliation across multiple care actors. Patient involvement is an important part of good care, and C3-Cloud has developed important empowerment and communication tools to support this.

George Despotou presented the C3-Cloud drug-drug interaction advisory service, which is part of the overall decision support infrastructure.



The clinician user interface for prescribing triggers running the new prescription against the existing drugs, offering a pop-up alert about a potential (see adjacent slide). The underlying knowledge comes from a British National Formulary (BNF) drug interaction database, which holds evidence about the nature, severity and evidence behind every drug-drug interaction (see slide below). C3-Cloud uses the ATC drug classification

system to match prescribed drugs to the interaction database. C3-Cloud contains 105,000 interactions between over 1000 substances, which have been translated into the pilot site languages (Spanish, Swedish, as well as the published form in English). An ontology model manages that matching process, which enables easier maintenance and would make it possible to change to a different knowledge database in the future. The solution permits filtering to only severe interactions, if the number of alert messages is too high. Not all EHR systems use ATC codes, and there is some work to be done when mapping data imports from these systems to C3-Cloud.



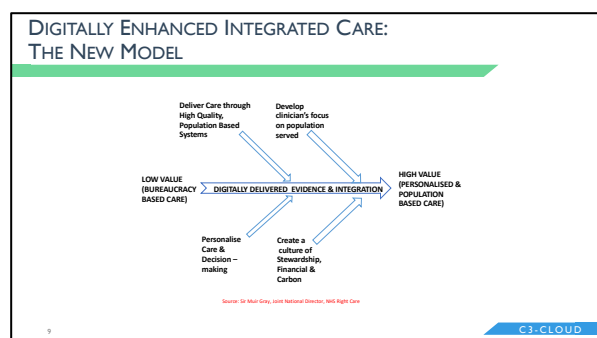
In the subsequent discussion, Chris explained further about the importance of homeostatic resilience, which reflects the ability of the body to withstand challenges such as acute infections or fluctuations in the severity of a long term illness.

He was asked how reusable the method adopted by the project's Clinical Reference Group would be for future guideline reconciliation. Chris recognised that each multi-guideline reconciliation required clinical decision making and consensus on how best to align the many recommendations each contains, whilst recognising that multimorbidity adds frailty to the challenge of treatment selection. However,

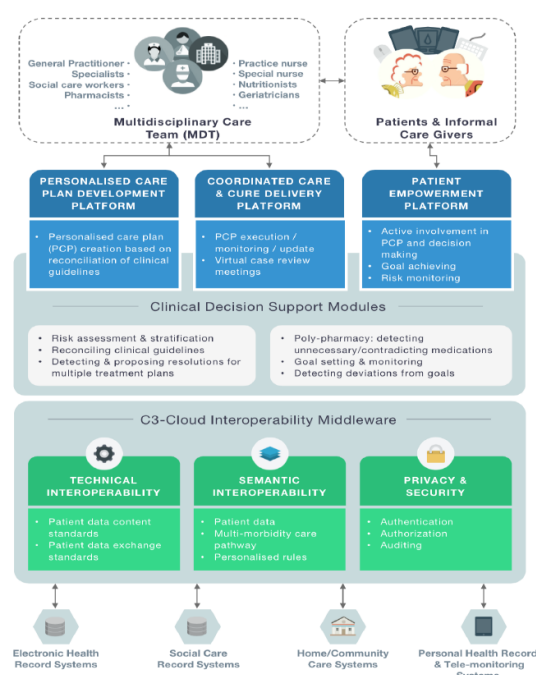
the C3-Cloud solution helps to validate a guideline reconciliation that has been specified by a clinical team, by enabling its implementation within an environment that could use patient data and clinical scenarios to validate that the reconciliation behaves appropriately. In the future it would be great to have a library of reconciled guidelines.

6.2.3. C3-Cloud solution demonstration

Sarah Lim Choi Keung presented an overview of the C3-Cloud digital solution. She set the scene on the scale and burden of multimorbidity and summarised the areas of digital transformation that are taking place in healthcare (see adjacent slide).



Sarah briefly described each of the main components of the C3-Cloud solution (see adjacent slide). These include user-facing components that present integrated clinical information, care planning tools, alerts and communications with patients. There are back end components dealing with technical and semantic interoperability, and security.



Mustafa Yüksel and **Pontus Lindman** then ran a software demonstration of the C3-Cloud solution. Mustafa logged in to the Co-ordinated Care and Cure Delivery platform (C3DP) as a GP and showed her patient list, incoming messages and active care plans. He showed the detailed medical summary record of fictitious patient George Best, highlighting features such as the differentiation between active and inactive conditions, which can be organised by date, name etc. The summary includes social care information, which is often not included in existing EHR systems. He walked through the creation of a new care plan, covering more than one of his conditions. He also showed how the patient's care team can be specified and linked to the new care plan. The screen enables easy access to the main care management topics within the care plan. He drew attention to the possibility of adding any clinical data that was missing from imported EHR data, that can be sent back to the EHR system, so that the record remains complete. Goals can be defined for the clinician or patient, such as a target blood pressure, which can be suggested by the decision support services based on the patient profile and the reconciled guideline rules. The goal can be linked to activities to be undertaken by the patient, which might be for self-measurement or something like blood pressure, or the completion of a status questionnaire. He then showed how the addition of new kidney function laboratory values can modify a suggested goal for a patient. Some goals can optionally be hidden from the patient, if they might appear overwhelming or confusing for a patient. He then showed how an alert now recommended the change of an antidiabetic

Mustafa then showed the Patient Empowerment Platform screens showing the patient his care plans. This can be accessed on a desktop or mobile device and can be linked by Bluetooth to measurement devices such as a home blood pressure measurement device. He showed a new patient entered blood pressure reading becoming visible to the clinician in a dedicated screen only showing patient generated data. He showed the patient completing a questionnaire, and this data also being shared with the care team members and compared with previous answers. The PEP highlights to the patient which activities need to be undertaken now. Patients can enter notes and feedback about their progress towards their goals, in addition to any requested data entry. The patient could upload a photograph, for example of a meal they plan to eat or the state of a skin ulcer, to share this with their care team. He showed the real time messaging module, with one channel with the patient and the other between care team members. There is also a calendar for care team members.


6.2.4. Interoperability of systems

The mission of Trillium II was to advance patient summary standardisation, to enable all patients to benefit from access to their health summary at any place and time (see adjacent slide). It tackled this ambition from multiple perspectives.

What about international patient summary (IPS) standards ?


- Highlight the **social value** of patient summaries and health data
- Contribute to their **Governance** of IPS specifications
- Develop, Collect, Assess **learning resources**
- Foster innovation & inform **health policy**
- Collaborate across **standardization bodies**
- Bridge grassroot **patient summary initiatives**
- Engage **mobile Health companies & app developers**
- Establish a **Global Community of Practice** for Digital Health Innovation using International Patient Summary Standards (IPS)






EU Horizon 2020
GA 727746

Scaling-up use of patient summaries



Consider the IPS as an active window to a person's health data, a landing page to navigate a person's health information across locations & jurisdictions.



Identification

vaccinations

encounters

problems

Therapeutic plan

allergies

medications

Implantable devices

Health team

Trillium-II will select and elaborate

- ✓ resources to accelerate implementation and sharing of experience
- ✓ new use cases on the use of patient summaries from unplanned emergency care

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C3Cloud Final Conference

5

closely with partner SRDC. This showed the import of IPS data into C3-Cloud and used as the basis for a new care plan, that was then visible to the patient. This was demonstrated at scale in the EU MODEX exercise in Romania, comprising 28 global countries, and worked closely with an Israeli medical team on the role of the IPS and C3-Cloud care plans in the 14 days after the emergency occurred.

Lessons Learned...

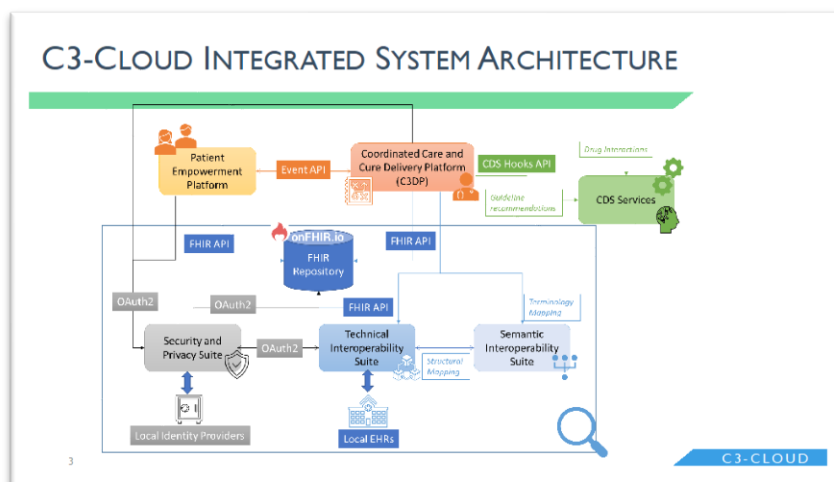
- Lesson 1: Focus on Provenance, Quality, and Trust on the source
- Lesson 2: Align Application Programming Interfaces (APIs) in health
- Lesson 3: Care plans matter for IPS, focus on daily use, make it easy
- Lesson 4: Tools accelerate integration and implementation of standards
- Lesson 5: Prioritize on IPS use, HL7 FHIR for FAIR data
- Lesson 6: Be aware of the gaps, SDO cooperation is a must
- Lesson 7: Invest on education, capacity building, and new ways of work

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Many valuable lessons were learned from Trillium II (see adjacent slide). In particular, someone accessing the IPS has to know how they can trust that information, and care plans are an important complement to the IPS. APIs matter, and collaboration between standards bodies is essential. Emergency teams indicated that they need to capture and digest health information using voice, because this is more practical for them. There is a real need to invest in education

and capacity building. Another critical challenge being tackled is the unique identification of medicines, through the UNICOM project, which is also vital for an interpretable IPS. Catherine closed with praise for the innovation of C3-Cloud.

Gökçe Banu Laleci Ertürkmen gave an in-depth presentation of the C3-Cloud architecture (see adjacent slide). She stressed that a critical objective was to ensure that clinicians can always see a complete health record picture of the patient. This complete information is also vital for the correct functioning of the clinical decision support services.



The interoperability architecture enables this. The PEP creates a bridge between the clinicians and the patient, also requiring a robust data exchange.

The interoperability services require a common data model, for which HL7 FHIR was chosen and adopted within the principal clinical data repository.

The import interfaces map the native EHR system's data to HL7 FHIR (see adjacent slide) including semantic interoperability mapping to the adopted terminology and term lists. The security and privacy suite also adopts international standards and APIs, so that it can support single sign on integrating with a locally-deployed authentication services. Many of these components are available open source via GitHub, such as onfhir.io. The technical interoperability ETL layer, developed by Warwick, works by querying an interface provided by a host EHR system or by importing data from an EHR extract file. In co-operation with Trillium II it was also shown that C3-Coud can import IPS extracts. The semantic interoperability suite maps terms and value sets between SNOMED-CT, LOINC, WHO ATC and national versions of ICD-10.

HL7 FHIR AS THE COMMON DATA MODEL

➤ Used FHIR STU3 Resources:

- CarePlan
- CareTeam
- Goal
- Appointment
- ReferralRequest
- MedicationRequest
- ProcedureRequest
- DeviceRequest
- Device
- CommunicationRequest
- Communication
- Questionnaire
- QuestionnaireResponse
- + tens of others for medical data, e.g. Condition, Observation, MedicationStatement, AllergyIntolerance, FamilyMemberHistory, Patient, Practitioner
- + foundation resources, e.g. AuditEvent, ValueSet

5. C3-CLOUD

The C3DP provides a view on the FHIR repository and delivers the various clinician side functions (see adjacent slide). The Clinical Decision Support (CDS) services span clinical guideline rules, drug-drug and drug-disease interactions. CDS Hooks were used to connect these services to the HL7 FHIR-represented clinical data.

COORDINATED CARE AND CURE DELIVERY PLATFORM (C3DP)

➤ The Web application for **collaborative and personalised care plan management** by the members of a multidisciplinary team of care (MDT). Main functions:

- Review of medical summary
- Cross-check of all patient data that are needed as input by the CDS services
- Management of the care plan building blocks; goals, activities and education materials
 - Manual entry from scratch
 - Recommendations from the CDS services
- "Execution" of a care plan
 - Updating the progress of goals and activities
 - Re-execution of CDS services during planned and unplanned encounters
 - Display of patient provided data
 - Commenting on the care plan items
- Management of the care team
 - Communication among care team members and with the patient / informal care giver
- Dashboard view
- Patient provided data screen
- Activity calendar
- Real-time system notifications

12. C3-CLOUD

PATIENT EMPOWERMENT PLATFORM (PEP)

➤ The Web application providing access for a patient to the published care plan and its associated information

➤ Based on the Medicine Suite PHR product of Medicine

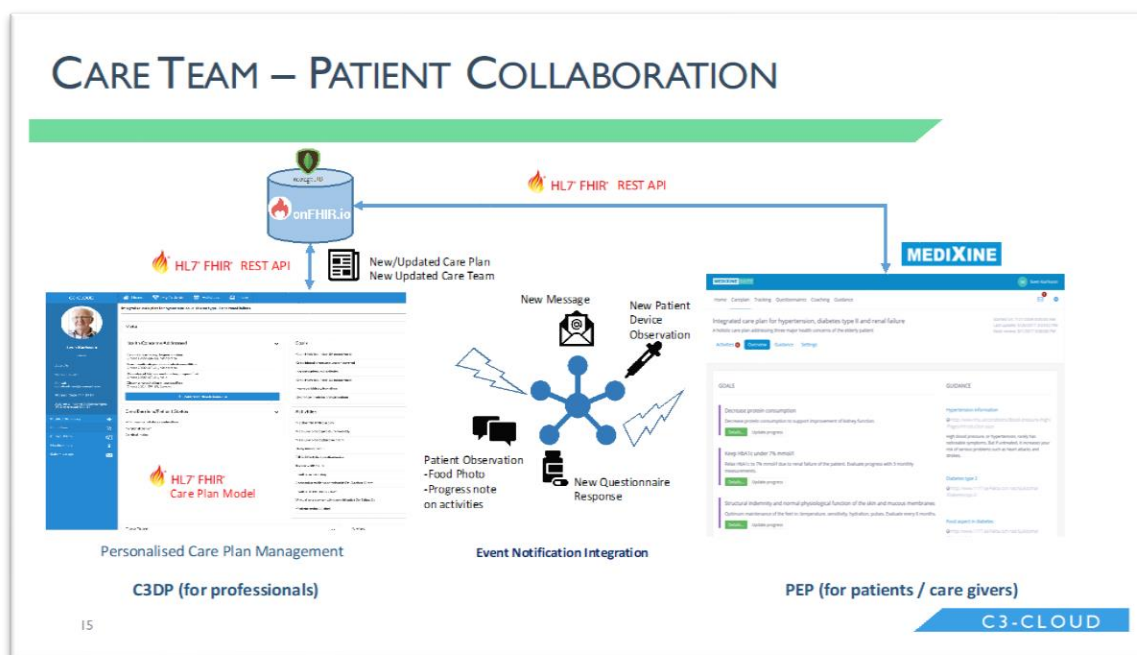
➤ Core user functionalities:

- Care plan access
- Reminders to increase adherence
- Actively collect data related to the care plan activities.
- Safe messaging
- Access to relevant self-management material.

