Digital technology and advanced analytics in Roche
Investor Relations Event May 2020
This presentation contains certain forward-looking statements. These forward-looking statements may be identified by words such as ‘believes’, ‘expects’, ‘anticipates’, ‘projects’, ‘intends’, ‘should’, ‘seeks’, ‘estimates’, ‘future’ or similar expressions or by discussion of, among other things, strategy, goals, plans or intentions. Various factors may cause actual results to differ materially in the future from those reflected in forward-looking statements contained in this presentation, among others:

1. pricing and product initiatives of competitors;
2. legislative and regulatory developments and economic conditions;
3. delay or inability in obtaining regulatory approvals or bringing products to market;
4. fluctuations in currency exchange rates and general financial market conditions;
5. uncertainties in the discovery, development or marketing of new products or new uses of existing products, including without limitation negative results of clinical trials or research projects, unexpected side-effects of pipeline or marketed products;
6. increased government pricing pressures;
7. interruptions in production;
8. loss of or inability to obtain adequate protection for intellectual property rights;
9. litigation;
10. loss of key executives or other employees; and
11. adverse publicity and news coverage.

Any statements regarding earnings per share growth is not a profit forecast and should not be interpreted to mean that Roche’s earnings or earnings per share for this year or any subsequent period will necessarily match or exceed the historical published earnings or earnings per share of Roche.

For marketed products discussed in this presentation, please see full prescribing information on our website www.roche.com

All mentioned trademarks are legally protected. All product names, trademarks and registered trademarks are property of their respective owners. All company, product and service names used are for identification purposes only.
Agenda

Welcome
- Karl Mahler, Head of Investor Relations

Digital technology and advanced analytics
- Alan Hippe; Chief Financial and IT Officer Roche

Digital endpoints and technology changing drug development
- Bryn Roberts; Global Head of Operations and Informatics, pRED

Healthcare data generating meaningful clinical insights in 2020 and beyond
- Mark Lee; Global Head for Personalized Healthcare, Product Development

Digital pathology and clinical decision support - tools to transform healthcare systems
- Mike Rivers; Lifecycle Leader, Digital Pathology, Roche Tissue Diagnostics

Information technology at Roche - underpinning our digital ambition
- Steve Guise; Global Head, Pharma Informatics

Q&A
Digital technology and advanced analytics

*Alan Hippe* Chief Financial and IT Officer Roche
Roche COVID-19 Response

FDA approved Elecsys Anti-SARS-CoV-2 serology test (3 May, 2020)

**cobas SARS-CoV-2 molecular test**

- FDA issued EUA for the cobas SARS-CoV-2 PCR test; test also available in markets accepting the CE mark

**Key initiatives:**
- Continuously increasing production capacity

**Elecsys® Anti-SARS-CoV-2 assay**

- FDA issued EUA for the serology test for detection of antibodies against SARS-CoV-2 (3 May, 2020)

**Key initiatives:**
- Ramp up to high double digit million tests per month by June

**Actemra in severe COVID-19 pneumonia (in collaboration with BARDA)**

- First-in-class interleukin-6 receptor antagonist
- Approved in >110 countries worldwide for rheumatoid arthritis

- Actemra (tocilizumab) targeted to reduce ICU admissions and/or improve ICU outcomes

**Key initiatives:**
- Randomized phase III (COVACTA) to show improved survival and outcome in severe COVID-19 pneumonia
- Increasing production capacity

---

EUA=emergency use authorization; BARDA=Biomedical Advanced Research and Development Authority; ICU=intensive care unit
Industry trends

Roche in Digital

Outlook: Building a digital culture across the organisation
Industry trends in Digital
*Increasingly impacting our core businesses*

### Product & Stakeholder Experience

<table>
<thead>
<tr>
<th>Increasingly consumerised healthcare</th>
<th>Patient outcomes easier to measure &amp; manage</th>
<th>Patients / citizens managing own health</th>
<th>Non-traditional players moving into healthcare</th>
<th>Next level of process optimisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Healthcare delivery complemented by digital solutions</td>
<td>• Healthcare delivery integrated across stakeholders</td>
<td>• Patients can access and control their health data</td>
<td>• New players collect data, build platforms, provide digital services</td>
<td>• Artificial intelligence and robotics improve internal processes</td>
</tr>
<tr>
<td>• Stakeholders engaging through digital channels</td>
<td>• Patient data collected &amp; acted upon in real time</td>
<td>• Personalised digital services empowered to take health decisions</td>
<td>• This reduces inefficiencies in healthcare system</td>
<td>• Result: higher quality, lower costs and faster speed to market</td>
</tr>
</tbody>
</table>
Increased investment in data

