

Excellent practices: Oslo - Translational Research and Innovation

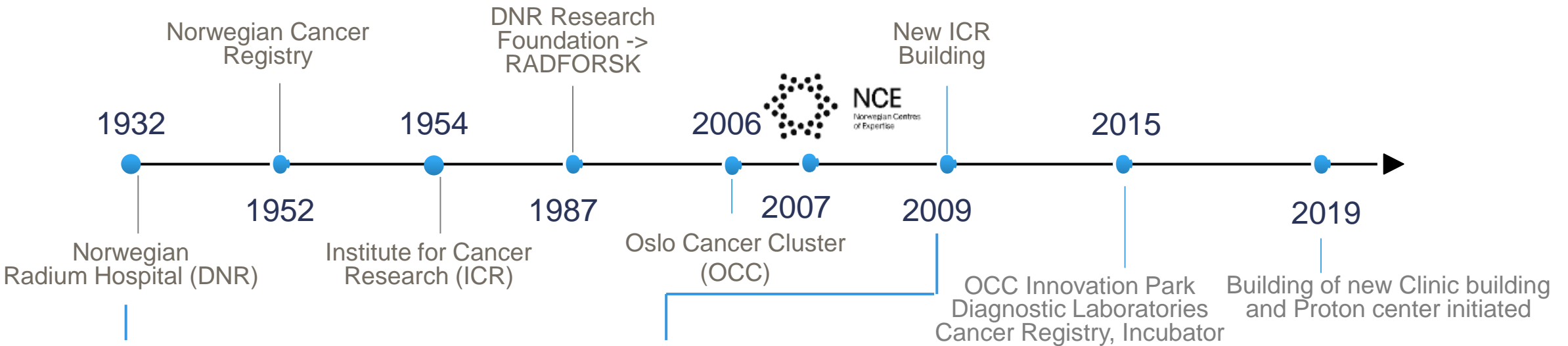
Kjetil Taskén
Oslo University Hospital
Comprehensive Cancer
Centre



Accredited from 2017



History of research and innovation



Oslo University Hospital CCC - Cancer Treatment and Care

Core Activity Data

Patient Treatment



Number of cancer patients:
28 141



Total number of new cancer patients referred to OUS:
9 646



Number of beds: **309**
Number of over-night stays: **76 169**

Number of outpatient consultations:
122 560

Number of chairs:
77



Chemotherapy treatments:
51 955



Radiotherapy: treatment series:
6 562



Radiotherapy: number of fractions:
98 513



Radiotherapy: number of patients:
6 530



Cytology:
9 892



Histology:
41 530



Molecular pathology:
13 896



Total number of peer-reviewed publications (with OUS-CCC first or last author):
768 (399)

Number of publications with impact factor >10 (with OUS-CCC first or last author):
104 (31)

Number of publications with impact factor >20 (with OUS-CCC first or last author):
42 (9)



Disclosures of Invention (DOFIs):
26

Active projects funded by EU (H2020):
12



Approx. Total number of FTEs in cancer research:
550

Key Indicators in Research



Budget: estimate of research budget (by parameters):
750 mill. kr



Completed Ph.D. degrees:
23



Number of active clinical trials:
223



Percentage of new patients included in clinical trials:
14.5

Number of new patients included in clinical trials:
1402

Large cancer center by European standards

Well established ecosystem for cancer research

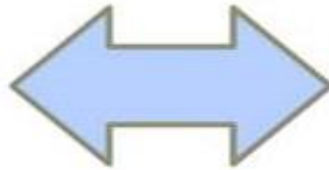
- Institute for Cancer Research
- Section for Clinical Research including Phase I unit
- Cancer Registry
- Innovation and start-up infrastructure (Inven2 and Oslo Cancer Cluster, CONNECT)
- Large biobank resources (breast, lung, CRC, prostate, lymphoma, sarcoma)

CCC / Div Cancer Medicine Development Priorities:

- Precision Cancer Medicine (diagnostics and treatment)
- Cell therapy
- Proton therapy
- Digital Pathology

* Number of radiology examination requests for cancer patients

Building on existing infrastructure



Clinical Cancer
TRIAL UNIT
www.phase1.no



Clinical Trial
OFFICE (CTO)
www.phase1.no



Oslo University Hospital
The Norwegian Radium Hospital
Institute for Cancer Research