14. C3-CLOUD

The PEP provides the corresponding patient view (see adjacent slide).

The architecture as a whole has been designed to enable rich clinician-patient collaboration.



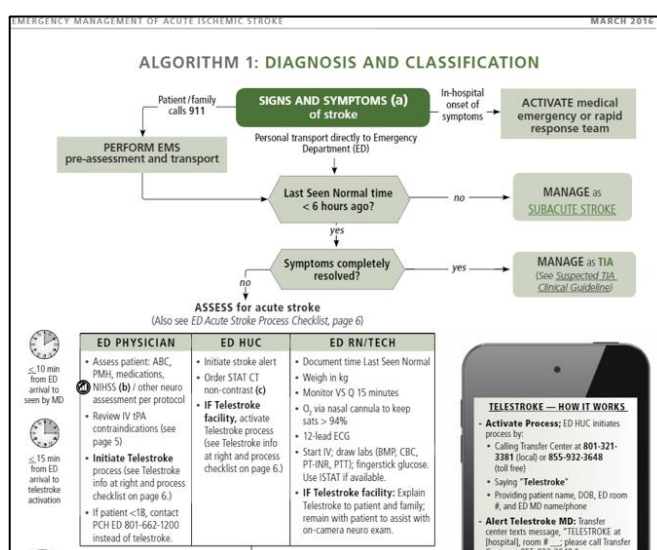
In discussion with the audience, Gökçe confirmed that collaboration with other projects and developments e.g. the CDS could be extended to other guidelines. CDS Hooks will allow these to also be connected to the FHIR repository. The collaboration with Trillium II demonstrated the ability to connect to any future IPS services.

There was a question about the use of cloud storage. In all deployment sites the data is stored in a locally deployed FHIR repository, within the firewalls of the healthcare provider's environment. There is strong security, authentication and access controls.

There was an audience question about the rights and control of the patient regarding their data. The care plan is shared with patients via the FHIR repository, and a lot of patient generated data is shared back to clinicians. There is a possibility that in the future a view-only version of the C3DP could be added, so that patients could be granted access to their medical summary by their healthcare provider.

6.2.5. Clinical decision support

Thomas Beale spoke about the success factors for guideline and clinical decision support in task planning and EHRs. A vital question for a clinician about to see a patient is "What is going on with my patient?", which is actually quite hard to answer. Our present approach is like your accounts being prepared by different accounting firms, each preparing a few of the pages independently! The need to solve this is great: there is increasing team-based care, long term condition care, disease monitoring needs, increasingly complex care. However, nobody is really in charge and knows everything that is happening to a given patient. Thomas showed some sample pages from an Intermountain Care



stroke emergency management guideline. Even an expert could not memorise this level of information density (see adjacent slide): computerisation is vital. How can this all be formalised and made suitable for computerisation. The stroke guideline lists seven kinds of MDT members, who also need to be co-ordinated using digital tools. The formalisation needs to take into account the tasks, events, timing, conditionality and patient specific factors etc. Thomas showed an example screen (developed by Cambio) showing how a guideline can be computerised and presented in a friendly way. However, how can we get the complete clinical data? It is not only a data access problem to be solved by standards. This is part but not all of the issue. The challenge is lifting the epistemic data and populating ontic concepts e.g. is the patient diabetic. We must tackle this. It is also important in design to prevent useful or minimally useful alerts. Medicine is a cognitive discipline; the primary actor is still the clinician. The CDS is acting as a kind of co-pilot but is not the pilot. The system has to be designed to support the clinician. This may include more convenient interfaces like voice, eye tracking. Thomas then listed the key general needs that CDS has to meet (see slide below). Published guidelines need to be issued in a computable form. However, our field does still harbour a lot of persistent problems (see slide below).

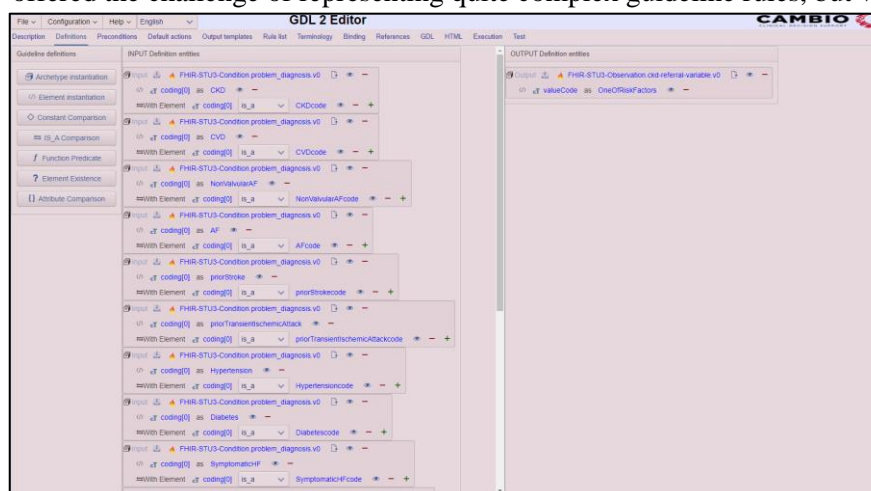
General Need

- Adaptive process / plan based system
- With 'plans' formally derived from care pathway guidelines
- And integrated analytic guidelines (Dx, risk analysis, medication etc)
- Semantic EHR backbone
- Solution for subject variables
- A new category of system

The problem that keeps on giving

- Different standards
- Different data-set definitions
- Different APIs
- Different query models
- Different terminology
- Absent data
- Get data from user
- Duplicated/competing data
- Formal type & naming

Rong Chen then explained how CDS was implemented in C3-Cloud. The computerised decision support rules were implemented using the openEHR Guideline Definition Language (GDL). Work on this language was started in 2012, to express clinical guidance in a formal language that is natural language and terminology system neutral. It was also essential for the representation to be EHR model neutral and be capable of representing the rules that are implied within narrative guidelines. No existing guideline formalism met these needs. The guideline language developed by Rong's team leveraged the archetype approach of openEHR, and was embedded initially within Cambio's system to enable validation and practical experience in Sweden, the US and other piloting environments. This generated to improvements to the language (leading to version 2) and to the GDL processing engine. C3-Cloud offered the challenge of representing quite complex guideline rules, but within a well-designed overall



architecture which made it quite straightforward to integrate. The decision trees that were initially developed by SRDC within the project (from the reconciled guidelines defined by the clinical reference group). The project work plan required some re-engineering of the guideline engine to cope with the rule complexity

(for example, the diabetes guideline resulted in 27,000 lines of code). Rong showed some screen shots of the guideline editor (see adjacent slide), through which rules can be edited and terminology bindings specified. The editor allows a guideline to be test run to check its correctness. Through the project, 23 guidelines were developed that contained a total of 500 rules, linked to the pilot site natural languages. All of these guideline resources have been published in GitHub.

There was discussion with the audience about the challenges of adoption. Thomas indicated that in the case of conventional narrative, usually printed, guidelines they may be used or not used, without much checking or governance. Formalising the logic within a guideline is not so hard, but inferring the ontic data is a challenge that everyone faces. Some teams are trying to implement BPMN, but this is a more complex method for tackling this challenge because it requires the technical connection to the health data to be specified each time.

The biggest issues are scalability: the challenging aspect is how we can engage the average healthcare professional to contribute to the content of guidelines, across all of the clinical domains that are needed.

Rong indicated that the GDL library now holds 400 guidelines. This community may now hold be the most important source of lessons that have been learned in touching the challenge of guideline representation and multi-guideline reconciliation.

There was a question about clinical acceptance of clinical decision support. Thomas had observed how voice interaction with a guideline system has radically changed clinician acceptance (a bit like asking Alexa or Siri for advice). Rong added that it was important to aim for low hanging fruit: to develop computerised guidelines and to deliver these in clinical areas where healthcare is under stress. In his experience, the stress relieving benefit of clinical decision support is partially in reducing the cognitive load and reducing errors by traditional clinical decision makers (e.g. doctors), and partially by enabling other staff like senior nurses to take CDS assisted decisions, thereby reducing the pressure on the doctors and on the system as a whole.

6.2.6. Patient empowerment and self-management

Nhu Tram introduced AGE Platform Europe, which works to enable the inclusion and equality for people aged 50 or more. She opened the afternoon with a strong message about the importance of patient empowerment and of involving people, including older persons, in the design of digital solutions. This was especially relevant to C3-Cloud's multimorbidity solutions which are mainly targeted at older patients. She first outlined what the challenges are for older persons in adopting technology to manage their health and conditions. She pointed out the older persons are not a heterogeneous group, especially across the older age range. Their needs, wishes and lifestyles need to be properly consulted and their views incorporated into the design of a new solution (see adjacent slide). Ageism

AGE Platform Europe
 The voice of older persons at EU level

➤ **Heterogeneous group:** Older persons are not a uniform target group. They are individuals with diverse needs, wishes, lifestyles and expectations.

- Were the **needs** clearly assessed?
- Were older people **involved** in the design (stage A to stage Z) of such technology?
- Were older people asked if they wanted a medicalised lifestyle?

AGE Platform Europe
 The voice of older persons at EU level

➤ **Accessibility:**

- can older people easily use these new technologies?
- Is it user-friendly?
- Is on-going training planned?
- Who will provide the training?
- Is long-term technical support envisaged?
- Were the target users consulted on how to make it more accessible?
- Were their feedback taken seriously?
- Can older people have access to the internet? (e.g. rural areas)

can manifest as stereotyping, discrimination and prejudice, which might become reflected into technology. For example, older persons are often thought about as having illness, dependency and decay, and being technology illiterate. Designers can sometimes misunderstand the reasons behind an initial reluctance to use technology is a

design issue, but need to find out. Sometimes the issue can be about cost on a pension budget. Nhu listed several key accessibility issues (see adjacent slide). Health literacy, the risk of creating stigmatisation through the technology, and real life (practical) considerations all need to be taken into account. Nhu closed by taking us through recommendations developed by the UN on human rights of older persons. She emphasised the importance of equal access to digital innovations, which may include solutions for the challenge of affordability. Older people should always have the choice of using a new technology, or not.

Pontus Lindman then presented the C3-Cloud Patient Empowerment Platform (PEP). He spoke primarily about the benefits and challenges of developing patient empowerment platforms. The PEP is integrated within the Medixine platform suite that has been developed over 15 years with input from 300,000 patients. An important challenge is that there are have too many single-purpose digital tools offered to patients, which may lead to a proliferation of devices the patient has to carry around and manage. Medixine has sought to offer a multi-condition, multi-app, multi-device platform that reduces the complexity for patients managing multiple diseases or measurement solutions. The integrated care plan allows customisation for the individual patient. The C3-Cloud PEP illustrates this. It collects data, shares information (readings, questionnaires, photographs, notes), enables patient or clinician responses to different changes in the patient's state, and supports communication between patients and their care teams. It is important that patients are not asked simply to collect data: the systems they collect data through must help decision makers (including the patient) to make sense of the inputs and to make relevant changes. For example, if a sensor reading is outside the expected range there can be a series of escalating rules, and prioritised alerts that draw attention to patients needing prompt review. Device connectivity, making the user experience easy and quick, improves acceptability of home monitoring. Patients can be requested to undertake the level of monitoring intensity that they really need, rather than asking all patients to collect a lot of data that might not be necessary for relevant decision-making. The PEP solutions had to be designed well, to cater for diverse patient levels of skills and knowledge and had to fit into clinical workflows so that its use by patients did not increase the burden on care teams. Pontus argued that for successful adoption of patient empowerment there must be a centralised planning of new organisational workflows. Information overload for patients is also a risk that requires careful design: layered information, starting with the minimum needed for the current activities and decisions. Information relevance is itself difficult to determine and requires patient consultation.

A discussion question from the audience probed how Nu saw the incorporation of the perspective of older people within the working relationship between state-based services, businesses, and especially the voluntary sector/NGOs? In other words, rather than each actor in a multi actor space connecting with patients or older citizens to identify their needs, can they collaborate and work collectively with their client base? Nhu responded that this is important and something AGE Platform is involved in a lot: helping different actors to work together and to avoid care provision silos.

It is also important that user-centred design thinking is not only focused on the technology, but also on the organisational environment in which it will be embedded.

It was also noted that patients (and people preventing illness) must be able to decline to use technology, and there must be alternative care pathways for those who decline.

6.2.7. Information sharing and change management

The session was held as a conversation between **Nathan Lea**, an external GDPR expert, and **Gunnar Klein**, an international data security expert who had led the C3-Cloud ethics committee and data protection approaches. The session was structured as a conversation between, initiated by a short presentation by Nathan.

Nathan introduced his personal background in data protection and information governance, which includes university, European projects and work within a large UK hospital. He first summarised the main principles of the GDPR. Use of data has to be lawful and ethical, must not cause harm or risk to the data subject. The data has to be sufficient for the intended needs, and accurate, but only processing

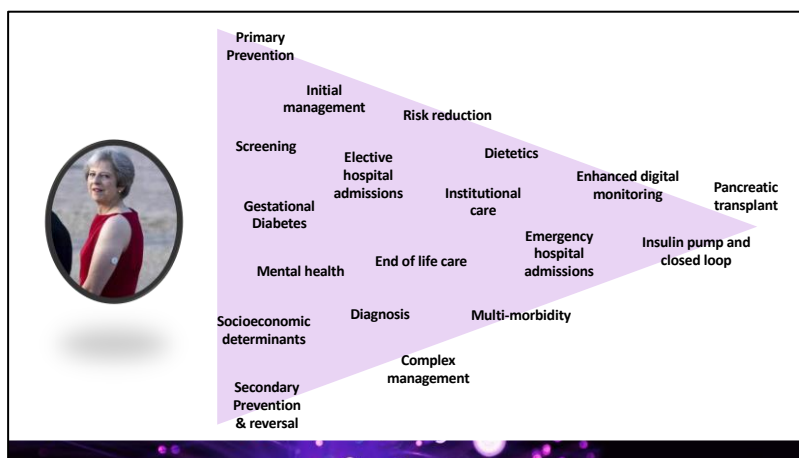
the data needed to achieve the declared goals. Data has to be held, processed and communicated securely. Organisations have to be open, clear and honest with how data are being handled, and ready to be accountable for that. He summarised the “new normal” that has been triggered by the COVID-19 pandemic. Within the UK, as a case study, some laws such as the duty of confidentiality have been set aside but not data protection. The pandemic now invites a new mandate: not to fuss or waste time on excess consultations and not to use data protection as an excuse for not making use of data. Gunnar felt that COVID-19 has not introduced major data protection change. The ethical challenge pre-existed the pandemic: how to support the best interests of patients whilst respecting the GDPR. Many EU countries has data protection legislation before GDPR that is not so different. C3-Cloud started before GDPR was finalised and its data protection, security and ethics approaches were strong and did not need to change.

