MIP Installed in thirty Hospitals
D8.2.1 – SGA2

Figure 1: The Medical Informatics Platform deployment map

At present, the Medical Informatics Platform has been successfully deployed in 30 centres distributed across 14 European countries.

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Description in GA:	MIP installed in Thirty Hospitals Demonstration of MIP software installation in 30 hospitals. Demonstration will be in form of a summary report of results: data profiling in each site, issues and lessons learned, user tests and feedback received during the hand-over and training.
Abstract:	This document describes the work performed by SP8 during the second year of SGA2 around the deployment of the Medical Informatics Platform in 30 centres by end of March 2020. To achieve this goal, a systematic deployment process has been implemented to help and support hospitals in all administrative and technical steps.
Keywords:	Medical Informatics Platform, MIP, deployment, hospitals, deployment process, MIP installation
Target Users/Readers:	Clinicians, Consortium members, general public, neuroimaging community, neuroinformaticians, neuroscientists, Platform users, researchers, scientific community, students

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History of Changes made to this Deliverable (post Submission)

Date	Change Requested / Change Made / Other Action
27 Apr 2020	Deliverable submitted to EC
31 Jul 2020	Resubmission with specified changes requested in Review Report Main changes requested: Change 1: Details on the various federations created should be made available, as a first demonstration step, e.g. in D8.2.1 before the deliverable is published, and also maintained on the portal. The main outcome of this would be the achieved "federation" but the document doesn't provide much detail on each of them, including how they have attracted more centres and data along the years and who to contact if somebody wants to join.
4 Sep 2020 7 Sep 2020	Revised draft sent by SP8 to PCO. Main changes made, with indication where each change was made: Change 1 (see Section 4.2): The section on Federations was substantiated and available updates after Covid-19-caused delays were included. Change 2 (see Section 4.2): Four links to the EBRAINS Knowledge Graph have been corrected.
8 Sep 2020	Revised version resubmitted to EC by PCO via SyGMa

1. Overview

The effective deployment of the MIP across hospitals and research institutions in Europe represents both the backbone and one mandatory step of the MIP project. Indeed, the added value of the federated analyses proposed by the MIP, can only materialise once a significant number of hospitals have the capacity to share data and participate to such a federation.

The establishment of a large-scale network of MIP-data providers and users involves the continuous recruitment of hospitals and research institutions, a process that implies:

- Identification of medical departments and research consortia that could provide relevant medical data.

- Approaching the group leaders to present the platform, invitation to join the project and provision of the relevant documentation about the MIP.

- Identification of the key personnel who will be involved in the deployment and alignment between the teams in order to set up the technical and operational bases for the installation.

- Collection and review of the signed MIP Installation Agreements.

- Set up of the required server with all appropriate specifications by the hospitals' IT teams

- Establishment of the necessary IT connection between the MIP team and the hospital MIP server for MIP installation.

- Constant monitoring of the deployment process through an effective coordination between the SP8 team and the external installation site.

2. Introduction

In this report, we summarise the work performed by SP8 for SGA2 Deliverable D8.2.1 (D49.1 D31) "MIP Installed in 30 hospitals" until the end of SGA2. The work revolves around the deployment of the Medical Informatics Platform in 30 centres by the end of March 2020 (see Figure 1).

3. MIP Deployment Process

The MIP deployment process follows several steps to facilitate the installation flow and progressively allows the hospital staff to gain experience along the implementation process (see Figure 2).

The first 5 steps fall within the scope of installing a local version of the Platform – the MIP-Local – which allows researchers to compare their data with the public databases already included in the MIP:

1) Identification of relevant hospital staff required to proceed to MIP deployment and presentation of the Platform and the deployment process to this group.

2) Signature of the MIP Installation Agreement by both the Hospital and CHUV legal representatives. This agreement covers installation of the MIP software, but not data sharing.

3) Preparation of the IT infrastructure (e.g. server) needed to install the MIP-Local according to its specifications. This preparation is typically performed by the Hospital IT staff with assistance from the SP8 team, if needed.