Ullernchausseen 70
N-0379 Oslo
Norway

P.O. BOX 4953 Nydalen
N-0424 Oslo
Norway

<http://ous-research.no/Institute/>

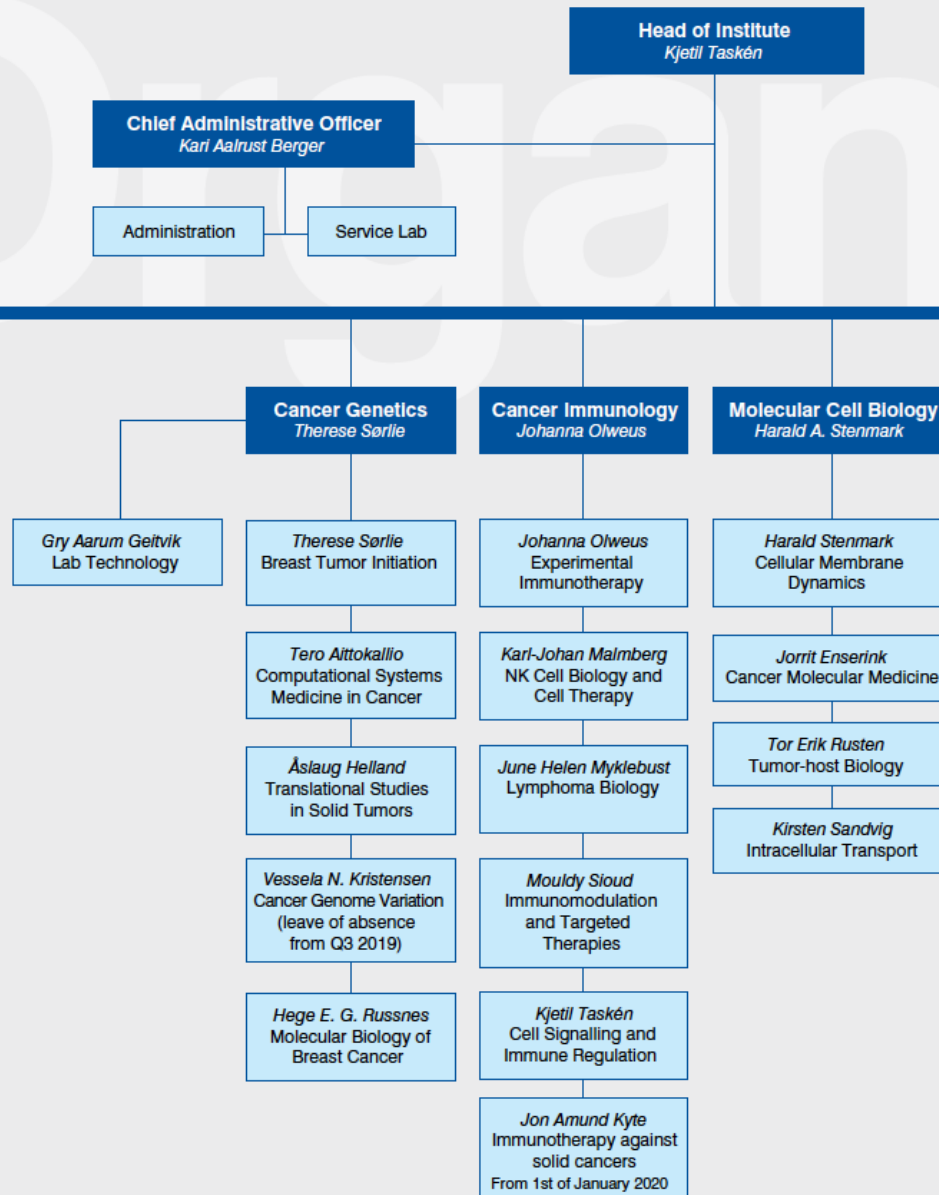
INSTITUTE FOR CANCER RESEARCH

ANNUAL REPORT 2021

INSTITUTE FOR CANCER RESEARCH ANNUAL REPORT 2021

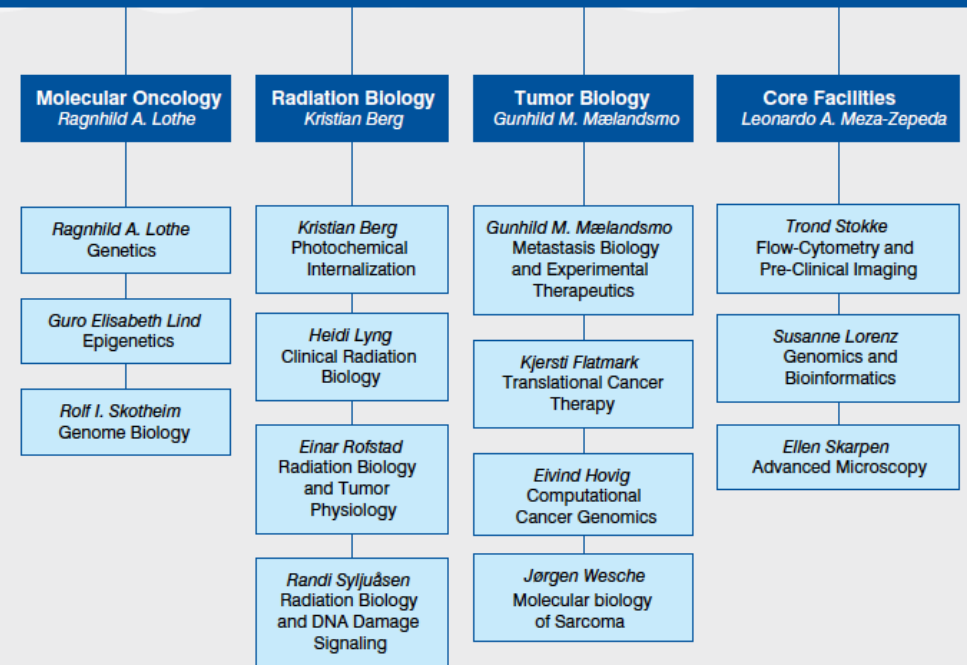
EXCELLENCE
IN FIGHTING
CANCER

Organisation



The Institute for Cancer Research

Institute for Cancer Research is organized in 6 research departments with 25 research groups, and one Department of (6) Core Facilities.

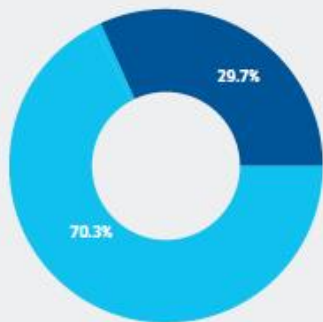


The Funding

The Institute researchers received a total of >300 mill NOK in new grants from external sources in 2021.