Emerging value of large scale healthcare data

Cumulative number of clinical decision support (CDS) companies

Substantial increase in big data driven investments

1 Based on the subset of companies screened and publicly available information; only includes companies still operating at time of screen
Industry trends

Roche in Digital

Outlook: Building a digital culture across the organisation
Today’s magnitude of Digital across Roche

*More than CHF 3bn annual spend in digital across the company*

---

**Significant M&A investment**

- World leading molecular insights business
- Fully acquired in 2015

**Flatiron**

- Healthcare technology and services company focused on accelerating cancer research and improving patient care
- Fully acquired in 2018

---

**Ongoing activities**

- 300+ key initiatives ongoing
- 3bn+ digital spend
- 30+ solutions on market

---

> 50 partnerships across data, analytics and digital supporting our continued focus on PHC over the last 3 years
Roche IT infrastructure and capabilities

**IT Performance (not only) in response to COVID-19**

<table>
<thead>
<tr>
<th>Connectivity</th>
<th>Working from Home (WfH)</th>
<th>New Employees</th>
<th>External Partners</th>
<th>Contact Center</th>
<th>Sourcing Balance</th>
<th>Manufacturing Blueprint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic investments in Roche’s connectivity</td>
<td>Strategic investment in Roche’s WfH</td>
<td>Different technologies to provide access to the Roche Core Network</td>
<td></td>
<td>Optimised and harmonized Contact Center Infrastructure</td>
<td>Investment into a balanced portfolio of internal and external resources, skills and services</td>
<td>Standard Manufacturing Blueprint, available for Pharma &amp; Diagnostics</td>
</tr>
<tr>
<td>1:1 to N:10000’s format meetings</td>
<td>All employees are able to connect from home</td>
<td>Effective on-boarding of new employees even w/o company device</td>
<td>Enabled external business partners to work from home</td>
<td>Agents to work from home, immediately, productively and securely</td>
<td>Provided flexibility and mitigation for vendor dependencies</td>
<td>Maintained high reliability and resiliency of our business critical services</td>
</tr>
</tbody>
</table>

**Increased Working from Home from 38K to 108K users**

**Increased remote collaboration by 375%**

**Maintained high reliability and resilience**
Roche IT infrastructure and capabilities

IT successfully passed stress test

Service Desk
Incidents Created

Remote Collaboration
Meet Participants

Non-VPN Apps
Cloudflare / WAF Connections

VPN Connectivity
Users
Industry trends

Roche in Digital

Outlook: Building a digital culture across the organisation
Outlook on Roche’s integrated strategy

Fitting treatments to patients
What Digitalisation means for Roche
Prerequisite to maintain and grow our core business

Leverage digital to enhance stakeholder experience

Differentiate core products with digital solutions

Optimise the internal value chain through digital
Current Digital highlights
Three examples

Augmented Products
Software as a medical device and digital biomarkers MS, ASD, HD, Parkinson's

- Continuous and longitudinal measurement

Stakeholder Experience
Digital go-to-market Model

- 360° customer view by assembling all customer interactions, content and data in a common platform

Internal Value Chain
Blood and Gas electrolyte sensors

- Program to replace manual sensor checks with a digital solution
- Image extraction and deep learning algorithm for quality control of sensors
- Improved monitoring results in higher yield and reduced manufacturing costs

MS=multiple sclerosis; ASD=autism spectrum disorder; HD= Huntington's disease
Finance: Shifting focus from data reporting to generating actionable insights