4) Installation of the MIP-Local software, usually through a combined effort of the Hospital IT staff and the MIP-CHUV deployment team. The installation can partially be performed remotely through a VPN connection, if required by the Hospital. On site, hospital-specific tuning is often required.

5) Capturing of pseudonymised patients' data from the Hospital or research department in the MIP-Local, in full compliance with all local ethics and regulatory procedures. This step is undertaken

under the full responsibility of the Hospital or research department and its local Data Coordinator. Once data have been captured in the MIP-Local, the Local Data Coordinator and his accredited local staff can use the MIP-Local to analyse their data. No other stakeholder has access to these data.

Thus, researchers can test the MIP and apply its algorithms to their own datasets in combination with public pre-existing cohorts. In case they want to create a federation together with other centres, they have to follow the next steps:

6) Signature of the MIP Data Sharing Agreement by both the Hospital and CHUV legal representatives. This agreement covers the possibility to perform federated analyses of fully anonymised data captured in the MIP-Federated node of the hospital.

7) Participation of the Local Data Coordinator to the relevant MIP DGSC disease-specific board.

8) Preparation of the IT infrastructure (e.g. server) for installation of the MIP-Federated Node software (same procedure as previously described in step 3).

9) Installation of the MIP-Federated Node software (same procedure as previously described in step 4).

10) Full anonymisation of the data stored in the MIP-Local and push of these data into the MIP-Federated Node database. This step is undertaken under the full responsibility of the Local Data Coordinator.
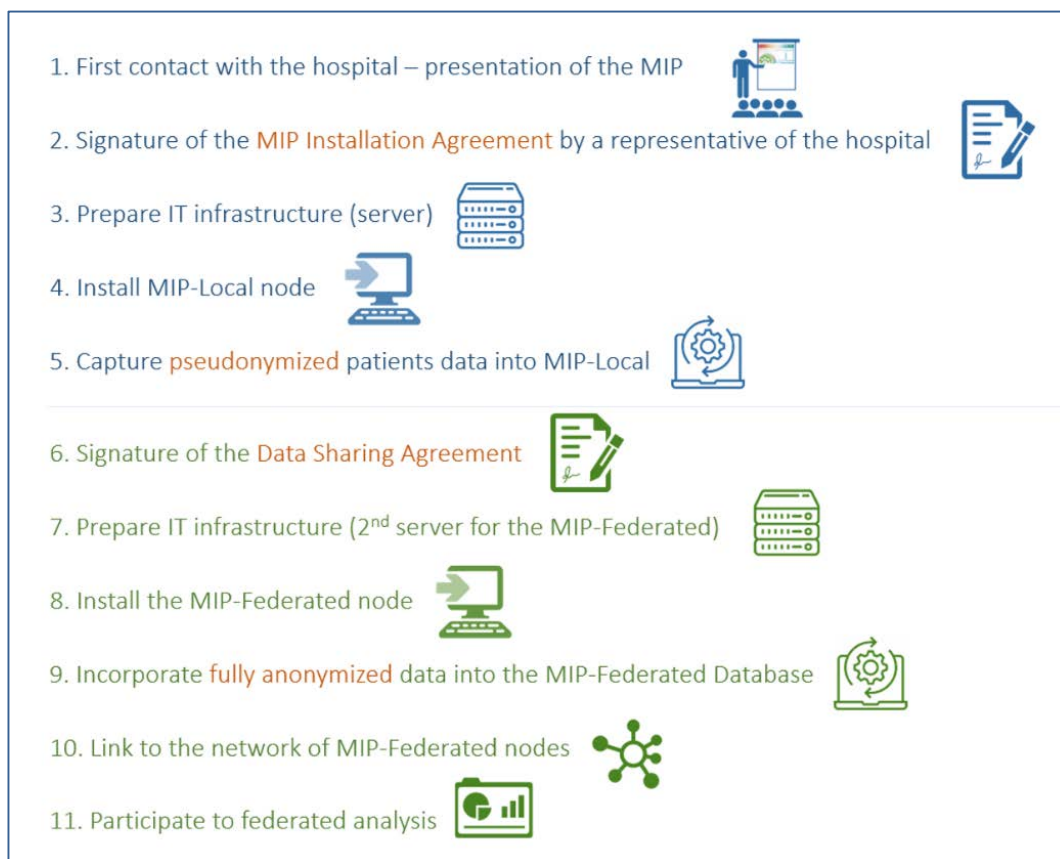
11) Performance of federated analysis.