THIS INCLUDED:

- 128 mill NOK from the Research Council of Norway to a new clinical research centre "MATRIX" led by Åslaug Helland
- Three new grants to Therese Sørlie (>20 mill NOK in total) from the Norwegian Cancer Society, the Regional Health Authority for South-Eastern Norway and the Research Council of Norway.
- 18 mill NOK in renewed grant from the commercial company Fate Therapeutics to Kalle Malmberg
- 12 mill NOK to pancreas cancer research, EU grant to Elin H. Kure and Tero Aittokallio

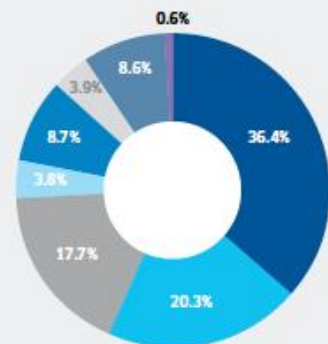


Funding

Percent

Actual Institute expenditure for 2021 by internal and external funding sources (total 347,3 MNOK - approx. 35,3 M€)

- Internal funding
- External funding



External funding by source

Percent

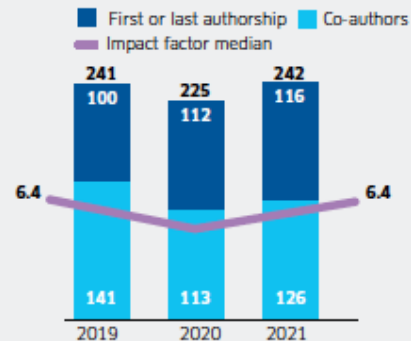
Sources of external competitive funding for 2021, based on actual expenditure (total 244,2 MNOK - approx. 24,8 M€)

- South-Eastern Norway Regional Health Authority
- The Research Council of Norway
- The Norwegian Cancer Society
- University of Oslo
- EU
- Other international sources
- Other private sources
- Other public sources



The Achievements

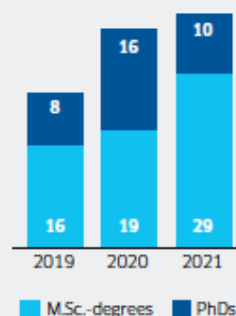
Articles published



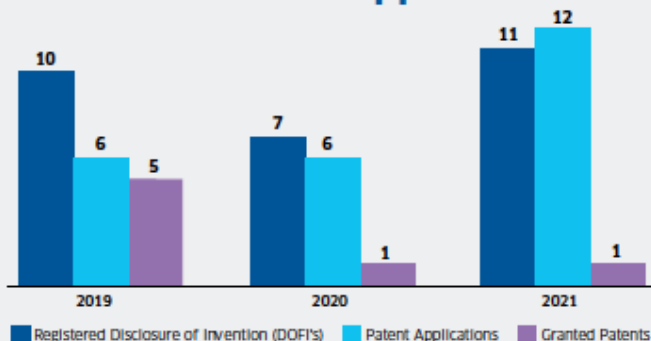
IMPACT FACTOR

	2019	2020	2021
Mean	8.5	7.6	8
Median	6.4	5.9	6.4

Completed PhDs and M.Sc.-degrees



DOFIs and Patent Applications



Selected papers with key authors from the Institute:

EMBO J 2021, 40:e107336 R. Khezri et al., and T.E. Rusten.

First and last author from Dept Molecular Cell Biology
Main finding: Host autophagy mediates organ wasting and nutrient mobilization that is utilized for tumor growth demonstrated in an in vivo model

Genome Medicine 2021 A. Sveen et al., and R.A. Lothe

First and last author from Dept Molecular Oncology
Main finding: The majority of somatic mutations in colorectal cancer are not expressed and the "expressed mutation dose" has prognostic and therapeutic relevance.

Hepatology 2021, 75:59-73. H.M. Vedeld et al., and G.E. Lind.

First and last author from Dept Mol Oncology
Main finding: Early detection of cholangiocarcinoma up to 12 months prior to diagnosis by tumor biomarkers in bile as the liquid biopsy source.

J Immunother Cancer, 2021, 9: DOI 10.1136/jitc-2021-003109. Flatmark K et al.

First author from Dept Tumor Biology
Main finding: Peptide vaccine targeting mutated GNAS may have application as treatment for pseudomyxoma peritonei.

Mol Oncol 2021, 16, 88-103. I.H. Rye et al., H.G. Russnes

First and last author from Dept Cancer Genetics
Main finding: Single cell immune profiling of lymph nodes with and without metastatic cells show that immune suppression occurs already in early stages of breast cancer progression.

Mol Syst Biol, 2021, 17, e9526, Jaiswal et al., and K. Alttokallio

Last author from Dept. of Cancer Genetics
Main finding: Identification of ECHDC1 as a novel breast tumor suppressor.

Nat Biotechnol 2021, Dec ahead of print. M. Ail", E. Giannakopoulou" et al., and J. Olweus.
 First authors and last author from Dept. of Cancer Immunology

Main finding: T-cell receptor-modified T cells targeting a lymphoid-specific enzyme (TdT) suggested as a promising immunotherapy for B-ALL and T-ALL that preserves normal lymphocytes.

Nat Commun 2021, 12:6427. O. Engebråten et al. A. Weyergang.

First and last authors from Dept Tumor Biology and Dept. Radiation Biology, respectively.
Main finding: Novel predictive biomarker for response to trastuzumab-emtansine in HER2+ breast cancer.

Nat Commun 2021, 12: 6577. K.O. Schink et al., and H. Stenmark.

First and last author from Dept Molecular Cell Biology
Main finding: Identification of a new regulator of macropinocytosis, the protein Phafn2 shown to modulate the cellular cytoskeleton and required for "cellular drinking".