<table>
<thead>
<tr>
<th>End-to-end processes</th>
<th>Smart Analytics &amp; Insights</th>
<th>Cognitive automation/ Digital Board Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementing single data source &amp; process automation</td>
<td>Implementing smart analytics for improved resource planning, simulations, &amp; forecasting</td>
<td>Implementing AI tools for automatic processes and systems</td>
</tr>
<tr>
<td>• Implemented Shared Service Centers in Budapest, Sao Paulo, Kuala Lumpur, Puerto Rico</td>
<td>• Finance as active business partner to business</td>
<td>• Finance as integrated partner in all business processes</td>
</tr>
<tr>
<td>• Centralized Procurement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AI=artificial intelligence
Meaningful data at scale (MDAS)

Genomics

Real world data (RWD)

Novel measurements & endpoints

Digital pathology

Decision support

Consumer ecosystems

Positive business impact by digital technology and advanced analytics established
**Digital: Impacting our entire value chain**

17 use cases highlighting the depth & breadth of digitalisation

<table>
<thead>
<tr>
<th>Use Case</th>
<th>Early R&amp;D</th>
<th>Clinical Development</th>
<th>Registration</th>
<th>Access</th>
<th>Production &amp; Supply</th>
<th>Diagnosis</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genomics</td>
<td>10</td>
<td>5 10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real world data (RWD)</td>
<td>10 11</td>
<td>4 5 10 11</td>
<td>7</td>
<td>8 9</td>
<td>4 5 10 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novel measurements &amp; endpoints</td>
<td>11</td>
<td>1 2 3 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital pathology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 13</td>
<td></td>
</tr>
<tr>
<td>Decision support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14 15 16 17</td>
</tr>
<tr>
<td>Consumer ecosystems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Positive business impact by digital technology and advanced analytics established
Digital endpoints and technology changing drug development

*Bryn Roberts* | Global Head of Operations and Informatics, *pRED*
Pharma use cases 1-6

1. Digital biomarkers in Parkinson’s disease
2. Digital biomarkers in Huntington’s disease
3. Digital biomarkers in MS (floodlight)
4. Deep image analysis in ophthalmology
5. Risk score calculation in oncology (RoPro)
6. Exploring Digital therapeutics in SMA, ASD

Novel measurements & endpoints
Genomics
Real world data (RWD)
## Enabling drug development with a suit of digital tools

*Efficiency, effectiveness and enhanced patient and investigator experience*

<table>
<thead>
<tr>
<th>Patient-focused: engagement, recruitment, trial experience</th>
<th>Investigator-focused: engagement, efficiency, effectiveness</th>
<th>Novel measurement &amp; endpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ForPatients portal</strong></td>
<td><strong>Study &amp; Investigator Portals</strong></td>
<td>Digital biomarkers using sensors, wearables, mobile</td>
</tr>
<tr>
<td>Data Driven Recruitment</td>
<td>Investigator Engagement Platform</td>
<td>AI – machine and deep learning models</td>
</tr>
<tr>
<td>Patient Engagement App</td>
<td>Investigator Meeting App</td>
<td>Algorithms for endpoint measurement and prediction</td>
</tr>
<tr>
<td>eConsent</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>AiCure</em> medication compliance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

AI = artificial intelligence
Measurement & endpoints
Digital biomarkers - providing enhanced patient insights and novel endpoints

- Clinical trials utilizing **mobiles, wearables** and **gaming** devices
- More **sensitive, precise** and **objective**
- **Continuous** and **longitudinal** measurement captures episodic and rare events
- Reduced **assessment burden** and greater **real-world relevance**

- Multiple Sclerosis
- Parkinson’s Disease
- Huntington’s Disease
- Spinal Muscular Atrophy
- Autistic Spectrum Disorders
- Angelman’s Syndrome...
Digital biomarker active tests
Supporting clinical development programmes – e.g. Parkinson’s Disease

Voice recording  Balance test  Gait test  Dexterity test  Rest tremor test  Postural tremor test

Postural tremor power spectrum

Digital biomarker continuous passive monitoring
AI (deep learning) classification of activity & performance in daily tasks

Human Activity Recognition (HAR)

**Parkinson’s disease**

**Digital Biomarker**

**Continuous Passive Monitoring**

**AI (deep learning) classification of activity & performance in daily tasks**

**Inactive**

**Walking**

**Stairs**

**Non-gait activity (cycling)**

**Sit to Stand transitions**

**STS transitions per**

**AI=artificial intelligence**
Roche HD digital monitoring platform has been developed to assess disease progression in clinical trials