Nathan asked Gunnar to outline how C3-Cloud has achieved this. Gunnar explained that C3-Cloud has been a research project and developed a formal research protocol to conduct its live pilot studies. The team had to obtain ethics committee approvals and also at times needed to engage with data protection officers and National DP Authorities. Robust access controls and technical solutions were built into the design from scratch. As an example of a design decision, it was agreed early in the project that cloud storage should not be pursued, but data held locally under the control of each pilot site. He reported that in near final testing a minor data breach occurred when a technical partner was accidentally given access to identifiable data, which was quickly detected, all copies purged, reported to the correct authorities and satisfactory conclusions reached.

Gunnar noted in closing that we have not taken active steps to support data portability, but this should be a future goal.

Nathan concluded that we should not do harm by over-regulating the environment.

Tim Robbins then gave a presentation about digitally integrated care for diabetes. Tim started by pointing out how, in the UK, the principles of integrated care (initially known as multi-disciplinary care) originated in the 1960’s. There has been a progressive evolution of concepts through to patient centred care and to patient empowered care, and in parallel the gradual adoption of integrated care pathways. The latest “NHS vanguards” are demonstrators of integrated care systems. Diabetes is one of the conditions focused on by the NHS. In Europe there are 60 million people with diabetes, 88.5% of whom have at least two multimorbid conditions. The UK cost of diabetes care is £10 billion per year. It is therefore a European priority and good exemplar for demonstrating how integrated care can best be designed and delivered. Good care means moving away from event based reactive care to strategic and pre-emptive planned care. Good diabetes care is not necessarily empowering because keeping a stable blood sugar does not automatically alter how a patient is feeling at any one time. Classical physician care is based on low quality and quantity of monitoring information. Fragmented and reactive care does not lead to empowered patients. Tim showed a photograph of the former UK Prime Minister



Theresa May, who has type I diabetes and uses the latest digital monitoring technology. Patient empowering tools have the potential to reduce the complex cascade across the many possible disease complications and adverse outcomes (see adjacent slide).

C3-Cloud enables patients to be more empowered, through education via the PEP and the ability to co-create a care plan with the GP. This proactive

planned care should reduce complications, admissions and burden for patients and health systems. Tim showed another innovation that allows weekly foot ulcer photographs to be shared between the patient and clinician to monitor progress more accurately than textual descriptions. Digital blood sugar

readings, accessible in real time, are more amenable to supporting timely decision making than a written record in a patient held book, possibly seen infrequently. Tim argued that COVID-19 has proved a catalyst for digital transformation. Coventry hospital has scaled up the use of digital blood sugar monitoring in order to cope with the COVID-19 clinical workload. Tim put the case for investment in clinical workforce education in digital technologies as an essential enabling factor.

Dipak Kalra outlined some of the health system ecosystem changes that C3-Cloud adoption catalyses, and to some extent relies upon. Firstly, that the C3-Cloud system requires access to complete health data, which might today exist across multiple provider specific silos. Although we have demonstrated the ability to integrate these silos, C3-Cloud needs to rely upon the completeness of key data items such as condition and medication lists. Data quality is something that still needs greater clinician efforts and motivation. Secondly, care pathways are today often picked up by each clinician from reading guidelines and replicating existing local practices and stay in their heads. Multi-professional teams do not often share their portions of a care plan with other team members, except in outline. C3-Cloud encourages clinicians to formalise, share and synchronise their parts of a holistic care plan with each other. Thirdly, it is even rarer to engage patients in sharing that care plan, and C3-Cloud has introduced a culture change in that regard, along with a shift of care responsibility from being mostly in the hands of clinicians to being shared with the patient. This has impact on how professional accountability is perceived and may require clinician training in how to educate and empower patients. Fourthly, shifting care within a team may alter the balance of care activities undertaken by different persons and organisations. If workload balancing and reimbursement models do not follow those changes, there can be winners and losers in terms of workload and money flows. Dipak summarised that C3-Cloud can be successfully adopted in an “as is” environment, but the four areas of change that C3-Cloud can catalyse would enable an adopting community to get the best value from it. These are also changes that are of wider value to an organisation or region, and so C3-Cloud can be used as an accelerator of a better integrated and empowering culture.

Theo responded that C3-Cloud has indeed sought to support organisations with change through its digital solutions, especially through integrating the EHR data, enabling teams and patients to develop and track care plans together.

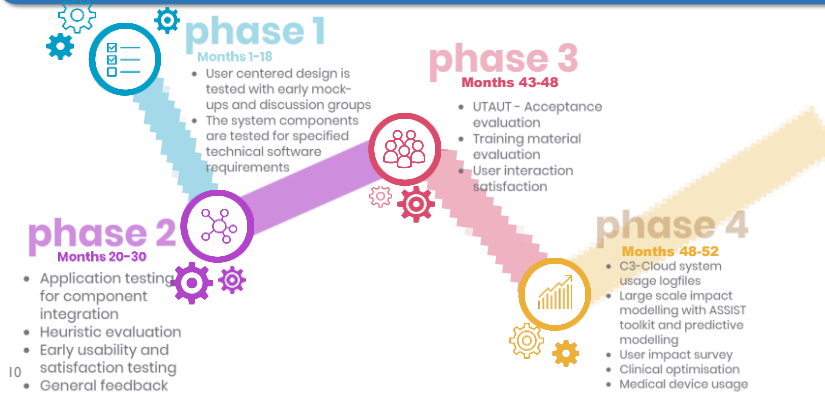
Tim felt that the opportunity of rethinking care pathways by clinical teams when preparing to adopt C3-Cloud would be of great value to teams, prompting them to question and discard outdated practices. He also agreed that reimbursement models have to change if we are to incentivise more integrated care.

6.2.8. What’s Next?

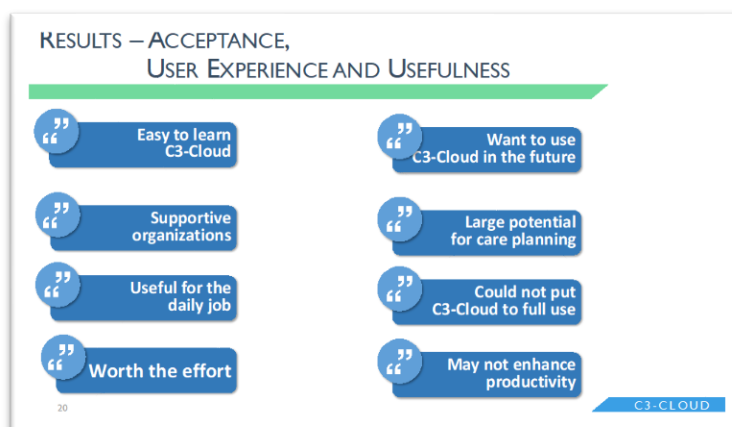
Malte von Tottleben presented the main evaluation findings of the C3-Cloud pilot evaluations. He outlined the different phases of the evaluation (see slide below).

RESEARCH PROTOCOL

Is the use of a personalised ICT tool that facilitates coordinated care planning, treatment optimisation and patient self-management acceptable to patients with multiple long-term conditions and their team of health professionals?



He outlined the results of each phase and explained how the results of each was used to guide the technical developments and the subsequent evaluation phases. Despite several months of delay mid-project to further improve the technology robustness, the resulting system was regarded as trustworthy by all three sites and ready to put into real patient care. It was successfully deployed and integrated in all sites, and the training materials (including videos) were regarded as useful and sufficient. About 70% of patients were lost to recruitment, for logistic reasons. Wider recruitment criteria helped to compensate, but the COVID-19 pandemic impacted the trial activity because clinicians had to be redirected towards that emergency and therefore away from the project and guidance that might have helped the trial patients. COVID-19, and a requirement for complete anonymity of the evaluation both contributed to the challenges of completing the pilot and conducting the evaluation.



User evaluation was positive, but respondents could not put C3-Cloud to full use in the time available and during the pandemic (see adjacent slide).

The finding about no possible increase in productivity may be due to the short trial duration. There were demonstrated benefits, for example an increase in teleconsultations but a reduced number of acute patient deteriorations. The ASSIST tool

modelling showed that different stakeholders experienced different costs and benefits through C3-Cloud use. The observed lower number of GP consultations may have an adverse financial impact to GPs if they are paid per visit, but a benefit to the healthcare payer. The payers have the best financial outlook from the use of C3-Cloud if there are no other ecosystem changes. This highlights the need to adopt C3-Cloud within a redesigned health service and reimbursement model.

Marie Sherman summarised the location and focus of each of the three pilot sites in the UK, Sweden and Spain. She presented the usage opportunities for C3-Cloud in their environment or country that

each site has identified as a result of their experience, and what they see as the exploitation possibilities. These slides are shown below.

WHAT'S NEXT?
POSSIBLE OPTIONS AND OPPORTUNITIES OF C3-CLOUD IN PILOTS' ECOSYSTEMS

Basque Country healthcare

- Enhance patient-centred and seamless care
- Coordination and continuity of care between service levels
- Strategies aligned with C3-Cloud
- Interoperability development
- Planning care "forward" of more complex patients
- Tool close to market

➔ Modular exploitation of the C3-Cloud components

➔ Consultancy services

C3-CLOUD

WHAT'S NEXT?
POSSIBLE OPTIONS AND OPPORTUNITIES OF C3-CLOUD IN PILOTS' ECOSYSTEMS

South Warwickshire health community

- Manage patients cost-effectively and safely
- Integrated IT-systems
- C3-Cloud facilitates a move to cross-organisation, multi-disciplinary care
- Complete summary shared managed in real time
- Two-way engagement
- Develop CDS Templates Library

➔ Central repository and clinical management system

C3-CLOUD

WHAT'S NEXT?
POSSIBLE OPTIONS AND OPPORTUNITIES OF C3-CLOUD IN PILOTS' ECOSYSTEMS

Region Jämtland Härjedalen healthcare

- New model of integrated care delivery
- Innovative components that form a holistic solution
- Organisation's structure, processes, and technical readiness
- Bridge gaps by an integrated care infrastructure
- Full integration with the EHR system (Cambio Cosmic)
- Better target capacity than EHR

➔ Roll out the "whole solution"

➔ Demonstrator for the C3-Cloud Partnership Ltd.

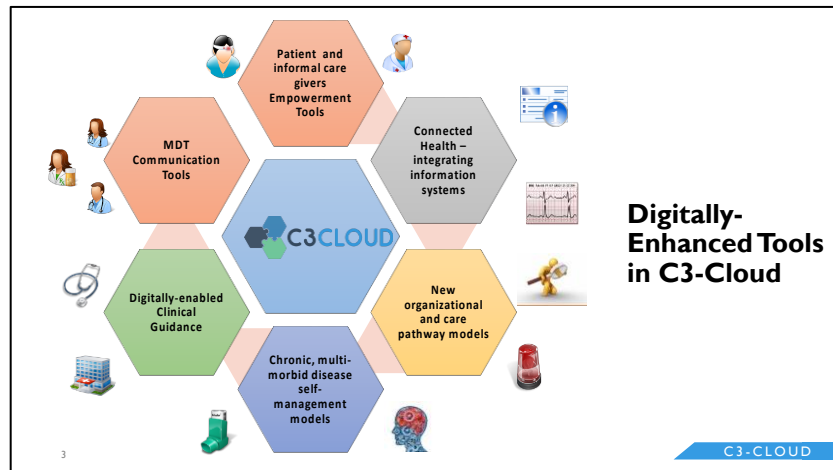
C3-CLOUD

Marie explained in each case how the sites now feel about carrying on with using C3-Cloud, as a kind of extended pilot (post-project) and contributing to its successful exploitation. Some sites foresee contributing to future guideline reconciliation and computerised representation, or to offer consultancy in how to do this or more widely how to get the best organisational value from C3-Cloud.




Theo Arvanitis explained that C3-Cloud has adopted a multi-faceted model of exploitation, including:

- commercial and incorporation exploitation
- health and social care practice exploitation
- industrial exploitation
- research exploitation, both in terms of published outcomes, research pollination and future research agenda
- education exploitation
- open access to selected assets and results (open source repository)
- standardisation & policy exploitation, in terms of influencing best-practice in digitally enhanced integrated (coordinated) care (both at national and European levels).

Theo presented a visual summary (see adjacent slide) of the potentially exploitable components of C3-Cloud, which can be exploited individually but also as package.

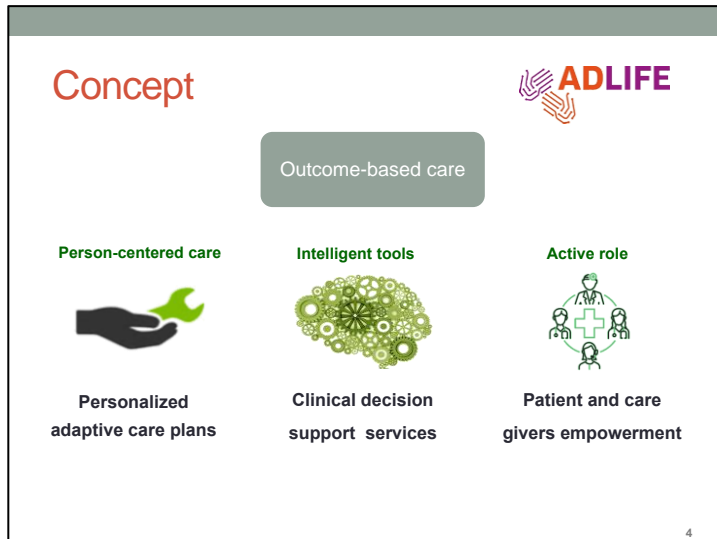


Theo presented the four components that have been showcased as high technology readiness successes by the EC Innovation Radar see below.

INNOVATION RADAR	
	
	
Innovation	Key innovators for this innovation
Application site integration toolkit <ul style="list-style-type: none"> Market maturity: Tech Ready Project: C3-Cloud Innovation Topic: Health & Care 	SRDC YAZILIM ARASTIRMA VE GELISTIRME VE DANISMANLIK TICARET ANONIM SIRKETI INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE MEDIXINE OY
C3 Cloud Architecture <ul style="list-style-type: none"> Market maturity: Tech Ready Project: C3-Cloud Innovation Topic: Health & Care 	SRDC YAZILIM ARASTIRMA VE GELISTIRME VE DANISMANLIK TICARET ANONIM SIRKETI THE UNIVERSITY OF WARWICK INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE
Clinical Guidelines: Interpretation, Specification, Implementation, and Execution <ul style="list-style-type: none"> Market maturity: Tech Ready Project: C3-Cloud Innovation Topic: Health & Care 	SRDC YAZILIM ARASTIRMA VE GELISTIRME VE DANISMANLIK TICARET ANONIM SIRKETI THE UNIVERSITY OF WARWICK CAMBIO HEALTHCARE SYSTEMS AB
Functional implementation of C3-Cloud components <ul style="list-style-type: none"> Market maturity: Tech Ready Project: C3-Cloud Innovation Topic: Health & Care 	THE UNIVERSITY OF WARWICK INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE MEDIXINE OY
https://www.innoradar.eu/resultbykeyword/c3-cloud	
	

Theo finally presented the final C3-Cloud business model, which is explained in detail in Deliverable D2.13.