Nat Commun, 2021, 12, 5307 DOI 10.1038, Taavitsainen S, Engedal N, et al and Urbanucci A. Shared first (Engedal) and last author from Dept Tumor Biology.
Main finding: Gene patterns can predict prostate cancer treatment responses.

Nature 2021, 591, 142-146. Agudo-Canalejo J, Schultz SW, et al
 Shared first author (Schultz) from Dept of Mol Cell Biol.

Main finding: Wetting whereby a liquid establishes a contact with a surface, is important for droplet sequestration during autophagy.

Science Signaling 2021 14(703):eabc8579. A.M. Lone et al., K. Tasken

First and last author: Dept Cancer Immunology
Main finding: Downstream signaling network through the EP1, EP2, EP3 and EP4 GPCRs on T cells involve more than 1,500 regulated phosphosites in receptor specific and shared signaling pathways.

OSLO CANCER CLUSTER INCUBATOR PROGRAM

Hands-on coaching to make start-ups investable

- Developing novel cancer therapies for the benefit of patients and avoiding the traps on the way
- 35 members: start-ups, global pharma, investors, IT companies, lawyer, TTO, academic groups, CROs
- 5.000 m² offices and labs embedded in Comprehensive Cancer Center Campus with University Hospital, Cancer Registry, Biobanks, Clinical Trial Unit and Institute for Cancer Research



A GROWING PIPELINE: STRONG IN CANCER IMMUNOTHERAPY



The Radium Hospital site

CLINICAL BUILDINGS

INSTITUTE FOR CANCER RESEARCH

OSLO CANCER CLUSTER BUILDINGS

The Radium Hospital site after completion of new clinical buildings and the new proton therapy centre Q1 2024 (new buildings with green/black roofs) amidst older clinical buildings and present ICR and OCC buildings. OCC buildings houses also pathology and Cancer Registry of Norway. Note proximity of clinical and diagnostic activity to research and innovation at ICR and in OCC.



Oslo Cancer Cluster development



Oslo Cancer Cluster 4th and 5th buildings





Proton therapy

- Proton therapy will be integrated in the existing treatment regimens in the Division of Cancer Medicine, as an inter-regional service
- Instrumentation to be delivered Q1 2023 with start of patient treatment in Q3 2024
- Majority of patients (>80%) in clinical trials
- Two clinical treatment rooms / gantries
- One treatment room / gantry with infrastructure for preclinical research





Head of the Department of Radiation Biology, Institute for Cancer Research, Oslo University Hospital combined with an adjunct full Professor position (20%), University of Oslo

Department of Radiation Biology, Institute for Cancer Research, Oslo University Hospital

[Apply for position](#)

Oslo University Hospital Radio- and Proton Therapy

The hospital hosts one of the largest radiotherapy centers world-wide, with about 6000 new patients receiving state-of-the-art radiotherapy each year. The center is located at the Radium Hospital in close vicinity to the Institute for Cancer Research. A Proton Therapy center is under construction at the same location. The Proton Therapy center will open in 2024-2025 and includes a cyclotron, 2 treatment rooms for cancer patients and a facility for preclinical research. We plan to include about 75% of all patients treated at the proton centre in clinical studies. The preclinical proton facility will consist of a treatment room with gantry, a room for stalling and work with small animals, a preclinical MR-scanner and laboratory for cell work and will offer a unique setting for proton therapy research.

Centre for Advanced Cell Therapy (ACT)

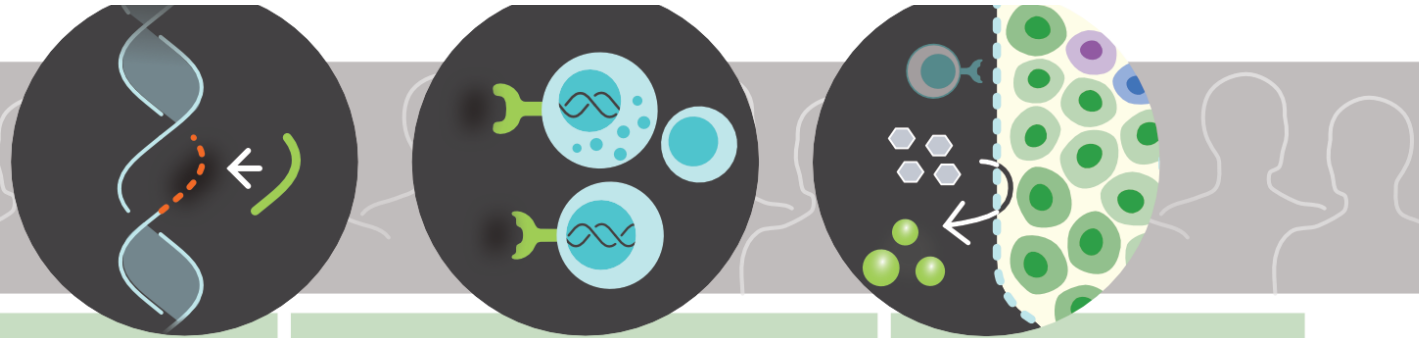
Section for Cell Therapy,
Department of Oncology
& ICR, Oslo University
Hospital



Centre for Advanced Cell and Gene therapy launched

ACT
norway

Advanced Cell
and gene Therapy



GTMP

Gene Therapy Medicines
Genes that lead to therapeutic, diagnostic or prophylactic effects

sCTMP

Somatic-cell therapy medicines
These contain cells or tissues that have been manipulated to change their biological characteristics. They can be used to cure, diagnose or prevent disease. Most often referred to as cell therapy.