Patients with HD in the RG6042 global development programme receive a smartphone and smartwatch

- Patients first complete active tests using these tools in a teaching session in the clinic. The active tests are then done remotely at home and at follow-up clinical visits
- For passive monitoring, patients are asked to carry the devices with them as they go about their daily activities
- The sensor data are securely transferred via WiFi to Roche, where they are processed and analysed

EQ-5D-5L=EuroQol 5-dimension 5-level; HD= Huntington's disease; PROs=patient-reported outcomes; SDMT=Symbol Digit Modalities Test; SWR=Stroop Word Reading (Test)

Lipsmeier F, et al. J Neurol Neurosurg Psychiatry. 2018; 89(Supp 1):A61.2
The use of the remote digital monitoring platform has the potential to provide new insights into HD progression outside the traditional clinical trial setting.
Digital healthcare solutions

Digital solutions offer us the opportunity to develop integrated personalised healthcare solutions around and beyond the medicine.

**Around**

*Optimising the Medicine*
- Treatment selection and management, e.g. earlier access, dose optimization
- Automation of delivery
- Patient empowerment, e.g. monitoring & reporting

**Beyond**

*Augmenting the Medicine*
- Skills development
- Cognitive behavioral therapy
- Disease management services
- Prognostics & prevention
- Human augmentation, e.g. implants, human-computer interfaces (AR, VR), robotic augmentation

Driven by evidence-based, differentiated medical value.

AR=augmented reality; VR=virtual reality
Floodlight MS

Shifting clinical practice towards objective and frequent measurements of multiple sclerosis in-between clinic visits

The first generation of Floodlight MS consists of five tests intended to measure motor and cognitive function:\n
1. Measure function
2. Measure disease progression
3. Predict disease progression

Floodlight MS will evolve in three generations, backed by ongoing clinical evidence:

1. Measure function
2. Measure disease progression
3. Predict disease progression

---

1 Intended for patients 18 years of age and older with neurological disease, such as multiple sclerosis. The patient is not intended to take action on the device output without consultation of a qualified healthcare professional. The HCP is solely responsible for interpreting the results; 2MWT=2 minute walk test.
Predictive algorithms

Applying machine and deep learning (AI) in multiple disease areas

Response to anti-VEGF treatment in patients with nAMD

nAMD=neovascular age-related macular degeneration; SD-OCT=spectral-domain optical coherence tomography; ARVO, April 2019

Progression of diabetic retinopathy

Arcadu F et al. NPJ Digit Med 2019;2:92

RoPro was generated by applying machine learning to data from 110,000 patients across 15 cancer indications

RoPro calculates a risk score1 that has a number of potential applications in drug development and clinical practice

RoPro shows better separation of survival curves compared to RMHS HR 4.66 (95% CI 4.56-4.77 vs HR 2.22 (2.15-2.28)

AI=artificial intelligence

RoPro = Roche Prognostic Score; RMHS = Royal Marsden Hospital Score;1 Rüttinger D Presentation at AACR, Atlanta, April 1, 2019. [patent application pending]
Digital healthcare solutions

Digital solutions offer us the opportunity to develop integrated personalised healthcare solutions around and beyond the medicine.

**Around**

Optimising the Medicine
- Treatment selection and management, e.g. earlier access, dose optimization
- Automation of delivery
- Patient empowerment, e.g. monitoring & reporting

**Beyond**

Augmenting the Medicine
- Skills development
- Cognitive behavioral therapy
- Disease management services
- Prognostics & prevention
- Human augmentation, e.g. implants, human-computer interfaces (AR, VR), robotic augmentation

Driven by evidence-based, differentiated medical value

AR=augmented reality; VR=virtual reality
Digital therapeutics
Exploring exergaming as a potential therapeutic adjunct in diseases such as SMA or ASD

- Appropriately designed ‘games’ have the potential to develop physical and cognitive skills, enable physical therapy at home, etc.