Esteban de Manuel then presented the relatively new EC project ADLIFE. This project focuses on reusing many of the C3-Cloud components for patients with advanced and severe chronic diseases. It is therefore a kind of extension and scale up project for C3-Cloud. ADLIFE aims to achieve quantified gains in health status, slow down deterioration and to improve health outcomes. It also aims to improve health system efficiency by making better use of resources. Patient autonomy and empowerment is also an important element of the ambition: their health might not improve by their quality of lie can improve. ADLIFE will deploy the solutions in different countries and health system environments.



Its main ingredients (see adjacent slide) are personalised adaptive care plans, CDS services and a patient/caregiver empowerment platform. ADLIFE will extend C3-Cloud by extending its scope of complex and severe conditions, an AI based enhanced CDS including just in time guidance to patients and shared decision making, reinforcing patient roles in self-management and measuring and improving patient reported outcomes. It intends a larger scale evaluation with nearly 600 HCPs in 75 different healthcare provider organisations across Europe, and a total of 190,000 patients. The project will run until the end of 2023.

Theo was pleased to inform the audience that 60% of the research proposals that partners have submitted to the EC to follow on from and build on C3-Cloud.

Audience questions included asking if the pilots continuing right now. Theo responded that the pilots themselves had to close, due to ethics approval constraints, but that we hope to set up advanced post-project demonstrators at the three pilots. Piloting will also take place through ADLIFE, as Esteban has indicated.

In response to a clarification question, Malte confirmed that 60 healthcare professionals + patients had returned the evaluation surveys. A very detailed evaluation report (400 pages) will be published as a deliverable on our web site within a couple of months.

6.2.9. Conference conclusions

Theo closed the event by thanking everyone for attending the conference. He expressed a wish that we had been able to meet in person, but he was grateful for everyone making the virtual event a success. He declared that this is just the beginning of integrated care delivery: we have demonstrated that it is possible technologically, but we need to now push forward its wide scale and practical use by healthcare systems.

He thanked all of the speakers and the C3-Cloud partners for working to plan and run the event. He thanked Dipak and the EuroRec team, Sarah and the Warwick team for organising everything, and the audience for their interest and participation.

Congratulations were submitted via the audience chat function by many participants, who expressed their appreciation of the meeting and, importantly, about the work and successes of the project.

7. APPENDIX 1: EXAMPLE SLIDE PRESENTATIONS AND PAPERS

CONGRESO DE SALUD DIGITAL 2018: CONECTANDO LA SALUD

Directora [Marisa Merino Hernández](#). Osakidetza

Validez académica 20 horas Cursos de Verano UPV/EHU. Convalidación del Dpto. de Educación, Política Lingüística y Cultura del Gobierno Vasco.

Duración Fecha de inicio: 13/09/2018. Fecha de cierre 14/09/2018

Idioma oficial: Castellano

INTRODUCCIÓN

La Salud Digital es imprescindible para hacer frente al continuo cambio que experimenta la atención sanitaria. En este contexto los datos de salud se configuran como una oportunidad. La utilización de la Inteligencia Artificial, el Big Data, y el Blockchain permitirá importantes avances en el conocimiento de diversas áreas relacionadas con la salud y los servicios sanitarios, ayudando a tomar decisiones más adecuadas, eficientes, sostenibles y que respondan a las necesidades de los usuarios.

Pero ¿qué opinan los pacientes? Y, por otro lado ¿qué papel tienen las redes sociales? ¿Qué experiencias de éxito existen ya en la Salud Conectada? ¿Cómo será el futuro?

Todo esto se debatirá en este espacio de encuentro entre profesionales sanitarios, gestores, empresas tecnológicas, universidad, pacientes y todo aquel interesado en el tema en un foro que pretende, con la participación y colaboración de todos los asistentes, debatir, aprender y generar conocimiento e innovación útil para la sociedad.

OBJETIVOS

- ✓ Conocer la oportunidad de la utilización de los datos de salud: Big Data, Inteligencia Artificial, Blockchain...
- ✓ Valorar el papel de las redes sociales
- ✓ Plantear el papel y la opinión del ciudadano ante estos nuevos escenarios
- ✓ Compartir experiencias entre los asistentes, potenciando la colaboración entre los distintos agentes de salud

DESTINATARIOS DEL CONGRESO

Todas las personas interesadas en la aplicación de las nuevas tecnologías en el ámbito de la atención sanitaria: profesionales sanitarios, gestores sanitarios, pacientes, profesionales pertenecientes al ámbito de las tecnologías, etc.

PROGRAMA DEL CONGRESO DE SALUD DIGITAL CONECTANDO LA SALUD

JUEVES 13 DE SEPTIEMBRE

9:30 Inauguración

Directora General de Osakidetza. *Maria Jesús Múgica.*

Directora del congreso: *Marisa Merino Hernández*

10:00 Conferencia inaugural. *Jaime del Barrio. ASD. Los diez retos de la Salud Digital*

10:45 Mesa 1. La oportunidad de los datos de salud

Moderador: *Jaume Raventós. Fundación Signo*

Marcos Arauzo. Biodonostia

Jordi Conesa. UOC

Oscar Lage. Tecnalia

12:00 Pausa Café

12:30 Mesa 2. El papel de las redes sociales

Moderador: *Manuel Bayona. SEDAP @Manbayona*

Miguel Angel de la Cámara @MiguelDlaCamara

Teresa Perez @DUEdevocacion

Virginia Ruiz @roentgen66

15:30 Presentación de proyectos y comunicaciones

Moderador: *Iñaki Lapuente. SEDAP*

VIERNES 14 DE SEPTIEMBRE

9:30 Mesa 3. Health 2.0 Basque

Moderadores: *Gonzalo López, Juan Carlos Santamaría. Inithealth. Blanca Usoz*

11:00 Pausa Café

11:30 Mesa 4. Conversaciones Ciudadanas: Los retos de la Salud Digital

Carolina Rubio. Cluster de empoderamiento de pacientes

Andrea Barbiero. CO-SALUD

13:00 Conferencia de clausura: Joan Cornet. European Connected Health Alliance

El rol y el impacto de la ECHAlliance

13:40 Clausura. Consejero de Salud del Gobierno Vasco. Jon Darpon Sierra



INTERVENCIÓN EN EUSKADI

A. de Blas de Blas¹, N. González López¹, M. Ogueta Lana¹, D. Verdoy Berástegui², A. Fullaondo Zabala² y E. de Manuel Keenoy², en representación del equipo local de Osakidetza y del consorcio C3-Cloud.

(1) Organización Central de Osakidetza, Vitoria-Gasteiz, País Vasco. (2) Instituto de Investigación en Servicios de Salud-Kronikgune, Barakaldo, País Vasco.

C3-Cloud, www.c3-cloud.eu (H2020, PHC-25-2015, 689181)

Desarrollo de planes de atención personalizados para **pacientes pluripatológicos** basados en la evidencia y apoyados en herramientas TIC, para **fomentar la atención integrada y la implicación de pacientes y/o cuidadores**.

PLANES DE ATENCIÓN PERSONALIZADOS

Basados en la evidencia (guías clínicas NICE), se estructuran en cuatro elementos principales:

- **Problemas de salud**
- **Objetivos:** personalizados, temporizados, cuantificados
- **Actividades:** relacionados con objetivos, clasificados en tipologías
- **Materiales educativos/formativos:** personalizados, accesibles



Se definen mediante acuerdos entre el paciente y el equipo multidisciplinar.

INTERVENCIÓN C3-Cloud EN EUSKADI



Este proyecto ha recibido financiación de la Unión Europea, Programa de Investigación e Innovación "Horizon 2020", número de contrato 689181.

CONFERENCE ABSTRACT**Facilitating coordinated Care for Multi-morbidity patients through integrated
preventive Clinical Decision Support (C3-Cloud)**19th International Conference on Integrated Care, San Sebastian, 01-03 April 2019George Despotou¹, Mustafa Yuksel², Gokce Laleci², Esteban de Manuel Keenoy³, Sarah
Lim Choi Keung¹, Dolores Verdoy Berastegui³, Lei Zhao¹, Theodoros N Arvanitis¹

1: University of Warwick, United Kingdom;

2: SRDC, Turkey;

3: Kronikgune, Basque Country, Spain

Introduction: A growing share of the population in OECD countries is of age 65 and over, expected to reach 22% by 2030 (compared to 15% in 2010). Life expectancy has also significantly increased. People at age of 65 are expected to live for an average of 21 and 17 years for women and men; an almost 40% increase since 1960. The profound success in improving life expectancy has resulted in a new set of challenges.

Challenge: Shift of resources was necessary, redirected to address the complex needs of multi-morbidity patients. Furthermore, patients' needs are not effectively met by current care models, which tend to operate in isolation. This results in static services that patients need to wander. It is common for patients to revisit all levels of care discussing their needs, and reconciling potentially conflicting objectives amongst their conditions (e.g., incompatible lifestyle goals, adverse drug effects and side-effects, undetected conditions). Optimal collaboration and coordination between professionals in the delivery of integrated care have become essential requirements for the provision of high-quality care. Coordinated care aims for the orderly arrangement of individual and group efforts providing unity of action in pursuit of a common goal.

Method: C3-Cloud is an e-health based ICT system, offering integrated, patient-centred care, considering all aspects of multi-morbidity and creating a collaborative environment, for all involved stakeholders. The navel of the system consists of the patient care plan, a digital shared picture of the patients' needs and care regime. The care plan allows all professionals to review and understand the implications of one condition in the presence of others; this by its nature is complex, containing a considerable amount of diverse information. Navigating, understanding, and interpreting all the information can be confounding. The C3-Cloud Clinical Decision Support Service (CDS) offers an automated means of interpreting the available data. CDSS connects to the care plan repository, and continuously searches records for relevant data. The algorithms and integration of recommendations to the service were reviewed and validated by clinicians. Human computer interaction methods were employed to ensure optimal interaction between C3-Cloud and its users.

Results: C3-Cloud offers CDSS for diabetes, renal failure, depression and congenital heart failure, with over 300 rules and checks that deliver four best practice guidelines in parallel; whilst

reconciling their objectives, and monitoring their outcomes. It creates warnings or recommendations for the patient as well as for formal and informal carers.

Discussion and Conclusions: C3-Cloud offers a powerful way to ensure that subtle, as well as critical, information about the patient, is presented to healthcare professionals, along with guideline based recommendations. The rules reconcile potential conflicts amongst conditions. Combined with a single patient and professionals interface, it provides a seamless experience throughout the health and care service. The C3-Cloud CDS service provides support to three pilot sites throughout Europe, currently undergoing evaluation.

Acknowledgements: C3-Cloud is funded from the EU Horizon 2020 research and innovation project C3-Cloud, under grant agreement No 6891810.

This abstract is based on the work and material of the entire C3-Cloud consortium.

Keywords: integrated care; multimorbidity; clinical decision support; clinical guidelines



C3-Cloud Research Study

Since May 2016, SWFT & Rother House Medical Centre have been taking part in a European research project called 'C3-Cloud'. The project has been led by the University of Warwick with involvement from a number of technical, clinical and research partners across Europe.

The project has developed a new concept system called 'C3-Cloud' which has been designed to improve the care of patients with multiple long term/chronic diseases.

The system aims to facilitate closer collaboration between patients and their care team and to encourage patient self-management through the use of shared care plans and education. Healthcare professionals are able to set goals and activities for the patients in the system, which patients can provide feedback on, and also assign training materials to improve the patients understanding of their conditions. Patients can access the system in their own homes, from their own devices. The system also offers a Clinical Decision Support function which uses clinical care datasets and NICE guidelines to make recommendations for care and treatment.

The system was trialled with 18 patients from the Rother House Medical Centre, and a limited number of health and care professional at SWFT and Rother House, between late November 2019 and April 2020. All patients were aged 55+ and had at least 2 of the following long term illnesses – mild to moderate heart failure, mild to moderate renal failure, diabetes type 2 and mild depression. The system was also trialled in Sweden and Spain.

Unfortunately, usage of the system was severely hampered by the pressures of COVID-19 which has limited the availability of evaluation data. However, with further research it is believed that the system could be developed into a commercial product which could offer real benefits for the management of patients with multiple long term/chronic diseases. The project is being further developed by the H2020 ADLIFE project - <https://adlifeproject.com/>

For further information about this project contact marie.beach@swft.nhs.uk.
Project website: <https://www.c3-cloud.eu/>



warwick.ac.uk

Dipak i-HD Data Saves Lives EHR2EDC SharePoint Box EHR2EDC

Please read our student and staff community guidance on COVID-19

WARWICK

News & Events

China | Europe | Press Releases | Expert Comment | Media Centre Services | Knowledge Centre | Team | Events | Social Media | Independent External Review

C3-Cloud: the digital coordinated care platform of the...

C3-Cloud: the digital coordinated care platform of the future

- The C3-Cloud could be the future for supporting coordinated care across GPs, hospitals and specialists

- The novel solution would benefit patients with multiple conditions who are most in need of a holistic care plan

- It has been recognised by the [European Innovation Radar](#) as 'tech ready' and could be used to support remote care, not only in everyday use but also in the current and future pandemics

Typically, when a patient is receiving care from GPs and Hospitals, these are normally uncoordinated and the patient is often presented with conflicting advice, or clinicians are required to assess patients without access to all of the patient's relevant history, often making care fragmented and inefficient, particularly for an ageing population who may have multiple conditions and need care from multiple specialists and stakeholders.

Healthcare has seen an explosive growth in the amount of data produced, which has led to more data driven and evidence based protocols. However, this has also presented challenges as data can become locked in silos or to particular vendors, limiting their availability for reuse, dissemination and potential to improve patient outcomes.

However, C3-Cloud (collaborative cure and care system) is a digital infrastructure offering integrated care capability for multi-morbidity management. It enables collaboration across a number of healthcare systems and settings, allowing clinicians to semi-automatically generate a holistic personalised care plan, which offers an integrated view of the patient's conditions, measurements, medication and goals.

Patients and their multi-disciplinary care team can collaboratively create, review and edit the plan, empowering the patient to make decisions about their care. The care plan personalisation process is supported by a Clinical Decision Support module, implementing over 500 rules, consolidating and reconciling multiple clinical practice guidelines of common comorbidities (for example, diabetes, heart failure, renal failure and depression). The system accommodates local organisational aspects such as roles, as well interoperability to existing systems, it is currently deployed in three pilot sites in the UK, Spain and Sweden, integrating with their health systems and supporting coordinated care.

The C3-Cloud technology is flexible enough to support other conditions, including supporting remote management generally, which can be applied to situations, such as in the current COVID-19 pandemic. The project has recently investigated plans for deployment in such pandemic scenarios.

Professor Theo Arvanitis, the C3-Cloud project co-ordinator from the Institute of Digital Healthcare at WMG, University of Warwick comments:

"As the world develops and becomes more digital it is essential our healthcare system does too. With an ever growing population and life expectancies increasing it's important to make a digital healthcare system that works for everyone and that is what the C3-Cloud does.

"Not only does the C3-Cloud work across all systems, it can recommend treatments for patients with multiple health problems, which is helpful when someone is seeing multiple care outlets such as their GP and local hospital for different care needs.

"Our first pilot has taken place, and with the European Innovation Radar identifying C3-Cloud's key components as tech ready, our next step is to expand this to large scale trials in multiple countries, this could lead to an enrolment in the system, and if there's ever a pandemic like Covid-19 again different strategies for people with different health problems could be deployed rapidly."