TEP

Tissue-engineered medicines
These contain cells or tissues that can be used to repair, regenerate or replace human tissue.



"...clinical-grade cell engineering represents a key bottleneck for the development of new cell and gene therapies.."



Anna Pasetto,
ACT Centre
Director

JOHANNA OLWEUS
HEAD OF THE
DEPARTMENT
OF CANCER
IMMUNOLOGY:

"This donation brings a lot of excitement as it removes the biggest hurdle for translation of novel concepts in cell and gene therapies generated in Norway all the way to patients."



KARL-JOHAN MALMBERG
SCIENTIFIC
DIRECTOR, ACT
CENTRE:

"With the launch of the ACT centre, we outline a path to acquire and establish new competence and equipment in existing GMP facilities to serve as a national infrastructure for ATMP manufacturing to make advanced therapies available to

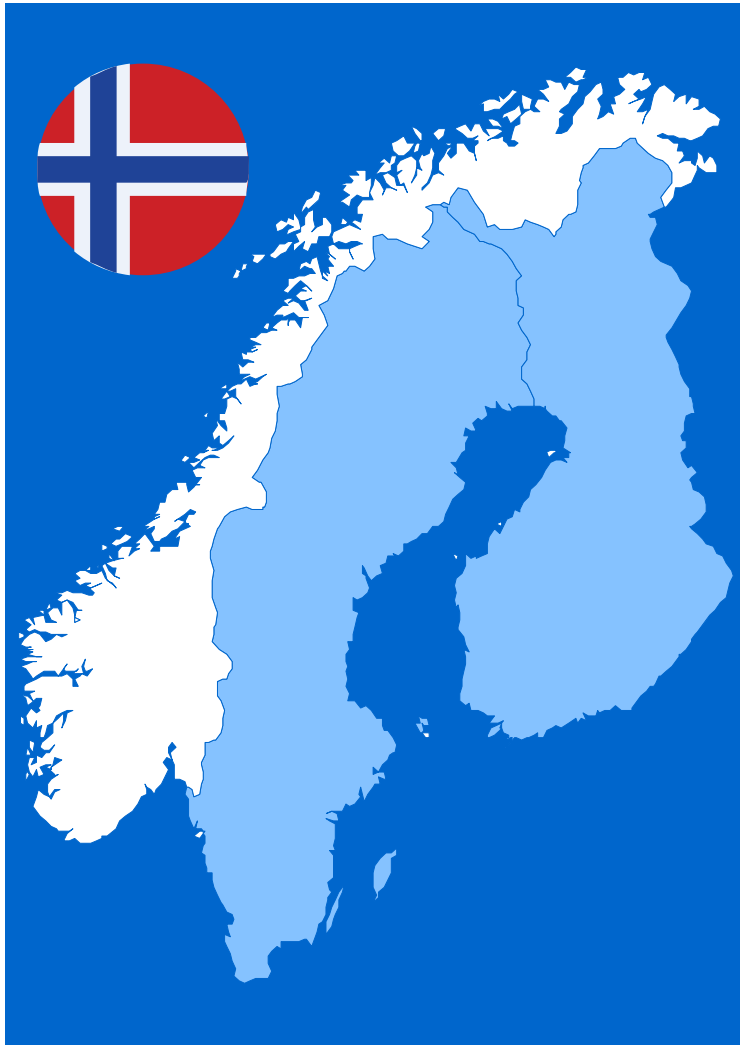


DAG JOSEFSEN
HEAD OF THE
SECTION OF
CELL THERAPY:

"The formation of a dedicated core facility for cell and gene therapy to tackle challenges in this rapidly developing field is a milestone for the Department of Cell Therapy and we are committed to make sure this unit can provide services at the international forefront."



Implementing precision cancer medicine in Norway via interconnected initiatives:



InPreD Norway:

National infrastructure for precision diagnostics

IMPRESS-Norway:

Improving public cancer care by implementing precision medicine in Norway

MATRIX:

Multimodal Approach Targeting treatment Rerefractory cancers using neXt generation technologies and trials

TRAIN:

Tumour Response Evaluation using Artificial Intelligence for Norway

INSIGHT / INCLUDE:

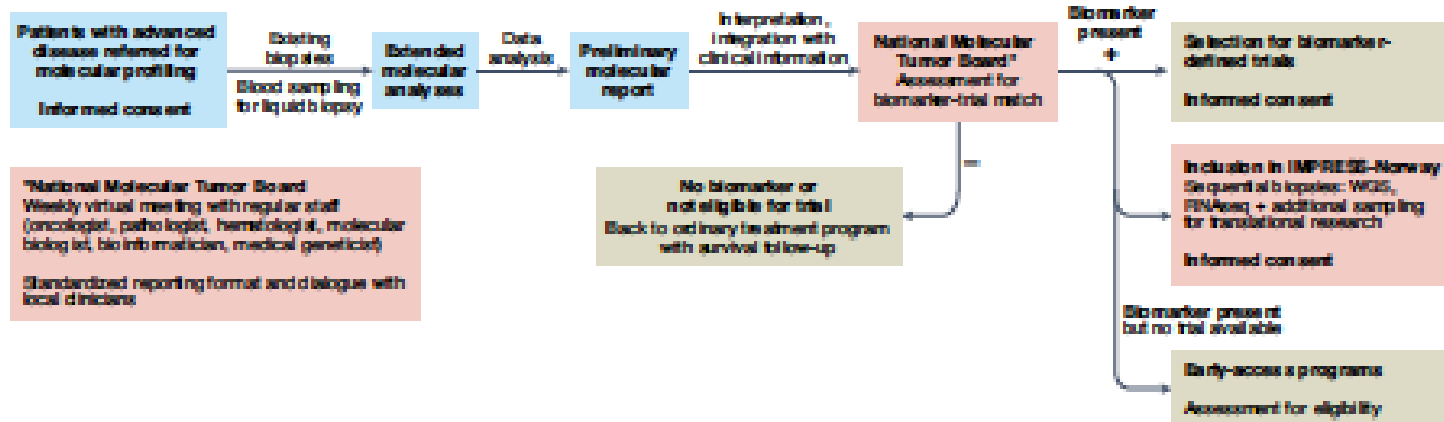
Sustainable implementation of precision cancer medicine