1. First contact with the hospital – presentation of the MIP

2. Signature of the MIP Installation Agreement by a representative of the hospital

3. Prepare IT infrastructure (server)

4. Install MIP-Local node

5. Capture pseudonymized patients data into MIP-Local

6. Signature of the Data Sharing Agreement

7. Prepare IT infrastructure (2nd server for the MIP-Federated)

8. Install the MIP-Federated node

9. Incorporate fully anonymized data into the MIP-Federated Database

10. Link to the network of MIP-Federated nodes

11. Participate to federated analysis

Figure 2: MIP Deployment process

This diagram summarises the steps defined by SP8 to facilitate the MIP deployment including two differentiated phases: the installation of the Local-MIP and the installation of the Federated-MIP.

4.   Deployment status

4.1   Deployment status

Since the beginning of the project, a growing number of hospitals across Europe have installed the Local-MIP (see Figure 3), with a quickly increasing number of deployments in the second year of SGA2, reaching the target of 30 institutions at the end of SGA2.
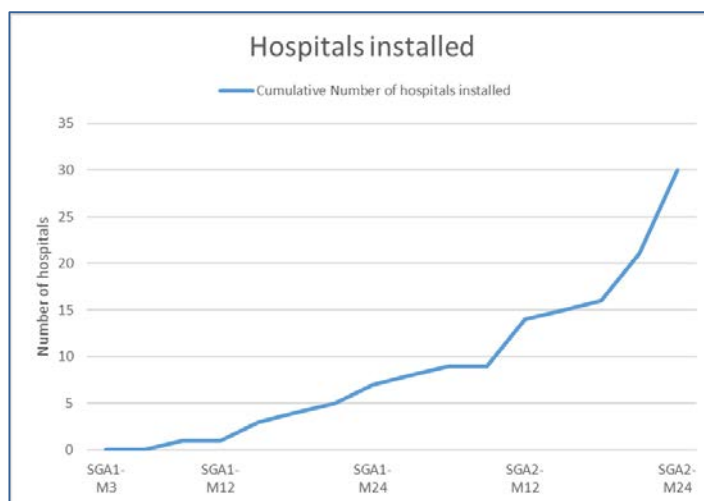

Figure 3: Evolution of number of centres that have installed the MIP

This figure shows the number of centres that have installed the MIP since the beginning of SGA1.

To summarise:

- 30 centres have already installed the MIP, including 28 hospitals, 1 private and 1 public research centre, covering 14 countries and 8 pathologies so far (see Figure 4 and Table 1).