ENDS

24 AUGUST 2020

NOTES TO EDITORS

High-res images available to view at:

<https://warwick.ac.uk/services/communications/medialibrary/images/april2020/theoarvanitis.jpg>
 Professor Theo Arvanitis, Institute of Digital Healthcare, WMG, University of Warwick
 Credit: WMG, University of Warwick

https://warwick.ac.uk/services/communications/medialibrary/images/july_2020/c3-cloud_logo.jpg
 Caption: C3-Cloud Logo
 Credit: WMG, University of Warwick

https://warwick.ac.uk/services/communications/medialibrary/images/july_2020/c3-cloud-infographic.jpg
 Caption: C3-Cloud Platform
 Credit: WMG, University of Warwick

FOR FURTHER INFORMATION PLEASE CONTACT:

Alice Scott
 Media Relations Manager - Science
 University of Warwick
 Tel: +44 (0) 7920 531 221
 E-mail: alice.j.scott@warwick.ac.uk

C3-Cloud: the digital coordinated care platform of the future

- The C3-Cloud could be the future for supporting coordinated care across GPs, hospitals and specialties
- The novel solution would benefit patients with multiple conditions who are most in need of a holistic care plan
- It has been recognised by the [European Innovation Radar](#) as 'tech ready' and could be used to support remote care, not only in everyday use but also in the current and future pandemics

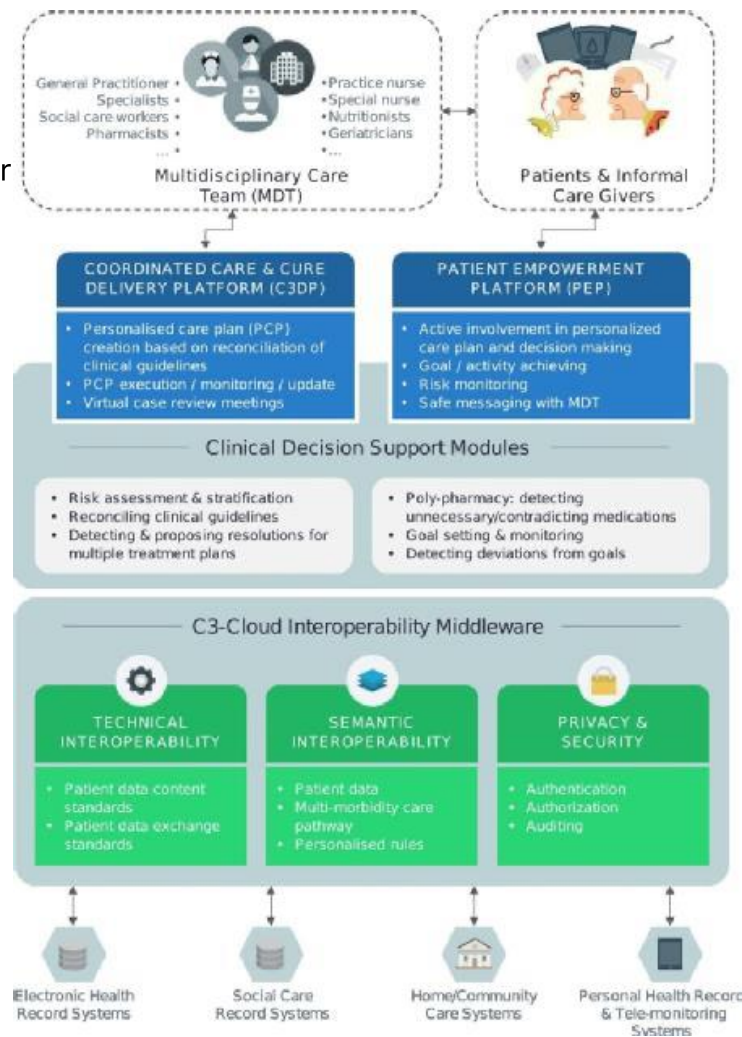
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Credit: WMG, University of Warwick

https://warwick.ac.uk/services/communications/medialibrary/images/july_2020/c3-cloud_logo.jpg

Caption: C3-Cloud Logo

Credit: WMG, University of Warwick

https://warwick.ac.uk/services/communications/medialibrary/images/july_2020/c3-cloud-infographic.jpg

Caption: C3-Cloud Platform

Credit: WMG, University of Warwick

C3-Cloud introductory video to the public at youtube channel:

https://www.youtube.com/watch?v=Y3K_IUQkupg

C3-Cloud Website

<https://c3-cloud.eu/>

C3-Cloud @European Innovation Radar

<https://www.innoradar.eu/resultbykeyword/c3-cloud>

FOR FURTHER INFORMATION PLEASE CONTACT:

Alice Scott

Media Relations Manager – Science

University of Warwick

Tel: +44 (0) 7920 531 221

E-mail: alice.j.scott@warwick.ac.uk

8. APPENDIX 2: JOINING THE DOTS C3-CLOUD BRIEFING PACK

The full delegate briefing pack, which summarises the project, its components and its pilot sites, is reproduced over the following pages.



We provide collaboration, care coordination and follow-up tools for patients, carers and clinicians to achieve high quality integrated care and better health outcomes.

Joining the Dots Conference

27 & 28 November 2019
Brussels, Belgium

Briefing pack

In this briefing pack, you will find information to get more familiar with:

- C3-Cloud project and partners overview
- Summary of C3-Cloud Solution
- Summary of the main components of the C3-Cloud implementation
- Detailed product sheets for the technical components (as above)
- Summary of the three European pilot site descriptions

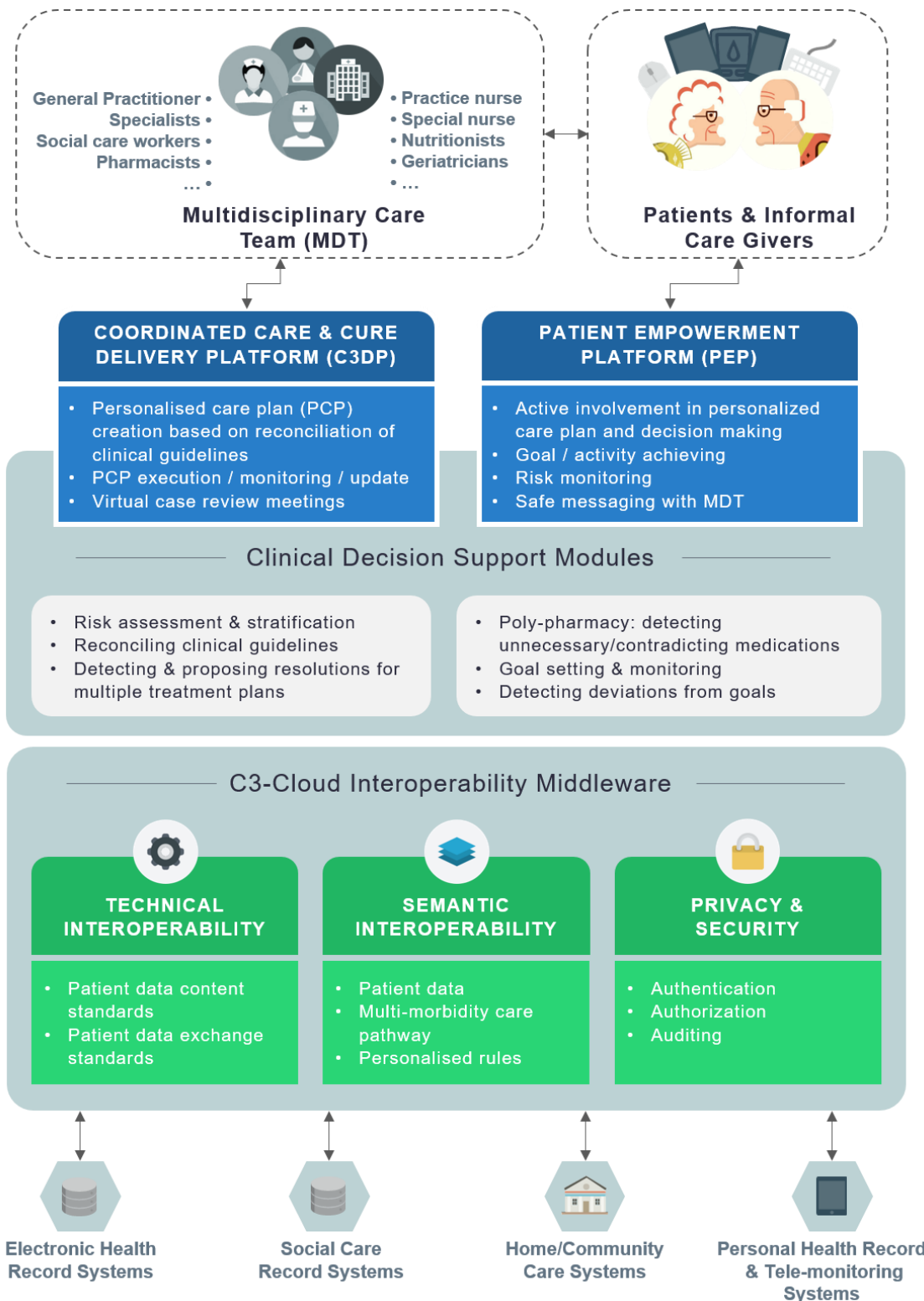
Join us on the 28 November from 12:00 for the C3-Cloud Spotlight!



<https://www.c3-cloud.eu>



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689181



C3-Cloud is a Horizon 2020 project for facilitating implementation of integrated care plans. C3-Cloud has established an ICT infrastructure to enable continuous coordination of patient-centred care activities by a multidisciplinary care team and patients/informal caregivers.

The Collaborative Care Plan Management Software allows collaborative creation and execution of personalised care plans for multimorbid patients. The system is integrated with tens of Clinical Decision Support (CDS) services for risk prediction and stratification, recommendation reconciliation, poly-pharmacy management and personalised goal and activity suggestions.

These CDS services have been implemented based on evidence-based clinical guidelines for four major chronic diseases: diabetes, chronic kidney disease, heart failure and depression. Integration with local healthcare systems is achieved via C3-Cloud Interoperability Middleware. Active patient involvement and treatment adherence is realized through a Patient Empowerment Platform, ensuring patient needs are respected in decision making.

Contacts

Prof. Theodoros N. Arvanitis
C3-Cloud Project Coordinator
 University of Warwick
 t.arvanitis@warwick.ac.uk

Mattias Fendukly
C3-Cloud Exploitation Manager
 Cambio
 Mattias.Fendukly@cambio.se

Project Partnership & Expertise



The Institute of Digital Healthcare (IDH) at the University of Warwick (UK) is the project coordinator and works across many disciplinary boundaries. The institute's expertise lies in biomedical and information engineering, making sense of health related data to improve public health and clinical knowledge through healthcare technologies, including clinical decision support systems.

SRDC is a research-oriented SME that has proven expertise in developing innovative software products for chronic disease management, clinical decision support, patient behavior change and data analytics. SRDC has developed the Coordinated Care & Cure Delivery Platform (C3DP) and is a strong contributor in the design and implementation of the overall C3-Cloud architecture.

The LIMICS Team is a public research team of the French National Institute for Health and Medical Research (INSERM). The LIMICS lab is specialized in medical informatics and knowledge engineering for e-health, mainly in the fields of terminologies and ontologies; semantic mediation and integration; clinical data warehouses and information quality; decision support systems; and public health systems for surveillance and epidemiology.

The European Institute for Health Records is a not for profit organisation focused on advancing the quality of electronic health record systems, and their use. EuroRec undertakes the formalised testing and quality labelling of EHR systems. It has run or been a partner in over 80 EU projects to advance state of the art in EHR systems design, EHR interoperability and patient-centred care

Empirica is a leading European and global institute with a broad understanding of the political, strategic, clinical, business and socio-economic questions raised by health system change and digital health tools. The team has global experience in applying advanced, but pragmatic benefit-cost assessment methods to health system related delivery processes and outcomes. empirica is thus in a position to develop and validate future-proof policies, sustained strategies, business cases, and exploitation scenarios for digital health supported healthcare delivery.

Medixine Ltd. is one of the world leaders in e-services for health care. Its mission is to support the paradigm change from provider centric care to patient centric care. Medixine combines expertise in healthcare, software technology and traditional and mobile cloud services to yield smooth communication processes between healthcare providers, patients and their families. Medixine has already signed agreements for its product for a population of over 2.5 million in Europe. Medixine is the leader of WP5 Patient Empowerment Platform, based on the Medixine Suite product.

South Warwickshire NHS Foundation Trust (SWFT) is a vertically integrated healthcare provider offering acute hospital services to the population of South Warwickshire, UK and integrated community and children's services across the whole county. SWFT is a high performing organisation within the NHS with a proven history of successful delivery of strategic projects. The Warwickshire ICT Services division provides ICT services to all GPs across the county and strategic ICT services to Coventry and Warwickshire, supporting over 11,000 staff across 200 sites.

Osakidetza, the public healthcare provider in Basque Country is one of the 3 pilot sites of the C3-Cloud project. Osakidetza has developed a model for integrated care for multimorbid patients, supported by complex information systems such as the EHR, Personal Health folder and ePrescription. Several pilots on remote monitoring for chronic patients and patient empowerment have already been implemented in Osakidetza.

Kronikgune is an Institute for Health Services Research that promotes and carries out management and organization research on health and social-health services. Its area of expertise comprises the study of the health services necessary for the management of chronic disease, evaluation of health services and identification of determinants in the management of chronicity, with a common framework that integrates both social and health aspects.

Örebro University is one of the fastest growing universities in Sweden with 17,000 students and 1,200 staff. The university provides education and research in humanities, law, social science, science, technology, health care, medicine, education, music and sport science. The eHealth research group is part of the Centre for Empirical Research on Information Systems works closely with the regional healthcare authority of Örebro and in C3-Cloud with Region Jämtland Härjedalen.

Region Jämtland Härjedalen is a public healthcare provider in a sparsely populated county with an ageing population and is a pilot site in C3-Cloud. The Region's special expertise is its ongoing close collaboration with small and large enterprises to create and test solutions for better and distance-independent care. It is currently involved in four Horizon 2020 projects in which the primary care organisation is strongly involved.

Cambio Healthcare Systems is one of Scandinavia's leading suppliers of healthcare information systems and a growing player in the European market with just over 100,000 users across general and university hospitals, specialist units and outpatient units. Through the use of our integrated solutions, our customers provide services to four million patients. Clinical Decision Support (CDS) systems are one of Cambio's main focus areas, which plays a key part in the C3-Cloud Project.



Functionality

C3-Cloud is a care plan development platform and collection of tools, services and applications, that allows for collaborative creation and execution of personalised care plans for multi-morbid patients. It supports clinicians and patients with the planning, delivery and monitoring of care of individuals with any combination of diabetes, heart failure, renal failure and depression.

The C3-Cloud solution consists of multiple components, which ensure seamless integration with existing information systems, aggregation and analysis of multimodal patient and provider data, as well as semantic reconciliation of clinical rules and guidelines. Other components of C3-Cloud perform systematic and semi-automatic risk prediction and stratification, reconciliation of guideline recommendations, management of polypharmacy and setting of care goals among others. In addition, C3-Cloud provides a platform for active patient involvement in the care process boosting patient engagement and adherence to treatment.