CONNECT Public-private partnership:

Norwegian Precision Cancer Medicine Implementation Consortium



A national precision cancer medicine implementation initiative for Norway



correspondence

Table 1 | CONNECT: a public-private partnership of stakeholders in precision cancer medicine

CONNECT working-groups interfacing

InPreD (WG1)	IMPRESS (WG2)	Innovative implementation methods (WG3)	Data governance, storage and sharing for secondary use and analysis (WG4)
InPreD national testing infrastructure	IMPRESS-Norway national PCM trial infrastructure	INSIGHT-INCLUDE: Impact of precision cancer medicine health economics and regulatory framework for implementation	INSIGHT-INCLUDE legal framework; InPreD ICT solution; IMPRESS aggregation of data in Europe

CONNECT is operationalized via working groups (WG1-WG4) that engage experts from the public and private sector: p ICT, information and communications technology; PCM, precision cancer medicine.

Kjetil Taskén^{1,2,3,4}, Hege E. G. Russnes^{2,4,5}, Eline Aas^{6,7}, Line Bjarne^{8,9}, Egil S. Blix^{10,11}, CONNECT Public-Private Partnership Consortium⁴, Espen Enerly¹², Gro L. Fagereng¹³, Åsmund Flobak^{14,15}, Bjørnar Gilje¹⁶, Bjørn T. Gjertsen^{15,16,17}, Tormod K. Guren¹⁸, Jutta Heix¹⁹, Eivind Hovig^{15,20,21}, Randi Hovland²², InPreD-Norway and National Molecular Tumor Board Consortium⁴, IMPRESS-Norway Consortium⁴, Per E. Lønning^{23,24}, Leonardo A. Meza-Zepeda^{25,26}, Per M. Mazhle²⁷, Hilde L. Nilsen^{28,29}, Steinar Ø. Thoresen^{30,31}, Ketil Widerberg³², Sigbjørn Smeland^{2,26} and Aslaug Helland^{33,34,35}

CONNECT Public-Private Partnership Consortium

Steinar Ø. Thoresen^{36,37}, Sigbjørn Smeland^{2,38}, Eline Aas³⁹, Terje C. Ahlquist⁴⁰, Nyosha Alkhanji⁴¹, Ali Arefat⁴², Eli Berg⁴³, Hege Edvardson⁴⁴, Gry Festarvoll⁴⁵, Åsmund Flobak^{46,47}, Grethe S. Foss⁴⁸, Pettar Foss⁴⁹, Bjørn T. Gjertsen^{50,51}, Ingvild Hagen⁵², Klara B. Hagen⁵³, Håvard H. Hauge⁵⁴, Bjørn V. Henriksen⁵⁵, Kristian Hveem^{56,57,58}, Elisabeth Jarnæs⁵⁹, Kristin Kittelsen⁶⁰, Kristin Krogsrud⁶¹, Monica Larsen⁶², Marlam Lotwander⁶³, Birgitte Lygren⁶⁴, Aslaug Muggenud⁶⁵, Cathrine S. Notland⁶⁶, Ole A. Oppdahl⁶⁷, Hege E. G. Russnes^{2,68}, Ravinder Singh⁶⁹, Svein Skalle⁷⁰, Fredrik Sund⁷¹, Lars P. Strand⁷², Kjetil Taskén^{1,73}, Lidziya Ulvenes⁷⁴, Gisla Ursin⁷⁵, Sverrir Valgardsson⁷⁶, Ketil Widerberg⁷⁷, Pål Witk⁷⁸, Naoko Yamagata⁷⁹ and Jutta Heix⁸⁰

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InPreD-Norway and National Molecular Tumor Board Consortium

Hege E. G. Russnes^{2,4}, Thomas Berg¹, Egil S. Blix¹⁰, Diana L. Bordin⁹, Hans-Rikard Brattbakk³, Richard Doughty¹⁰, Karl Erstad²¹, Åsmund Flobak^{14,15}, Rakeil Forthun¹⁶, Bjørnar Gilje¹⁶, Einar Gudlaugsson¹⁵, Hanne Hamre¹⁴, Hans Kristian Haugland^{20,21}, Eivind Hovig²², Randi Hovland²², Emiel Janssen^{34,35}, Mari Jøbens²⁷, Tonje Lian¹⁴, Susanne Lorenz²⁴, Torben Løders²⁶, Leonardo A. Meza-Zepeda^{25,26}, Per M. Mazhle²⁷, Pitt Niehusmann²⁸, Hilde L. Nilsen²⁸, John C. Noone²⁹, Vigdis Nygaard¹, Ulla Røden²³, Anne Rønne¹,

Anne J. Skjultveit³¹, Sigmund V. Sparstad³¹, Olav K. Vintarøy^{32,33}, Daniel Vodak³⁴, Teresia Wangersteen³⁵, Ragnhild M. Wold³⁶, Kristin Åberg³⁷ and Tormod K. Guren³⁸