- 8 new installations are in the pipeline (see Table 2).
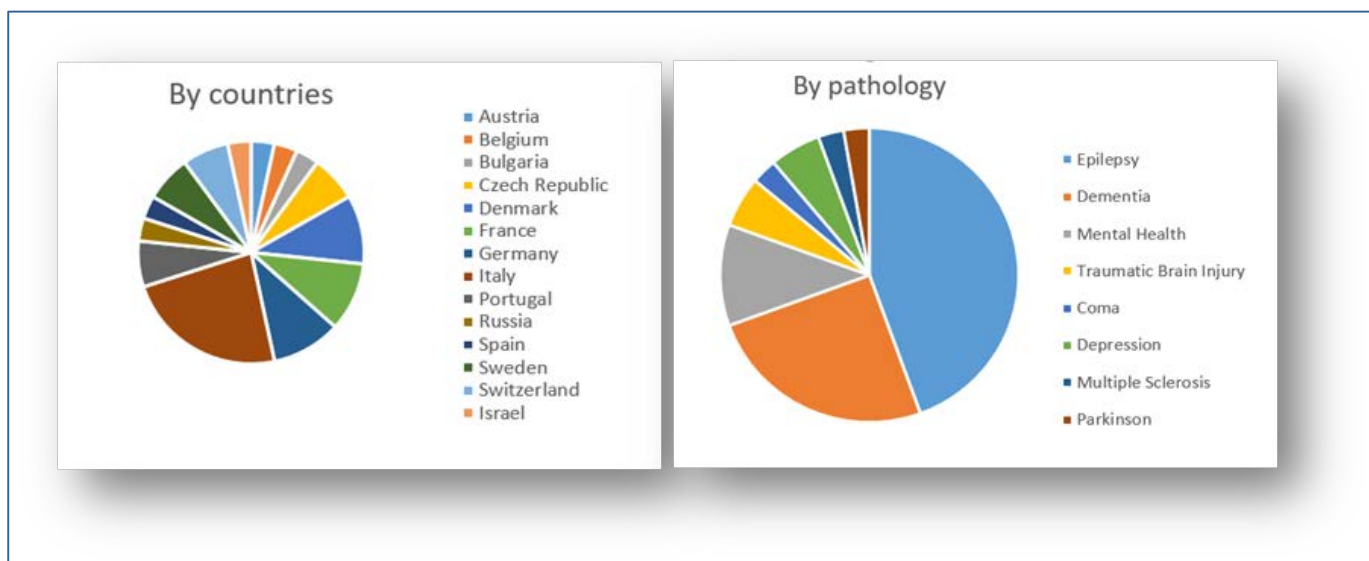
These centres are distributed in the following way:

Figure 4: Distribution of centres by country and pathology

The MIP has been installed across 14 countries and it will incorporate data corresponding to at least 8 different brain disease-related fields.

Table 1: List of centres with a MIP installed and their field of research

HOSPITAL	CITY/COUNTRY	Pathology*
Centre Hospitalier Universitaire Vaudois - CHUV	Lausanne / Switzerland	Dementia
IRCCS Centro San Giovanni di Dio, Fatebenefratelli Hospital	Brescia / Italy	Dementia
Medical University of Plovdiv	Plovdiv / Bulgaria	Depression/MS
CHU Lille	Lille / France	Dementia / Epilepsy
Niguarda Hospital	Milan / Italy	Dementia / Epilepsy
University Hospital Freiburg	Freiburg / Germany	Dementia / Epilepsy
Mario Negri Institute for Pharmacological Research	Bergamo / Italy	TBI
IRCSS Neurological Institute Carlo Besta	Milan / Italy	Dementia
IRCSS Fondazione Istituto Neurologico Nazionale Casimiro Mondino	Pavia / Italy	Dementia / Epilepsy
St. Anne's University Hospital	Brno / Czech Republic	Epilepsy
Motol University Hospital	Prague / Czech Republic	Epilepsy
Filadelphia Epilepsy Hospital	Dianalund / Denmark	Epilepsy
Hospital del Mar	Barcelone / Spain	Epilepsy
Sahlgrenska University Hospital	Gothenburg / Sweden	Epilepsy
CHU Grenoble	Grenoble / France	Epilepsy
IRCSS Don Carlo Gnocchi	Milan / Italy	Dementia
Universitätsklinikum Aachen	Aachen / Germany	Mental Health
IRCSS Ospedale San Camillo	Venice / Italy	Dementia
Max Plank Psychiatric Institute	Munich / Germany	Mental Health
Karolinska Institute - INCF (International Neuroinformatics Coordinating Facility)	Stockholm / Sweden	TBI
IRCCS Institute of Neurological Sciences	Bologna / Italy	Epilepsy
Paracelsus Medical University	Salzburg / Austria	Epilepsy
Centro Hospitalar do Porto	Porto / Portugal	Epilepsy
Moscow Research and Clinical Center for Neuropsychiatry	Moscow / Russia	Epilepsy
CHU Liège	Liège / Belgium	Coma
Novo Nordisk	Bagsværd / Denmark	Dementia/ Mental Health
Hospital de Santa Maria - Centro de Referencia para a Area de Epilepsias Refractarias	Lisbon / Portugal	Epilepsy
Neurospin	Paris / France	Psychiatrie
Rigshospitalet	Copenhagen / Denmark	Epilepsy
Tel-Aviv Medical Center (TLVMC)	Tel Aviv / Israel	Parkinson