- Roche is exploring solutions with the potential to offer meaningful benefit, demonstrated through robust clinical evidence

- Signed development and commercialization agreement to create a digital therapeutics (DTx) platform for autism and other digital health products with HARMAN

SMA = spinal muscular atrophy; ASD = autistic spectrum disorder
Healthcare data generating meaningful clinical insights in 2020 and beyond

Mark Lee | SVP and Head of Personalised Healthcare, Product Development
Pharma use cases 7-11

- RWD for regulatory interactions: Rozlytrek in ROS1+ NSCLC
- RWD for access: Perjeta in early-stage BC
- RWD for post-marketing safety: Kadcyla in mBC
- Clinico-Genomic data (Flatiron/FMI)
- Automated analysis of medical imaging data to enhance RWD
Utility of RWD: Data scale, depth, and quality are critical

Flatiron Health electronic health record (HER)-derived de-identified database

- 2.15m active patients
- 2500 clinicians
- 280 cancer clinics
- 800 sites of care

Rigorously curated, integrated, structured and unstructured data ¹

- 78% Sensitivity
  - Structured EMR
  - Commercial Source (Early 2016)
- 87% Sensitivity
  - Unstructured EMR
  - Nov 2016
- 91% Sensitivity
  - Propensity-score modeling
  - SSDF Linkage
  - Revised commercial link (Jun 2017)

Propensity-score modeling replicates control arms from randomized clinical trials

- Validated for high sensitivity to mortality clinical endpoint
- Example: Tecentriq in NSCLC (OAK)
- 8 other NSCLC randomized clinical trials modelled ³

100+ applications active across R&D, access, and regulatory with RWD from Flatiron and other sources

---

¹ Based on Jan 10

³ 35
Rozlytrek in ROS1+ NSCLC
Accelerated filing and launch based on RWD

Due to rarity of ROS1+ NSCLC, a placebo controlled trial of Rozlytrek (entrectinib) versus crizotinib was not feasible.

Comparative RWD enabled early submissions to EMA and the Japanese Health Authority; included in US dossier.

Enabled approval in Japan (1st in world for Rozlytrek).

Robert C. Doebele, et al. Time-to-treatment discontinuation and real-world progression-free survival as endpoints for comparative efficacy analysis between entrectinib trial and crizotinib real-world ROS1 fusion-positive NSCLC patients. 2019; RWD=real world data; TTD=time to treatment discontinuation; ISE=integrated summary of efficacy across 3 single-arm, open-label studies of entrectinib; OS=overall survival.
Perjeta in early-stage BC
Supporting reimbursement decision based on RWD

- Understanding of real-world Perjeta treatment duration and cost in 1L mBC was used to contextualize value of Perjeta treatment benefit in early-stage BC
- Datasets derived from Flatiron enabled largest-ever RWD study of Perjeta use, demonstrating extended duration of treatment in 1L mBC in standard of care
- Helped address questions from German HTA, resulting in support for reimbursement for Perjeta in early-stage BC in April 2019

Benefit: Additional NPV of CHF 25mn for Germany

RWD=real world data; mBC=metastatic breast cancer; HTA=health technology assessment; NPV=net present value
Kadcyla in mBC
RWD study of cardiac events to fulfill post-marketing commitment

- Post-marketing commitment to evaluate Kadcyla cardiac risk in HER2+ mBC patients with low LVEF (40-49%)
- Flatiron RWD enabled analysis of largest cohort of Kadcyla-treated patients with low LVEF
- With only a small number of patients experiencing an LVEF drop of >10% and/or CHF; deemed not an unacceptable cardiac risk for patients with low LVEF
- CHMP supported label update based on this RWD study

Note: The events identified prior to index date are not to time scale. If a patient died within the 84 days following last administration the treatment was considered discontinued. Patients are sorted by duration of follow-up.