The C3-Cloud solution is capable of integration as individual components or as a whole solution into different existing EHR systems.

Solution Components

The C3-Cloud solution consists of multiple open-source and standards-based software components:

❖ Interoperability Middleware

- Ensures seamless integration with existing health care, social care, and home/community care information systems. It has 3 subcomponents:
 - **Technical Interoperability Suite**
 - Provides a standards-based data exchange protocol that enables information exchange between C3-Cloud pilot sites and C3-Cloud components.
 - **Semantic Interoperability Suite**
 - Handles structural mappings among different information models and resolves semantic mismatches due to use of different terminology systems and different compositional aggregations.
 - **Security and Privacy Suite**
 - Ensures encrypted and auditable data exchange across C3-Cloud software components and based on open source toolkits for authentication and authorization.

❖ Coordinated Care & Cure Delivery Platform

- User-friendly graphical interface for creating and editing personalised care plans. Also supports patient activity measurement and tracking, collection of feedback and questionnaires, activity planning with calendars, notifications and messaging among care professionals and patients.
- Strong reliance on HL7 FHIR® clinical resources and RESTful APIs.

❖ Patient Empowerment Platform

- Ensures active patient participation in the management of their multi-morbidities by granting access to the current integrated care plan, goals, activities and educational/training materials.
- Supports collection of data from sensor devices and questionnaires, for sharing with multi-disciplinary care teams.
- Supports messaging and video communication with multi-disciplinary care teams.

❖ Clinical Decision Support Services

- Digitizes computes and presents knowledge from evidence-based clinical practice guidelines at the point of care.
- Employs Guideline Definition Language v2 (GDL2), part of the openEHR official specification, as well as other open-source components to enable the reconciliation of clinical guidelines for diseases, risk stratification, poly-pharmacy management and care plan goal setting and monitoring.
- Ensures that clinicians make well-informed decisions and increases adherence to clinical practice guidelines.
- Provides live alerting features, clinician-invoked applications as well as background calculation and analytics services in a host EHR system.

The C3-Cloud solution is currently adopted in three pilot sites around Europe each with local language adaptations – Swedish in Sweden, English in the UK and Spanish in Basque Country. The components can be deployed in any of the ISO 639 languages.

Users

Target end-users include:

- Patients and caregivers
- Health and care professionals

Potential ICT adopters:

- Healthcare information system developers
- Health and care provider organisations
- Health system funders

Benefits

Access to the C3-Cloud platform will help patients by:

- ensuring continuous and reliable contact with multidisciplinary care teams
- provide them with information about their diseases
- allow them to take an active role in planning their care.

Healthcare professionals will be helped by:

- together with the patient, be able to plan the optimal care management for each patient based on the reconciled clinical guidelines

Benchmarking

C3-Cloud solution is unique in several ways:

- Components developed using open-source and standards-based technologies
- Components are easily upgradeable
- Integrates with any existing healthcare information system
- Supports full semantic interoperability
- Can be deployed and used component-wise or as a full solution
- Delivers personalised evidence-based recommendations for care
- Promotes adherence to clinical practice guidelines
- Clinical decision support logic can be rapidly updated
- Promotes patient engagement

Limitations

The limitations of the C3-Cloud product are:

- Poorly coded or structured patient data at the local EMRs/EHRs is a challenge.
- Maintaining and facilitating the clinical content over time

- Clinical practice guidelines are not produced in a machine readable format so there is sometimes a need of translations and/or interpretations of clinical information
- Mapping of data between systems is not automated

Business Model

The business model of the C3-Cloud product is flexible. There is one fee for a one-off integration and customisation. Then the business model of the product is based on a license that is decided based upon amounts of users and/or patients, as well as service agreement.

Implementation

The estimated effort and time plan of implementation is highly dependent on the health information system where the C3-Cloud product will be implemented. A few factors play a key role:

- The clinical information shall be provided in a structured format based on open informatics standards
- Possible adaptations to clinical content in CDS Services (needs to be based on medical practice and/or guidelines)

Dependencies

The C3-Cloud product dependencies to technical and organisational parameters are the following:

- Technical setup of underlying health information system where the C3-Cloud product is to be implemented (need to conform with existing security measures and server setup)
- Acceptance tests
- Clinical expertise is required to assess the relevancy of the clinical content in the C3-Cloud product
- User training, possible to provide it remotely (video based or e-learning)

Customisation

As the C3-Cloud product is a platform-based product, it is generic and flexible in its nature. An adopting vendor or healthcare provider organisation can have the product customised in various ways depending on what clinical areas/scenarios that should be implemented and the technical setup of an underlying/hosting system.

Coordinated Care & Cure Delivery Platform (C3DP) is a Web application for collaborative creation and execution of personalised integrated care plans for multi-morbid patients by a multidisciplinary care team. The key features of C3DP are:

Personalised goal and activity suggestions via CDS services implementing clinical guidelines: The system is integrated with tens of Clinical Decision Support (CDS) services for risk prediction and stratification, recommendation reconciliation, poly-pharmacy management and personalised goal and activity suggestions. These CDS services are implemented based on evidence-based clinical guidelines for four major chronic diseases: diabetes, chronic kidney disease, heart failure and depression. Integration via the CDS services is enabled via the CDS Hooks API.

Seamless integration with local care sites: C3DP supports HL7 FHIR® RESTful API to synchronize clinical data of the patient with local EHR systems. These data are shown in the medical summary and automatically mapped to relevant CDS services without the need for manual data entry. Integration with local health care systems that do not inherently support HL7 FHIR® is achieved via C3-Cloud Interoperability Middleware.

Active patient involvement in care planning: C3DP is integrated with a Patient Empowerment Platform ensuring patient needs are respected in decision making and reinforce treatment adherence. It is possible to exchange information among patients and their care team via vital sign measurements, questionnaires, structured feedback, safe messages, and real-time notifications.

Care plan and patient data models based on global knowledge: C3DP is fully compliant with tens of HL7 FHIR® clinical resources for both care plan and patient record data models. It benefits from the high-performing, scalable, and open-source HL7 FHIR® Repository onFHIR.io and all the interactions between the Web-based frontend and the backend takes place via the HL7 FHIR® RESTful API.

Secure handling of patient data: C3DP is enhanced with role/identity-based authorisation, integration with existing Identity Providers (IdP), secure storage of patient data, and audit logging. OpenID Connect 1.0, OAuth 2.0, Smart App Authorisation, IHE ATNA, and custom JWTs are supported.

Further user-friendly functions including: Dashboard views, automatically matching EHR/PHR data with the care plan activities and input requirements of CDS services, user calendar, safe messaging among multi-disciplinary care team, real-time notifications linked to care team and patient actions.

Goals					Activities			
Title	Start Date	Target Date	Target	Actions	Title	Type	Start Date	Actions
Monitoring eye disease	27 Mar 2019	27 Jun 2019		...	Referral to Ophthalmologist	Referral	27 Mar 2020	...
Comply with the dietary restrictions of mild renal failure and diabetes. Evaluate every 6 months.	27 Mar 2019	27 Jun 2019		...	Follow-up to check the results of the treatment	Appointment	08 May 2019	...
Reduce weight	25 Feb 2019	25 Aug 2019	Body weight < 75 kg	...	Mediterranean diet with reduced sodium level (salt intake)	Diet	27 Mar 2019	...
Keep HbA1c level below agreed target	25 Feb 2019	19 Apr 2019	HbA1c < 53 mmol/mol	...	Have HDL-C test before the control visit Last Observation: 52mg/dL	Lab Request	27 Mar 2019	...
Education Materials					Sulfonylurea	Medication	26 Feb 2019	...
Title	Start Date	Actions			Self-measurement of blood pressure Last Observation: 130mmHg/90mmHg	Patient Order	27 Mar 2019	...
Type 2 Diabetes	27 Mar 2019	...						
High blood pressure - hypertension	22 Feb 2019	...						

C3DP provides a generic and disease-independent platform, which **can easily be customised according to the local care pathways, targeted diseases and clinical guidelines**. C3DP can be implemented in a new site and integrated with local systems in **only a few months**.

Coordinated Care & Cure Delivery Platform (C3DP)



Functionality

Coordinated Care and Cure Delivery Platform (C3DP) allows collaborative creation and execution of personalised integrated care plans for multi-morbid patients by a multidisciplinary care team (MDT) including GPs, specialists, nurses, physiotherapists, geriatricians, nutritionists, social care and homecare workers. Via integration with tens of Clinical Decision Support (CDS) services automating evidence-based clinical guidelines, C3DP processes electronic health records of the individual patients and provides guidance to the multidisciplinary care team members for i) risk prediction and stratification, ii) personalized selection of treatment goals and interventions in the light of evidence based guidelines, iii) reconciliation of conflicting treatment options, and iv) management of polypharmacy. Integration with local health and social care systems is achieved via C3-Cloud Interoperability Middleware. Active patient involvement and treatment adherence is achieved via integration with a Patient Empowerment Platform (PEP), ensuring patient and informal care giver needs are respected in decision making and their preferences and psychosocial aspects are considered.

C3DP can easily be integrated with existing EHR/EMR systems thanks to its patient data and care plan data model based on HL7 FHIR®. C3DP can be also easily integrated with existing CDS services, especially when they are compliant with CDS Hooks specification.

Solution Components

C3DP is composed of the following software components:

- *C3DP Web Application*: The rich and modern Web application for management of personalised care plans
- *onFHIR.io FHIR Repository*: Easily customisable, high-performance and highly scalable open source HL7 FHIR® Repository.
- *Event API*: For real-time system notifications
- *Internal CDS Services*: Supporting CDS services with less complex decision trees, compliant with CDS Hooks specification.
- *Security and Privacy Suite (SPS)*: Authentication and authorisation of all users via integration with existing Identity Provider (IdP) systems. Supports OpenID Connect 1.0, OAuth 2.0, Smart App Authorisation, and custom JWTs.

C3DP is also integrated with all other C3-Cloud components (complex CDS services, PEP, Interoperability Middleware) via standards-based interfaces.

Users

The end users of C3DP are members of a multidisciplinary care team including health (GPs, specialists, nurses, physiotherapists, geriatricians, nutritionists ...) and social care professionals. Ideally, C3DP is targeted for organisations that aim to provide integrated care (i.e. regional / national health authorities), but it is also possible to benefit from C3DP in a single node (e.g. inside a hospital).

Benefits

The major benefits are:

- Serving a generic, disease-independent platform for personalised care plan management supporting both longitudinal integrated care plans and disease-specific treatment plans
- Standardisation of high-quality health and social care in chronic disease management by implementing regional / national clinical guidelines
- Empowering the clinical work force in chronic disease management via CDS services automating evidence-based clinical guidelines
- Semi-automatic reconciliation of conflicting recommendations from multiple disease guidelines
- Improved cooperation among health and social care workers
- Facilitating active participation of patients and informal care givers
- Easy integration with existing local systems (EHR, CDS, AuthN & AuthZ) through support of widely-used standards and specifications
- Extended service / product range for industry customers

Benchmarking

Compared to similar solutions on the market, C3DP care plan management software is:

- Based on open standards and specifications (HL7 FHIR® resources and API, CDS Hooks, OpenID Connect 1.0, OAuth 2.0, ...) to facilitate integration.
- Disease independent. Support for a new disease can be added easily with new CDS services in a plug-and-play manner.
- Agnostic to natural languages and reference terminologies. It already supports 4 languages and several terminologies.

Limitations

Limitations and future plans:

- Although C3DP supports bi-directional data integration with local EHR systems, it could not be possible to integrate care planning data in C3DP to local systems in C3-Cloud, due to non-technical reasons. However, this has been achieved in another national-scale project.
- Poorly coded or structured patient data at the local EMRs/EHRs is a challenge.
- As a near-time upgrade, C3DP will support HL7 FHIR® R4 in addition to STU3.
- Integration with local appointment scheduling, e-prescription, and laboratory order systems is also in development plans.

Business Model

C3DP business model is based on one-time integration and customisation fee at first and then yearly fee for usage license and maintenance support for health organisations. Model is more flexible for industry partners. C3DP and all sub-components are maintained in-house; there is no third-party license or fee involved.

Implementation

C3DP can be implemented in a new site and integrated with local systems in only a few months. The exact duration would depend on a few factors:

- Is clinical data provided already in a standard format and API? In case there is support for HL7 FHIR®, clinical data integration is almost immediate. If not, C3-Cloud also provides an Interoperability Middleware.
- Will there be need for new CDS services? If so, are the clinical guidelines and/or implementable specifications in place?

Having said that, the C3-Cloud technical team members are experienced in implementation of such systems in diverse settings.

Dependencies

Technical and organisational dependencies:

- C3DP is installed inside the secure perimeters of a health organisation. If the user requests, it can be installed in a secure European cloud as well.
- There is no OS dependency, but Linux servers are preferred.
- User training can be done remotely via videos and reading materials.

Customisation

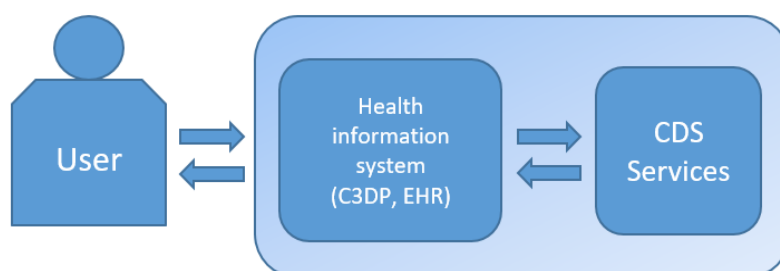
C3DP provides a generic and disease-independent platform, which can easily be customised according to the local care pathways, targeted diseases and clinical guidelines.

Purpose

Clinical practice guidelines (CPGs) are of great importance to clinicians when it comes to providing high quality care to patients – especially to a primary care physician who meets a large variety of patients with different conditions. However, providing CPGs to the practicing clinicians is a process that requires a big communication effort and it can also take a long time before new information is spread out to a majority of practicing clinicians. These problems can be addressed by digitising the CPGs – implementing them as CDS services into the electronic health record (EHR) system. Having CPGs integrated as CDS services at the right place in the EHR can easily support the clinician when it comes to having the right information at the right time. In the C3-Cloud project, the CDS services are implemented in the Coordinated Care and Cure Delivery Platform (C3DP) in order to assist the clinicians in taking the important care decisions for the patient with at least two chronic diseases (of diabetes mellitus type 2, heart failure, renal failure, and depression).

High level summary of its functionality

The CDS Services are supporting modules of the C3DP which is the user facing interface. The CDS Services enable the reconciliation of clinical guidelines for diseases, risk stratification, poly-pharmacy management and care plan goal setting and monitoring. As part of C3DP platform, CDS services access patient data from different sources to subsequently fuse and analyse all these data.



What makes it great

Integration of healthcare information systems is usually a process that requires a relatively large work effort. The reasons why can vary but are mostly related to a lack of standardised ways of building software which creates the need of investing more time in mapping data elements and ensuring that data is seamlessly flowing through the system barriers. The CDS Services in the C3-Cloud solution are built based on the Cambio-produced Guideline Definition Language v2 (GDL2) which is a part of the openEHR official specification. This means that the CDS Services are relatively easy to integrate into other systems, provided they also utilise medical informatics standards.