*MS= multiple sclerosis; TBI= traumatic brain injury

Table 2: List of centres that have signed the MIP Installation Agreement and will install the MIP

HOSPITAL	CITY/COUNTRY	Pathology
University Hospital Magdeburg	Magdeburg / Germany	Neurological Disorders
Clinical Center Charité	Berlin / Germany	Mental Health
Ludwig Maximilian University of Munich	Munich / Germany	Mental Health
Hospital Universitario y Politecnico La Fe	Valencia / Spain	Epilepsy
The Children's Memorial Health Institute	Warsaw / Poland	Epilepsy
Kings College London	London / UK	Epilepsy
Swiss Institute of Bioinformatics (SIB)	Lausanne / Switzerland	N/A
Hôpital Necker - Enfants Malades	Paris / France	Epilepsy

4.2   Federations

The MIP project aims to develop disease-oriented federations for medical and research centres that wish to share their data in order to perform federated analysis of large-scale distributed datasets.

For each federation, specific data models have been created, based on well-accepted common data elements (CDE) approved by all participating centres. To this end, SP8 has provided support to the centres to facilitate their coordination and communication, and to assist in the creation of the data models.

Current Federations on the MIP

As of August 2020, three federations were successfully created and made available in the MIP:

1) The MIP federation in Dementia connects three hospitals (Brescia, Lille, Lausanne) and incorporates several public databases (ADNI, PPMI, EDSD) as well as a cohort from a population-based longitudinal study (the so-called Three-Cities study), from a Centre not directly connected to the HBP (Bordeaux), with altogether more than 6,300 patients. The Pilot Study of the application of MIP analysis to dementia subsamples of the Italian cohorts (i.e. IRCCS Fatebenefratelli hospital, IRCCS Besta Institute, CHT/Niguarda) is described in the article "*Medical Informatics Platform (MIP): a pilot study across clinical Italian cohorts[1]*", accepted for publication in Frontiers in Neurology in Aug 2020 (P2409, doi: 10.3389/fneur.2020.01021 – *SGA3 publication*).

2) The Traumatic Brain Injury (TBI) federation has been set-up between the two largest EU-funded TBI cohorts, respectively stored in Bergamo (CREACTIVE) and Stockholm (Centre-TBI at INCF), totalling 11,816 patients. The COVID-19 pandemic, with its European epicentre in Bergamo, severely affected the medical team in charge of CREACTIVE (i.e. the intensive care department). Despite this major incidence, active MIP federated nodes containing both, Centre-TBI and CREACTIVE data have been installed in Stockholm and Bergamo, respectively. Both research teams are testing the developed algorithms, like the Calibration Belt algorithm, and are in the process of fine-tuning the data model. First research results are expected to be produced by the last quarter of 2020.

3) The MIP federation in Mental Health has been installed between Aachen and Lausanne, including 1,408 patients from the Imagen database. The dataset has been curated, the data model is ready, and the UK Aachen team is testing the algorithms in order to produce the first scientific results about a MIP federation-approach, to get new insights from Mental Health data. A first research focus is on OCD (Obsessive-Compulsive Disorder), as high associations between the volume of basal ganglia (and hippocampus and thalamus) and the disease was shown. After dementia, OCD presents the most converging reports in that regard. Other MIP algorithms being explored are: 1)

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[1] https://www.frontiersin.org/articles/10.3389/fneur.2020.01021/abstract

CART: first results obtained, further analysis and validation required. 2) Naïve Bayes: currently being tested and 3) Logistic Regression: lined up for testing.

The output of the project will be presented to the network of German hospitals working in the mental health field. The aim is to enlarge the cohort size by adding data from several of these hospitals, all using the same data model. In this respect, Charité Berlin, MPI of Psychiatry (Munich) and LMU (Munich) have already signed the MIP installation agreement.