Thibaut Sanglier, et al. Cardiac events in patients with HER2-positive metastatic breast cancer who have low left ventricular ejection fraction prior to initiating treatment with ado-trastuzumab emtansine: A retrospective cohort study using EHR data. 2019 SABCS; mBC=metastatic breast cancer; LVEF=left ventricular ejection fraction; CHF=congestive heart failure; RWD=real world data; CHMP=The Committee for Medicinal Products for Human Use
Clinico-Genomic Database

Addition of genomics increases depth and impact of RWD

- Understanding the genomics of rapidly progressive disease
- Natural history cohorts for molecularly defined populations (ALK, NTRK, EGFR, ROS-1, RET, KRAS, etc.), including patterns of metastatic spread
- Mechanisms of resistance
- Improved prognostic classifiers
- Higher resolution representation of patients for downstream analysis, including external controls
Clinico-Genomic Database

**Scientific hypothesis generation feeds back into early R&D**

<table>
<thead>
<tr>
<th>Recent use cases gRED</th>
<th>Recent use cases pRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Analysis of the clinico-genomic data base (CGDB) provided insight and further evidence for team to take a <strong>pan tumor approach</strong></td>
<td>• Analysis of CGDB contributed to a decision to bring a target into the portfolio based on <strong>increased understanding of current treatment outcomes of mutated vs non-mutated</strong> patient populations</td>
</tr>
<tr>
<td>• Analysis of CGDB found cumulative <strong>incidence of brain metastases in patients with a certain mutation</strong> is significantly higher than patients with the wild-type allele or other mutations; Partly based on CGDB results the decision was taken to develop a brain-penetrant molecule as part of the broader development strategy</td>
<td>• Analysis of CGDB used to decipher a <strong>molecular mechanism for checkpoint inhibitor resistance</strong> and ultimately helped address a fundamental question that can potentially benefit many cancer immunotherapy projects</td>
</tr>
</tbody>
</table>

**Linking advanced tumor genetics with clinical outcomes drives scientific hypothesis generation**

gRED=Genentech early research and development; pRED=Roche early research and development
Prospective Clinico-Genomic Platform
Novel EHR-enabled, scalable, prospective, longitudinal, multi-modal data- and bio-repository

**PCG Platform**

- Leverages FMI tissue and liquid genomics capability + Flatiron RWD platform
- By eliminating case report forms, expands clinical research access to more patients and investigators
- Program launched in December 2019, target enrollment 1000 metastatic lung cancer patients
- Understanding the genomics of rapidly progressive disease

**Study Design**

- **Active Phase**
  - At enrollment
  - Treatment: 1st tumor scan (± 14 days)
  - Progression or end of treatment (± 30 days)

- **Passive Phase**
  - Until withdrawal of consent, loss to follow-up, death, or the end of study

**Data Repositories**

- **Clinical histories**
  - Flatiron OncoEMR

- **Genomic data**
  - Tissue optional (tissue/ctDNA) + ctDNA

- **Digital pathology**
  - Flatiron

- **Clinical Imaging**
  - Flatiron

- **Bio-banking**

**EHR**=electronic health record; **FMI**=Foundation Medicine; **RWD**=real world data; **ctDNA**=circulating tumor DNA
Next-generation RWD

Automated analysis of medical imaging data to enhance RWD

The approach

• An automated FDG-PET segmentation method was devised using a deep learning model
• Model trained on radiology reads that served as ‘ground truth’

The promise

• Automated analysis appears to outperform radiologist-to-radiologist agreement (~80%) for tumor volume
• Potentially more reproducible, quantitative assessment of response and progression
• Application to real-world imaging data would enhance reliability of real-world clinical endpoints

Whole-body FDG-PET/CT fused coronal images from three different patient scans

Summary of whole body results

<table>
<thead>
<tr>
<th>Clinical trial data</th>
<th>Scans (n)</th>
<th>Dice score</th>
<th>Sensitivity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLBCL (training)</td>
<td>2266</td>
<td>0.895</td>
<td>93.2</td>
</tr>
<tr>
<td>Follicular lymphoma (test)</td>
<td>1124</td>
<td>0.886</td>
<td>92.6</td>
</tr>
<tr>
<td>NSCLC (test)*</td>
<td>274</td>
<td>–</td>
<td>93.0</td>
</tr>
</tbody>
</table>

*Only a partial ‘ground truth’ is available for the NSCLC data set, so only sensitivity analyses are reported; CT=computed tomography; DLBCL=diffuse large B-cell lymphoma; FDG-PET=fluorodeoxyglucose-positron emission tomography; NSCLC=non-small-cell lung cancer