Applying CDS Services in a clinical setting can significantly improve the produced care by making sure that clinicians make well-informed decisions and increasing adherence to guidelines.

How it can be used

As the CDS Services used for the C3-Cloud project are based on medical informatics standards, they have the potential to be easily integrated into other health information systems. They can be either directly coupled with an EHR system, or as in the C3-Cloud solution be coupled with another user interface. Bearing the care market needs in mind – the CDS Services are flexible in terms of what kind of clinical decision it shall support, in which context and for which user it shall be available. In general, CDS Services are and can be used as live alerting features, clinician-invoked applications or background calculation services inside an EHR.

Functionality

The Clinical Decision Support (CDS) Services uses evidence-based clinical guidelines and combines them with patient-specific information to support clinicians in managing patients. For a user of the C3-Cloud solution, the functionality of the CDS Service is to provide advice and recommendations based on patient information from the EHR system as well as from information inserted from the clinician in the Coordinated Care & Cure Delivery Platform (C3DP).

As part of C3DP, the CDS Services access patient data from different sources to subsequently fuse and analyse all these data. As an output from the analyses, the CDS Services returns patient specific recommendations to the user in the management of e.g. poly-pharmacy and care plan goal setting. CDS Services has in the C3-Cloud project been developed to incorporate NICE guidelines in four different clinical areas: type 2 diabetes, renal failure, depression, and heart failure.

Solution Components

The typical C3-Cloud CDS Service components consist of:

- machine readable clinical information (such as clinical rules indicating thresholds, calculative formulas and other logic)
- Guideline Definition Language (GDL)¹ rules engine

Users

The type of user will be different depending on the purpose of the CDS Service, some apps are directed towards nurses, some towards general practitioners etc. In general, the user is a clinical worker. In the C3-Cloud project, the users of the C3DP are members of multidisciplinary care teams.

Benefits

The expected benefits are:

- Improved patient safety and treatment efficacy by facilitating evidence-based care
- Optimise care process by prompts/reminders and automate repetitive clinical tasks such as documentation or ordering
- Improve equality of care and reduce unnecessary variations of care
- Users receive relevant clinical information at relevant times at point of care
- Healthcare providers gain more control and assurance that evidence-based clinical practice guidelines are followed
- Reduce total ownership of cost of knowledge based by enabling sharing and reuse of informatics standards based clinical models across language and technical barriers
- Low maintenance cost due to cloud based CDS systems with rapid deployments whenever needed

¹ The Cambio-produced Guideline Definition Language is a part of *openEHR*'s official specification for CDS.

Benchmarking

Compared to existing CDS solutions on the market, CDS Services developed with tools from the CDS Platform are:

- Based on open standards (such as *openEHR* archetypes or HL7 FHIR profiles)
- Agnostic to natural languages and reference terminologies
- Vendor neutral
- Easy to maintain and facilitate due to CDS Services are managed as stand-alone products

Limitations

The general limitations for CDS systems are:

- Clinical practice guidelines are not produced in a machine readable format so there is sometimes a need of translations and/or interpretations of clinical information
- Variations in how data is structured. Not all EHR systems provide standards-based structured clinical information

Business Model

The business model of providing the CDS Platform is a very flexible Software-as-a-Service (SaaS). The pricing model can either based on the total number of inhabitants or clinical professions as the end users depending on the nature of the subscriber of the CDS Platform.

Implementation

Implementing CDS Services is in general a straightforward process. The implementation effort varies depending on the context in which the CDS Services are to be implemented in. Important parameters that influence the implementation are:

- How well clinical data in an underlying system is structured and based on medical informatics standards
- What the integration capabilities from an underlying system provider are
- How well clinical rules and guidelines are documented

Dependencies

Technical and organisational dependencies are:

- One-off configuration of CDS in underlying healthcare information system (e.g. EHR system or another platform such as C3DP):
 - Firewall whitelisting of CDS service in the system client
 - Mapping of necessary datatypes such as keywords and search words in underlying system
- Users training
- Clinical expertise is required while translating clinical practice guidelines into computerised CDS models

Customisation

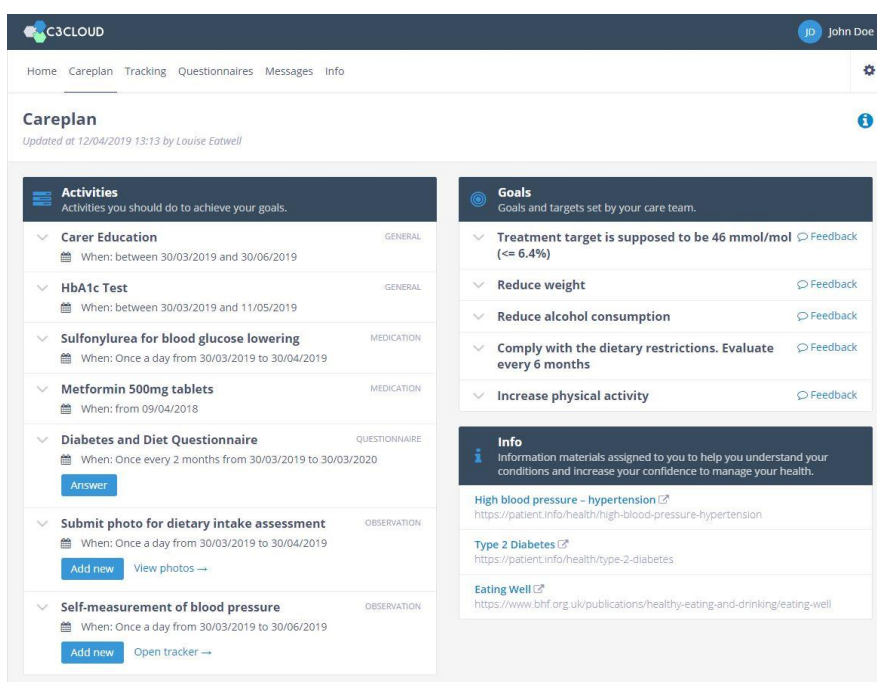
A healthcare provider organisation can decide where in their patient management flow to allow for clinical decision support. The CDS Service can for instance be implemented in:

- a care planning context,
- a referral process,
- a health risk assessment context, or
- an order management system/module (to check for contraindications while placing orders).

The Patient Empowerment Platform gives the patient and their informal caregivers a voice in the management of their own care and ensures their active participation in the management of his multi-morbid chronic conditions.

The Patient Empowerment Platform provides the following main functionalities to patients and their informal caregivers:

- Access to the current integrated care plan with quantitative and qualitative outcome goals, activities to help the patient achieve his goals, and supporting educational training materials.
- Collect relevant data from patients and share these with the multi-disciplinary care team (MDT). This includes data entered using patient questionnaires, data entered as observations (like measurements) and data collected from sensor devices.
- Communicate with the MDT using messaging and video appointments.



The Patient Empowerment Platform is an online, Internet-facing system used primarily via a web application. It is accessed using modern, standard web browsers on mobile devices or PCs. The platform also supports data upload from connected sensor devices. The content and functionality available to any individual PEP user at any specific time depends on the integrated care plan created in the C3DP component and shared via integration.

The Patient Empowerment Platform is based on the Medixine Suite cloud software product. Medixine Suite provides everything a healthcare provider needs for patient-centric connected care. Based on the open and scalable Medixine platform, the product provides key functionalities to patients and their informal caregivers. Medixine Suite functionality can be used for any disease or condition. It can be used on mobile phones, tablets and desktop PCs, either using browsers or apps. The platform can easily be connected to other systems and services using its extensive set of open APIs. The product has powerful tools to configure and extend the functionality and content of the solution. The user interfaces are responsive, mobile-friendly HTML5 user interfaces.

Patient Empowerment Platform (PEP)



The Patient Empowerment Platform enables active participation of patients and their informal caregivers to the management of their multi-morbid chronic conditions. The Patient Empowerment Platform is based on Medixine Suite, a configurable platform and solution for connected care. It includes all the pertinent functionalities for communication, data collection, triage and analysis built on a flexible and scalable platform. Medixine Suite is configurable for use with any disease or condition.

Functionality

In C3-Cloud, the key functionalities are access to the integrated care plan, messaging to stay in contact with the multi-disciplinary care team, access to personalised set of information material, and data collection and sharing this data with the MDT.

The platform integrates with the other C3-Cloud Components using HL7 FHIR standard. FHIR is the next-gen health care interoperability standard leveraging the latest web standards.

For an EHR provider, the platform is a full solution for connected care, both for patients and professionals, with modern APIs making it easy to integrate with the EHR.

Solution Components

The following functional modules are available in PEP:

- Patient portal
- Secure messaging, Secure Chat* and video meetings*
- Configurable questionnaires and forms
- Remote monitoring with device connectivity
- Advice and guidance
- Automatic coaching*
- Programmable flagging and case management*
- Alerts and reminders
- Reporting

*Not activated in the first C3-Cloud deployment

Users

The platform solution connects health care providers, their patients and patients' families. The solution works at any level of care.

PEP supports the following languages: English, German, French, Spanish, Swedish, Danish, Finnish, and Flemish. Portuguese will be available in Q4 2019.

Benefits

Patients. *Easy and secure contact to caregivers: patients feel safe and can perform selected tasks independently*

Healthcare provider organisations and payers. *More care made available outside of the hospital or office. Better quality of care by monitoring and follow-up.*

Adopting ICT vendor. *A scalable and proved comprehensive solution for all connected care. Easily configured to support different use cases.*

Benchmarking

Medixine started as a connected care/telehealth project organization in 2000 being one of the pioneers in the field. In 2015 Medixine decided to create a product, Medixine Suite cloud software, being able to use experience from 10 countries and over 300.000 patients.

Medixine Suite's breadth, configurability and scalability is proved by references such as Linde, Nestle Health Sciences, NHS and several hospital regions in Scandinavia.

Business Model

The use of platform is priced per use, either €/patient/month or €/population/per year. It is available as a SaaS service or as software.

Implementation

The delivery time for a standard version of the software is two weeks. Implementation projects are agreed separately.

Dependencies

The platform can be deployed in generic cloud environments such as Microsoft Azure or AWS or in private clouds. Medixine Suite runs in a Microsoft server environment.

Customization

The customer organisation can configure the product using the administration user interface. Medixine and its partners can assist with the configuration work. Medixine is available for advanced modifications.

The Semantic Interoperability Suite (SIS) is designed to enable common understanding of clinical data and resolve semantic mismatches due the use of different terminology systems between pilot sites and C3-Cloud top-level components. SIS addresses the challenge of heterogeneous clinical data representation formats.

Due to local terminologies used, the SIS is developed in close relation with the C3-Cloud pilot sites and offers them the opportunity to keep on using their local coding systems with the possibility to benefit from Standardized and European wide deployable ICT solutions. The architecture of the SIS is provided in Figure 1 below. SIS is articulated around two main sub-components: SIS Structural Mapper and SIS Semantic Mapper.

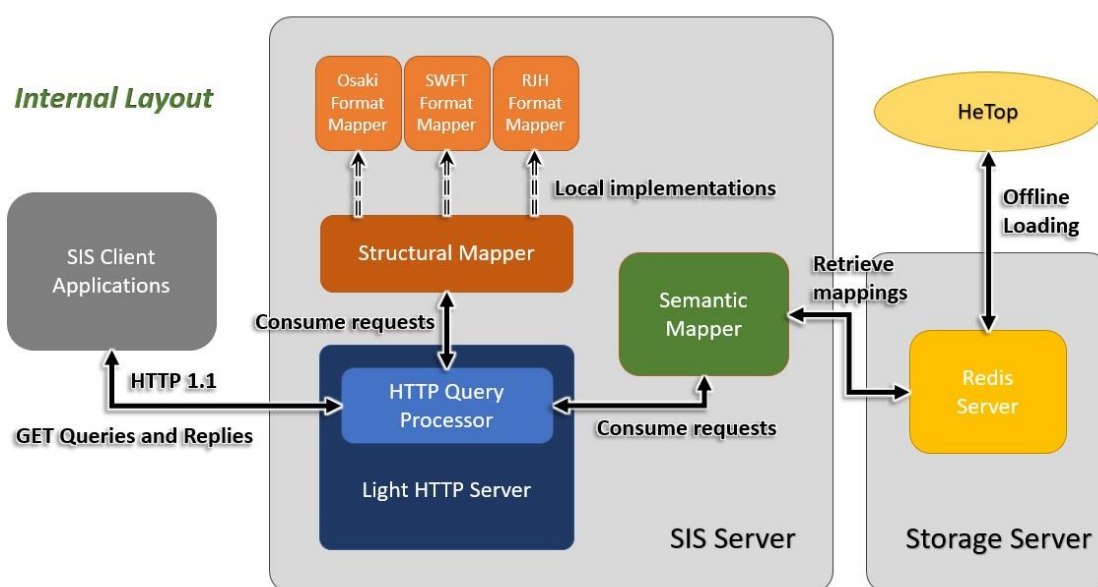


Figure 1 : Semantic Interoperability Suite Architecture

To achieve its purpose, the Structural Mapper consists of pilot site dedicated local format mappers. These mappers provide precise mappings to create correspondence to every relevant data exported by the pilot site to its correct interpretation and place in a FHIR resource. The FHIR resources mapped from pilot site data are defined in the C3-Cloud data dictionary.

Regarding the Semantic Mapper, a clinical concept mapping sheet is being maintained as the source of reference, which includes all the clinical concepts that are needed by the CDS services, in reference terminologies like SNOMED-CT, LOINC and WHO ATC, and all the local codes (Spanish and Swedish versions of ICD-10 and READ codes for UK) that are used by the pilot sites for these concepts. Following the current pilot site needs, available language versions are English, Spanish and Swedish. Further language versions can be integrated on demand and with close collaboration concerned partners. In the scope of C3-Cloud project, all the required integration activities of the Semantic Interoperability Suite have been completed.

Functionality

In the scope of the C3-Cloud solution, the team developed the Semantic Interoperability Suite (SIS). The SIS handles both structural mappings among different information models and resolves semantic mismatches due to the use of different terminology systems and different compositional aggregations, used to represent the same clinical concept. Due to local terminologies used, the SIS is developed in close relation with the pilot sites and offers them the opportunity to keep on using their local coding systems with the possibility to benefit from Standardized and European wide deployable ICT solutions.

Solution Components

To achieve its purpose, the structural mapper consists of pilot site dedicated local format mappers. These mappers provide precise mappings to create correspondence to every relevant data exported by the pilot site to its correct interpretation and place in a FHIR resource. The FHIR resources mapped from pilot site data are defined in the C3-Cloud data dictionary.

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Users

Targeted group of users include:

- Health professionals who need structured and sharable computerized records, new decision support systems to improve the diagnosis and treatment of patients.
- Researchers in life sciences who must have tools to manage data integration and knowledge platforms.
- Citizens who are the primary beneficiaries of e-Health applications and must have IT tools to access knowledge and to improve their own care.
- EHR system vendors or other platform solution provider that treat complex medical data from heterogeneous information systems.