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IMPRESS-Norway Consortium

Aslaug Helland^{33,34}, Hege E. G. Russnes^{2,4,5}, Gro Liva Fagereng¹³, Eline Aas^{6,7}, Khalid Al-Shibli⁸, Yvonne Andersson⁴⁰, Thomas Berg¹, Line Bjarne^{8,9}, Egil S. Blix^{10,11}, Bodil Bjørkhaugen¹, Sigmund Brabrand^{12,13}, Odd Terje Brustugun¹⁴, Marie G. Cameron¹⁵, Astrid Dalhaug¹⁶, Dalla Diezel¹⁷, Tom Dønne^{18,19}, Espen Enerly¹², Ragnhild S. Falk²⁰, Åsmund Flobak^{14,15}, Sverre Fluge²¹, Bjørnar Gilje¹⁶, Bjørn T. Gjertsen^{15,17}, Bjørn H. Grenberg^{14,15}, Karl Grenbe¹⁴, Tormod K. Guren³⁸, Hanne Hamre¹⁴, Åse Haug²², Daniel Heinrich²³, Geir Olav Hjortland²⁴, Eivind Hovig^{20,21}, Gunnar Houge²⁵, Randi Hovland²², Ann-Charlotta Ivarsen^{26,27}, Emiel Janssen^{34,35}, Slián Knappskog²⁸, Jon Amund Kyte²⁹, Hedda von der Lippe Gythfeldt³⁰, Kristina Lindemann³¹, Ragnhild A. Lothe^{32,33}, Jo-Åsmund Lund³⁴, Per Eystein Lønning^{23,24}, Leonardo Meza-Zepeda^{25,26}, Monica C. Munthe-Kaas²⁷, Olav T. D. Nguyen²⁸, Pitt Niehusmann²⁹, Hilde L. Nilsen²⁸, Katarina Pucco²⁹, Ulla Røden²³, Anne H. Roe^{23,24}, Tonje B. Røtø²⁵, Karin Semb²⁶, Eli Sihn S. Steinskog²⁷, Andreas Stensvold²⁸, Pål Suhrke²⁹, Øyvind Tenne³⁰, Geir E. Tjønnfjord³¹, Liv J. Vassbotn³², Sissel F. Wahl³³, Kjetil Taskén^{1,2} and Sigbjørn Smeland^{2,26}

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Author contributions
 K.T. wrote the manuscript and integrated edits from other authors. Important discussions and contributions to the initiatives described were made by all authors. All authors have approved the final version of the text.

Competing interests
 Participation in the CONNECT Public-Private Partnership is regulated by a consortium agreement that handles conflicts of interest and regulates interaction with the publicly funded infrastructure: InPreD-Norway and the investigator-initiated and publicly funded trial IMPRESS-Norway. IMPRESS-Norway (principal investigator A.H.) has company contributions from Roche, Novartis, Incyte and Eli Lilly and collaboration projects with Roche Foundation Medicine and Illumina, regulated by separate agreements with Oslo University Hospital as the coordinating institution. The authors declare no competing interests.

PROTOCOL

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Improving public cancer care by implementing precision medicine in Norway: IMPRESS-Norway

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Norwegian Centre for Clinical Cancer Research

***MATRIX: Multimodal Approach Targeting treatment
Refractory cancers using neXt generation
technologies and trials***



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JUTTA HEIX
ADVANCING THE ONCOLOGY INNOVATION ECOSYSTEM


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RESEARCH SCIENTIST: Following a compound from start to finish

CHIEF MEDICAL OFFICER: Accelerating clinical development

CHIEF STRATEGY OFFICER: Innovation in early drug development



discovery and development, she says. "I also worked as consultant for different pharma and biotech clients for a few years before I moved to Norway and joined the newly created Oslo Cancer Cluster team in 2008, at first in a consulting role. My role and my tasks are very varied and they have evolved a lot since I started."

Managing a broad project portfolio Jutta Heix develops and leverages the international network of OCC and its members, both when it comes to business development (scouting and innovation days for pharma companies and investors, dedicated events, partnering conferences and supporting individual member companies), and scientific and translational research (where the annual Cancer Crosslinks is one of OCC's flagship events).

She is also actively working with the Norwegian SPARK Academic Innovation Program led by Morten Egeberg, UiO: Lifescience, University of Oslo. Through the program, mentoring, involvement of industry experts, milestone-based funding and education to further develop ideas are provided.

"It is impressive to see how the SPARKees grow during the two-year project period. The program identifies promising academic innovation projects, accelerates and professionalizes the project development aiming to turn good ideas into great products benefitting patients and society. SPARK Norway has also inspired the University of Oslo to launch their new Life Science Growth House and changed the university's approach towards entrepreneurship, innovation and collaboration with external partners," says Jutta.

Since last year she has also been the project lead for the public-private Norwegian Precision Cancer Medicine Implementation Consortium (CONNECT), one of four national interconnected initiatives in precision cancer medicine (PCMs).

"Implementing precision treatment for cancer patients in a public healthcare system is a great opportunity to increase patient care and to use limited resources more effectively. However, this is an extremely complex endeavor and requires a coalition of resources, expertise and partnering that is beyond the capacity and resources of any single organization. CONNECT addresses this by providing an arena/initiatives for all stakeholders – university hospitals, regulators and payers, industry partners and patients via the Norwegian Cancer Society for a balanced and informed approach and debate," explains Jutta.

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Jutta Heix together with Sverre Thorsrud (left), Strategy Lead, Oslo Cancer Cluster, The Barnek and Berntsen, Henrik Sjøberg, Chairperson of the CONNECT Steering Committee and Sigrun Simonsen (right), Head of the Division of Cancer Medicine, Oslo University Hospital, Chairperson of the CONNECT Steering Committee.