4) The MIP federation in Epilepsy is under development. Sixteen epilepsy centres have a local MIP installed and the common CDE has been recently developed. It will be tested by using a virtual cohort of epilepsy patients created by the SP8 Data Management team.

How to join a federation on the MIP

The process to join a federation is simple: Clinicians/neuroscientists or also pharmaceutical or biotech companies and SMEs interested in the Platform and joining a federation, need to contact the HBP High Level Support Team using the information provided on the MIP website https://mip.humanbrainproject.eu/ going to "Request Access", which will be granted on a case by case base. Hospitals and Centres interested in installing the MIP and in joining a federation, can retrieve more information about the MIP and its network also on https://mip.ebrains.eu/. The Deployment Team provides the necessary information and facilitates the process of joining an existing federation, as the current members of a federation must approve the addition of the new centre, before its admission.

If hospitals or centres want to create a new federation with other centres, they must follow the next steps:

- Signature of the MIP Data Sharing Agreement by both the Hospital and the CHUV legal representatives. This agreement covers the possibility to perform federated analyses of fully anonymised data captured in the MIP-Federated Node of the hospital.

- Full anonymisation of the data stored in the MIP-Local and push of these data into the MIP-Federated Node database. This step is undertaken under the full responsibility of the Local Data Coordinator.

Descriptions of the metadata schema, data sets and data models are already public and available through the EBRAINS Knowledge Graph on the EBRAINS web site, at the following links:

Dementia:

https://kg.ebrains.eu/search/instances/Dataset/42b69ce8-9a73-4522-9be9-07f1ea8fb60d

Depression:

https://kg.ebrains.eu/search/instances/Dataset/5390fd8f-b095-4963-addc-f984df119265

Mental Health:

https://kg.ebrains.eu/search/instances/Dataset/e5aad7e8-b42d-4cd2-8cac-90998a4dd6ff

Traumatic Brain Injury:

https://kg.ebrains.eu/search/instances/Dataset/75b01958-b59a-42a1-9e1d-326532beabee

The four established federations will be regularly updated, and the new and upcoming federations will be added to the MIP website. An update for the website is currently under construction.

4.3 Feedback received and lessons learned from hand-over and training

Clinicians and scientists show increasing interest for using the MIP, which is reflected by the rising rate of installations during SGA2, when the SP8 development team delivered an improved and easier to install version of the MIP (see Figure 3). This upgrade was very well received by users, who saw a considerable reduction of the efforts required on their side to install the MIP.

The main lessons learned from the experience deploying an innovative platform like the MIP across Europe are:

1) Establishing a well-structured deployment process (see Figure 2) helped both the SP8 team and the users to align the corresponding staff and chain up administrative and technical steps in a fluent and efficient way.

2) The teams involved in the deployment (engineers, data managers and administration) have been restructured to enhance productivity and coordination according to industry standards not usually available in academic environments.

3) The scientific community proved eager to engage in installing and testing the MIP, understanding that the project was still in development and would not provide immediate returns on investment, but appreciating that moving towards federated analyses of distributed in-hospital medical datasets is the future.

4) In this context, having a more stable, easy to install and user-friendly version of the MIP was still essential to raise interest from end-users.

5.   Conclusion and Outlook

The results described in this document reflect the advancements made by the SP8 teams on the Platform and of the interest of the neuroscientific community in the MIP. Clinicians and scientists are eager to adapt new technologies providing federated machine learning tools – such as the Medical Informatics Platform – with the ambitious view to improve the understanding, diagnosis, early prediction and treatment of patients with brain diseases.

The next two major steps will be to federate the majority of the current MIP users (so far, the majority are still using their MIP local only) and to deploy the MIP further within the 9 centres currently in the pipeline, as well as in an additional 20 centres identified within the SGA3 work plan (partners of the Human Intracerebral EEG Platform HIP). We thus foresee the expansion of the MIP to federate 50 to 60 of the main EU hospitals by the end of the HBP in 2023.

Apart from hospitals, private (Novo Nordisk) and public research centres (Neurospin, Swiss Institute of Bioinformatics) also proved interested by testing the MIP, efforts in this direction will continue and further increase, thus more institutions are expected to join in the future.