The Roche Advanced Analytics Network (RAAN)

Leveraging the scale and diversity of our scientific community

**Events and trainings**
- RAAN conferences, AA trainings, self-study groups, academic seminars

**Data challenges**
- Annual Roche-wide challenge plus regular masters & community challenges

**Advisory group**
- Team of more than 35 experts providing expert consultation & white papers

**Academic collaborations & interns**
- Executing 5 RAAN capstones and ~30 AA internships throughout the organisation

**Technology**
- Sharing infrastructure and tools for advanced analytics

**Individuals and teams** to grow their Advanced Analytics (AA) expertise through collaboration

**Departments and functions** across Roche Diagnostics and Pharma to solve questions with Advanced Analytics

**The whole Roche organisation** to embed Advanced Analytics

RAAN has now >1300 members at 40 Roche sites

AA=advanced analytics
RAAN Data Challenges
“Crowdsourcing” science for insights from Roche data assets

Challenge
Use Advanced Analytics to develop a prediction model to identify IL NSCLC patients who are most likely to respond to Tecentriq treatment versus standard of care.

The data
- **The training data set**
  - 10 curated clinical trials
  - ~5000 patients
- **Test data set**
  - 1 clinical trial
  - ~1000 patients

517 participants 141 teams 38 Roche sites

NSCLC=non-small-cell lung cancer
Digital pathology and clinical decision support - tools to transform healthcare systems

Mike Rivers | Lifecycle Leader, Digital Pathology, Roche Tissue Diagnostics
Dia use cases*12-17

Early R&D → Clinical Development → Registration → Access → Production & Supply → Diagnosis → Treatment

NAVIFY®
- Digital pathology
- Decision support
- Consumer ecosystems

Digital Pathology
- DP200/600 slide scanners
- NAVIFY Digital Pathology
- Roche image analysis App PD-L1 (SP263) lung
- NAVIFY Mutation Profiler
- NAVIFY Tumor Board

Decision Support
- Roche image analysis App Her2 Dual ISH, breast

* Non-exhaustive
Workflow of Future Pathology Lab

Superior clinical lab workflow enhanced by multiplex IHC* with NAVIFY Digital Pathology and Tumor Board solution

- Patient specimen arrives for analysis
- Whole slide scanning (BF**, FL**)  
  Automated multiplex IHC staining
- Spatial characterisation of tumor micro-environment  
  Automatic whole slide image analysis with NAVIFY Digital Pathology
- Result interpretation “cold” vs. “hot tumor” with TILs**  
  NAVIFY portfolio and platform of decision support solutions
- Diagnostic and/or treatment decision

* IHC = Immunohistochemistry
** BF = brightfield; FL = fluorescent; TILs = tumor-infiltrating lymphocytes
Roche Digital Pathology Portfolio

Establishing a platform ecosystem and controlling the pathologist interface is key to our long-term success

Scanning

Roche DP 200 and DP 600* Slide Scanners

Interoperable with DICOM images and other open formats from third party scanners

Pathologist Interface

NAVIFY Digital Pathology platform manages the full pathologist workflow

Image Analysis

Roche Image Analysis Apps
PD-L1 (SP263) lung, Her2 Dual ISH, Her2, Ki-67*, ER*, PR*

Open API to support third party image analysis algorithms

In development
ISH=In situ hybridization; ER=estrogen receptor; PR=progesterone receptor
For the NAVIFY® Digital Pathology demonstration please click on the link below

https://www.roche.com/dam/jcr:28f7fe67-3ed6-4d70-b7c0-78ac86511d50/combined-video.mp4
Personalized Oncology
Bridging precision diagnostics, and personalized patient management

An ecosystem of digital value

CDS\(^1\) Apps
- Image analysis
  (PD-L1, Breast Panel\(^*\), HER2 DISH, MPx\(^2\))
- Therapy matching
- Clinical trial matching
- Clinical guidelines\(^*\)
- Patient pooling\(^*\)

Precision clinical diagnostics

NAVIFY\(^{®}\) Digital Pathology
NAVIFY\(^{®}\) Mutation Profiler

17

Personalized clinical management

NAVIFY\(^{®}\) Tumor Board

Continuous learning as systems become more integrated

\(^1\) CDS – Clinical Decision Support  \(^2\) MPx – Multiplex  \(^*\) In Development
NAVIFY is a trademark of Roche; DISH= dual in situ hybridization
Information technology at Roche - underpinning our digital ambition

Steve Guise | Global Head, Pharma Informatics
Go-to-market Model

Roche Capabilities

Roche Response to COVID-19
Digital Strategic Priorities have been identified on top of Digitalisation initiatives across all areas of business.