CONNECT

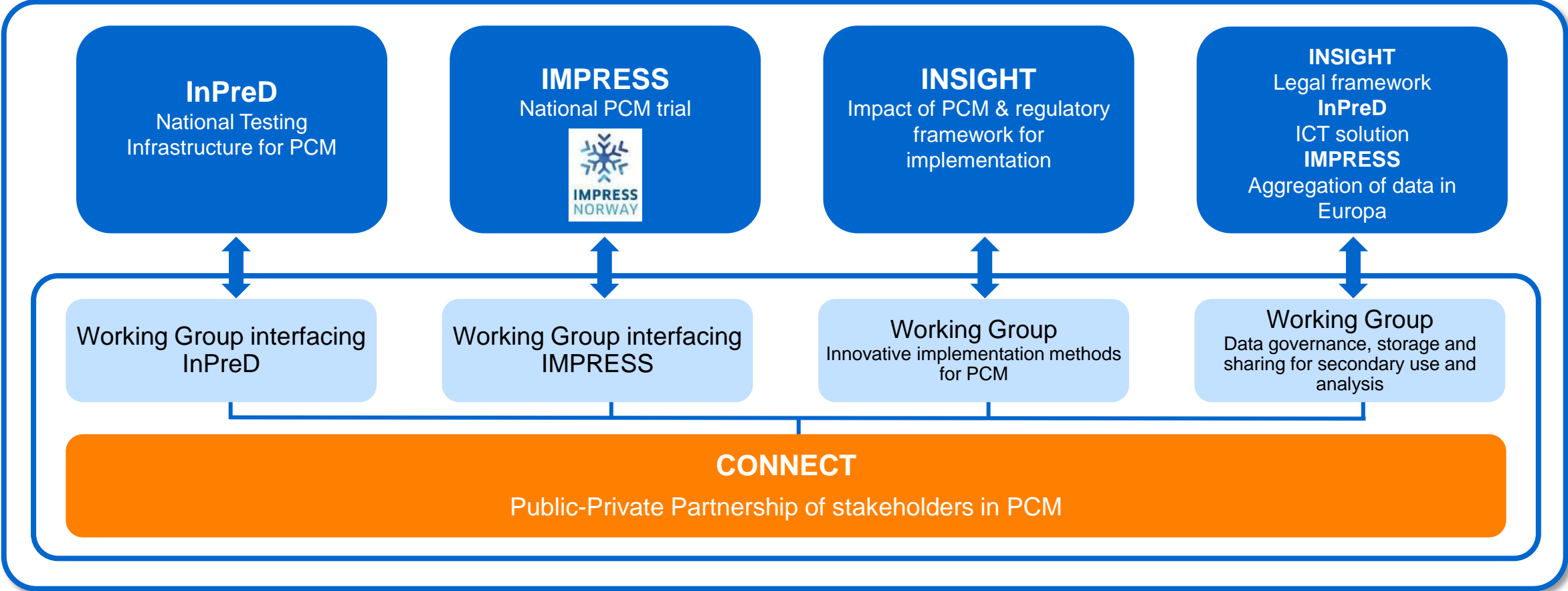
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Norwegian Cancer Precision Medicine Implementation Consortium

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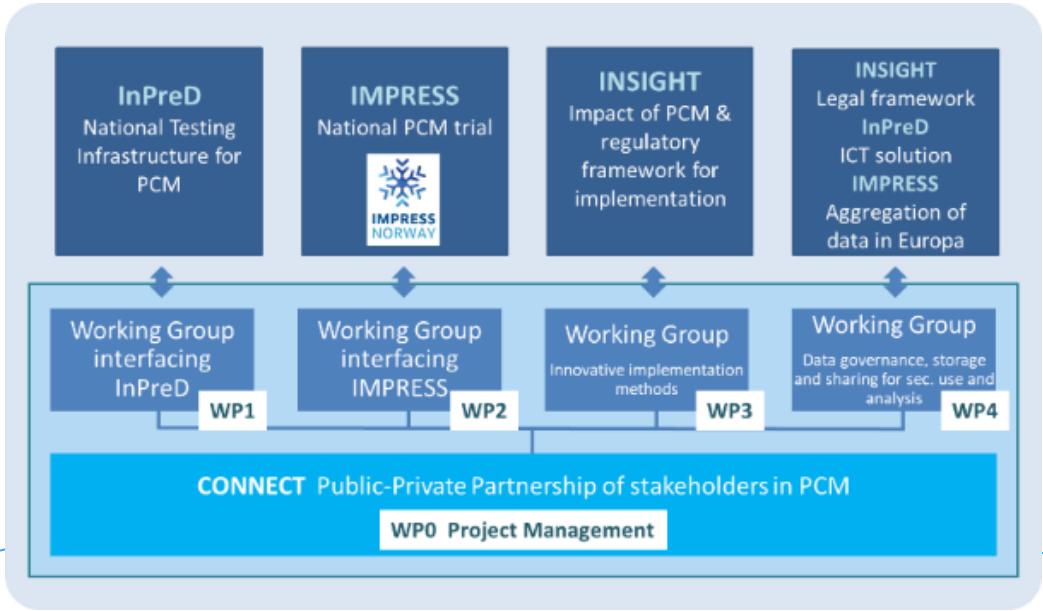


CONNECT is operationalised via working groups engaging experts from the public and private sector



Content courtesy of, and based on personal experience and observations of, Prof Kjetil Taskén.

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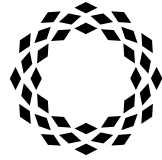
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