Benefits

Expected benefits are to:

- Support integrated care for National & European wide deployable ICT solutions to adopting vendors.
- Improve cooperation among healthcare providers, patients and informal care givers.
- Offers end users to keep on using their local coding system with the possibility to benefit from standardized Decision Support Modules and guidelines.

Benchmarking

- Possibility to consider all the local codes that are used by the pilot sites
- Usage of standards initiatives (FHIR) and reference terminologies like SNOMED-CT, LOINC and WHO ATC
- Created Value of new mappings (structural and Semantic) for the community

Limitations

To maintain and update clinical content for the knowledge hub part will be challenging to define sustainable maintenance actions and partners responsibilities as time passes. The SIS is an open source and the community has the possibility to enrich its content knowledge hub. Further additional feature upgrades would be:

- Automatizations of the mapping process and maintenance of the knowledge hub, with a validation process of involved experts.
- Provide SIS terminology mapper services (interface, module) as open service for potential users with an idea to enrich the resources and clinical content.
- Consider end users feedbacks following the evaluation at pilot sites.

Business Model

The team is interested to establish collaboration with relevant partners to improve the current Technology Readiness Level scale of the SIS services. We are looking at a licencing model for the service. Main stakeholders who would license the SIS solution are:

- Healthcare system industry & vendors: Electronic Health Record (EHR), Electronic Medical Record (EMR), Personal Health Record (PHR)
- Clinical Research centers, Pharma, Terminologists and Researchers in life sciences (basic, clinical or epidemiological)

Implementation

C3-Cloud Semantic Interoperability Suite can be easily deployed by running its related Docker image as containers.

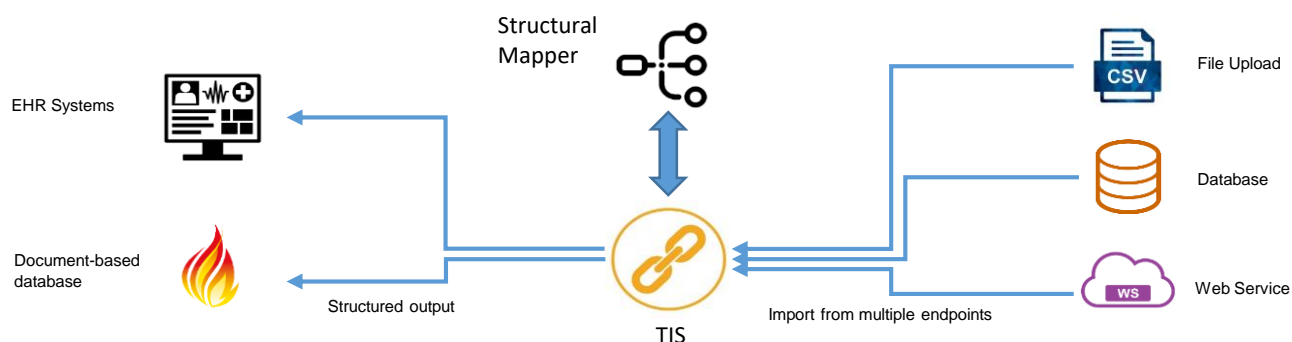
Dependencies

C3-Cloud SIS is implemented as a fully deployable exchange suite, running on independent Docker containers. It is based on HTTP communication standards, with embedded JSON content. Regarding the terminology server, Python 3 is used to develop an application that reads the mappings from use case files and creates an HTTP service (Flask) that is able to achieve the tasks listed in the specifications.

Customization

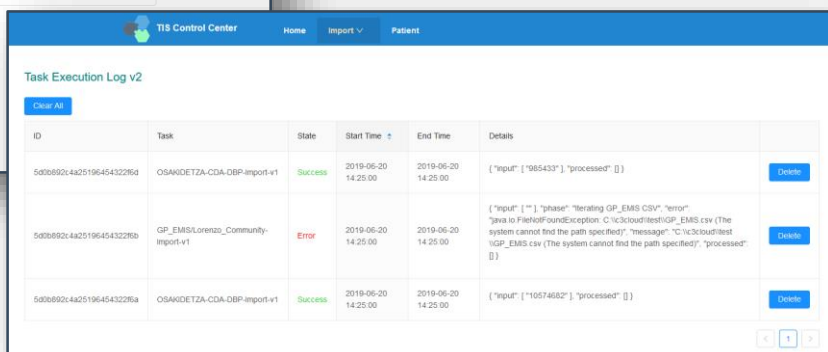
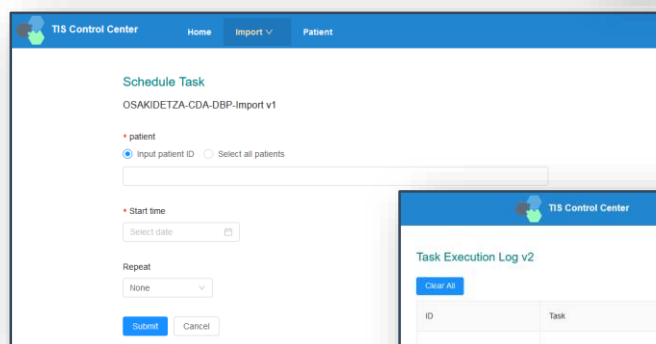
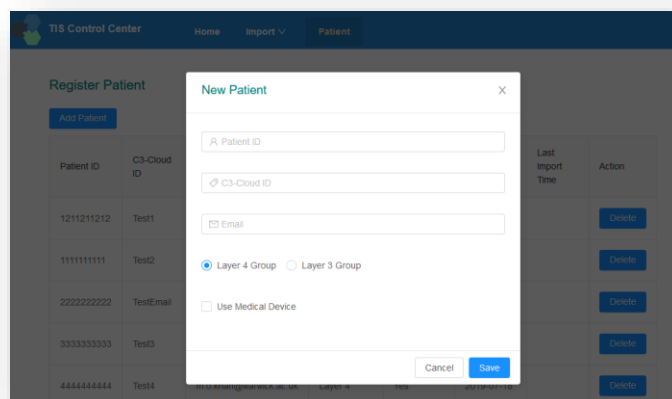
Trainings can be provided to health professionals and pilot study management team so end users in each site become efficient with the system. A comprehensive testing is also carried out by health professionals and technical partners. As a final attempt to reassure bugs are fixed before the system goes live.

The Technical Interoperability Suite (TIS) allows integration between health systems through an Extract-Transform-Load model. Configurations for connections to multiple data sources can be created. These sources can be of any type from commercial database systems to simple CSV files. Utilising a structural mapper, through a plug-and-play style component structure, TIS can output the data in the required format needed for any given repository. TIS supports both web console administration and API calls to trigger ETL processes.



Main Features for users

- Secure password authentication
- Patient administration web interface for managing multiple groups of patients
- Mappings and import processes for multiple data sources
- Scheduling and repeatable imports
- Robust execution log for audit and issue tracing



Functionality

The Technical Interoperability Suite (TIS) enables patient data synchronization from local health and social care systems to C3-Cloud. Following an Extract-Transform-Load (ETL) approach, TIS extracts patient data from local EHRs, transforms the data into FHIR resources using the SIS Structure Mapping Service, and loads the FHIR data into the C3-Cloud FHIR repository. TIS is an extensible platform that provides both a suite of ETL toolkits to support development of integration pipelines for a particular context of use and a task execution engine that allows to schedule and manage the execution of ETL pipelines. A web-based control panel is available that allows users to register patients, schedule pre-configured integration tasks and monitor the task execution. In addition to allowing a user to import data through the control panel, TIS also exposes a REST service that allows a data integration pipeline to be triggered by another software component (e.g., C3DP) in a synchronous manner. TIS is part of C3-Cloud Interoperability Middleware which enables the integration of tools, such as the Coordinated Care and Cure Delivery Platform (C3DP) for the collaborative creation and execution of personalised integrated care plans for multi-morbid patients by a multidisciplinary care team (MDT) with local health and social care.

Solution Components

The Technical Interoperability Suite is composed of the following software components:

- TIS Service – a web application that bundles all web services for scheduling and executing integration tasks and the control panel user interface.
- TIS MongoDB Database - stores the data required to support TIS Service.

Users

The targeted user groups are:

- EHR/EMR system vendors or other platform solution providers needing access to heterogeneous information systems.
- Healthcare provider IT Systems Administrators looking to integrate isolated systems across their hospital

Benefits

The major benefits are:

- Supporting interoperability of heterogeneous systems for integrated care.
- End users can use their local systems while benefiting from the C3-Cloud integrated care solution.

Benchmarking

Compared to other interoperability solutions on the market TIS is:

- Lightweight and simple to customise
- Easy to execute and schedule ETL tasks for non-technical users

Limitations

Limitations and future plans:

- TIS currently only supports the FHIR messaging standard but other standards will be investigated in the future
- TIS requires data sources to have a known API for extraction of patient data

Business Model

The project team seeks to collaborate with relevant partners to build and configure integrations for clients. We will adopt a service and licence model for this.

Implementation

C3-Cloud TIS can be easily packaged and delivered as Docker images.

Dependencies

Technical and organisational dependencies:

- TIS requires a destination FHIR repository be accessible for loading data and a suitable structural mapper for transforming data into the required format.
- There is no OS dependency, but Linux servers are preferred.
- User training can be done remotely via documentation or teleconference

Customisation

Customisation of TIS can be performed by the project team to interrogate a chosen system's API.

Region

Osakidetza is the public healthcare service of the Basque Country, a region located in the north of Spain. Osakidetza was created by the Health Department of the Basque Government in 1983. All the public hospitals and primary care centers of the Basque Region are under this organization. The Basque Health System includes 14 hospitals, more than 100 primary care clinics organized through four different geographical areas, apart from the Mental Health Centers, Emergencies and Basque Transfusions and Human Tissue Centre. More than 30.000 professionals work for Osakidetza, which could be considered the biggest organization of the Basque Country. Osakidetza has a target population of 2.17 million inhabitants, where in 2015 more than 20% of the total population was 65 or older. 100% of Basque population has been stratified since 2010.

Osakidetza has developed processes and tools to promote integrated care Integrated governance bodies between primary care regions and hospital, creating Integrated Care Organizations (OSI), with the support of the deployment of integrated communication systems: Electronic Health Record (EHR), e-prescription, intranets and other communication mechanisms. 100% of Osakidetza centres (including hospitals and primary care centres) have deployed the Unified Electronic Health Record (called Osabide) and the e-Prescription system all over the Basque Country.

Requirements

Osakidetza has developed a common care pathway for multi-morbid complex patients. Without a common platform, difficulties arise from care fragmentation and lack of communication (DSS solutions from C3-Cloud are crucial). The Empowerment Platform will facilitate the collection of self-reported parameters and increase the information that patients have access to regarding their health and treatment, by providing access to their personalized care plan.

Expectations

Basque Country expects that C3-Cloud, built on top of existing legacy information systems, helps to improve the care and cure pathways for multi-morbid complex patients that Osakidetza has already put in place, by enabling direct platforms for information sharing, not only between professionals but also between patients and the health service. It is also expected to help empowering this complex target group of patients. The support modules developed by C3-Cloud will improve the delivery of the care pathways.



Region

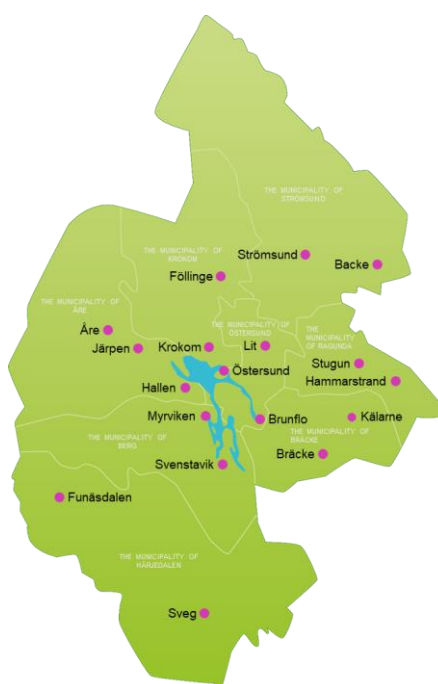
Region Jämtland Härjedalen is the public healthcare provider for 130,000 inhabitants in a sparsely populated county almost as large as Belgium and the Netherlands together. The 28 primary healthcare centres and sole hospital provide all care except for the highly specialized. All caregivers, including 5 private primary healthcare centres, are publicly financed and use a common electronic health record provided by Cambio. An ageing population (24 % above 65 years of age) of which many live remotely, call for distance-independent care and support-deliverance. In order to develop the healthcare of today and tomorrow, there is a strong need to collaborate with small and large enterprises and the eight municipalities in the region. Locally, such a platform is the Region's e-Health Centre, while internationally, the Region's collaboration is shown in its participation in different Horizon 2020 as well as regional projects.

Requirements

Region Jämtland Härjedalen has provided medical expertise to the specifications for the Decision Support and to the Empowerment Platform. It is also a test arena for the final solution.

Expectations

Region Jämtland Härjedalen expects that C3-Cloud, integrated in the EHR, helps to improve the care and cure pathways for multi-morbid complex patients by enabling unified information shared between professionals, patients, and informal care givers. To this, C3-Cloud will contribute by empowering patients.



Region

South Warwickshire NHS Foundation Trust (SWFT) provides hospital services to South Warwickshire from four hospitals: Warwick Hospital, Leamington Spa Hospital, Stratford Hospital and Ellen Badger Hospital.

SWFT also deliver out-of-hospital community services to the whole of Warwickshire serving a population of more than half a million from various clinics.

Warwickshire ICT Services is a division of SWFT and provides ICT services to all GPs across the county and strategic ICT services including project and programme management support to Coventry as well as Warwickshire.



Warwickshire has a significant elderly population and more people are living for longer with long term medical conditions. The county currently has approximately 13,356 people aged over 85, and by 2021 this group is expected to grow by 42%. Our growing and ageing population means increasing pressure on health and social care services. More people are likely to suffer from long term physical and mental health problems such as heart disease, high blood pressure and dementia. People living with multiple health conditions will become the norm. This trend brings with it poorer quality of life, higher hospital admissions and increased mortality.

There are also a range of socioeconomic factors which need to be taken into account. For example, the south of the area has a higher cost of living, and as such, hosts a wealthier and possibly more educated population. This creates different health challenges between the population in the north and south as well as differing exposure to technology. Also the rurality of the area poses some challenges to delivering ICT solutions.

Requirements

SWFT became a partner in the consortium in order to contribute to the key research themes. The region has a significant aging population with increasing levels of comorbidity which an electronic solution like C3-Cloud can help to manage by developing more integrated services, particularly in relation to multi-disciplinary team working and long term condition management'.

Expectations

SWFT is expecting to gain significant knowledge of managing complex care through the use of electronic tools within an integrated healthcare system. The project will provide experience of how to introduce patients to new technologies and how to work with multiple stakeholders across different care organisations.

SWFT is increasing its research participation particularly focused on shared care and patient empowerment. This project allowed us to contribute to the design and testing of a patient empowerment platform which we believe will be a key feature of the healthcare environment in the immediate future. The C3 solution shared care plan structure is also, we believe, a key component of care systems for the immediate future and a technology we are looking at as an organisation.