**Digital Strategic Priorities 2030**

*Pharma: Differentiating innovative medicines*

### Differentiation options in Pharma industry

<table>
<thead>
<tr>
<th>Faster and more successful drug discovery and development</th>
<th>Better treatment effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addressing ever smaller patient populations</td>
<td>Addressing evolving customer and patient expectations</td>
</tr>
</tbody>
</table>

### Digital Strategic Priorities 2030

1. Industry-leading R&D effectiveness
2. Medicine augmentation
3. Mass-customised manufacturing & supply chain
4. Go-to-market model

Digital Strategic Priorities have been identified on top of Digitalisation initiatives across all areas of business.
## Go-to-market Model

### Shift in the market

<table>
<thead>
<tr>
<th>Engagement</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Mass field&quot; largely in-person</td>
<td>More targeted and often virtual</td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td>Static information</td>
<td>Personalised, digital content and services</td>
</tr>
<tr>
<td>Content release</td>
<td>Synchronised with field force cycles</td>
<td>Continuous and real-time</td>
</tr>
<tr>
<td>Customer targeting</td>
<td>Decided by sales representatives</td>
<td>Supported by advanced analytics</td>
</tr>
<tr>
<td>Conference</td>
<td>Physical attendance</td>
<td>Virtual and real-time exchange</td>
</tr>
</tbody>
</table>
Go-to-market Model
**Personalise stakeholder interactions**

### Needs

- Digital, personalised and real-time interactions and information expected

- Patient populations smaller and globally connected, e.g., communities for rare diseases

- Further stakeholders besides clinicians involved in decision making, e.g., patients, payers

### Elements of personalised go-to-market model

- **Globally consistent, real-time digital content**
- **Stakeholder engagement via digital channels**
- **Personalised marketing** *(segments of one)*
- **Significantly lower cost** per stakeholder touchpoint
Increasingly automated, enriched and objective...

1. Increasingly automated, enriched and objective...
   - Descriptive Analytics
     - What happened and why? Explaining the past

2. Increased use of advanced analytics that deliver actionable insights, namely...
   - Predictive Analytics
     - What might happen? Predicting the future
   - Prescriptive Analytics
     - What should we do? Delivering intelligent recommendations
Go-to-market Model
Technology and infrastructure investments

Benefits

- Make our customer interactions as meaningful as our science
- Deliver efficiency gains and enable a cost effective go-to-market approach for rare diseases and small products
- Bring globally consistent content and messaging to our stakeholders

HCO=health care organization; HCP=health care professional
Go-to-market Model

Roche Capabilities

Roche Response to COVID-19
Roche Capabilities

People, technology and information

"Few people straight out of undergrad have the opportunity to dive head first into machine learning. Our work is at the cutting edge of computer science and biotechnology. I love knowing that I am making a positive impact in the company and also in the people we help with our technology."

Jordan L. Meck
Software Engineer

"We have a Mission and we live it by using technology to help people. PHC is real and happening right here. We are using cutting edge technologies to solve problems that impact patients’ lives - we choose the tech stack that we need now which makes us just as fast as a startup."

Maurice Carmon
Senior Software Engineer

"Pharma is the next big data driver – we produce more data in a day than Facebook."

Jason Hitzen
Senior Data Engineer

Senior Data Engineer
Roche Capabilities

*Digital investment ensures we are attractive for the next generation of tech and data science talents*

**Dedicated site for data science an IT recruitment**

- Enable Roche to attract, recruit & retain tech talent by leveraging digital solutions to convey targeted messages and visuals, which differentiate Roche as the employer of choice and ultimately convert the right tech people into candidates and employees at Roche.

**State of the Art events engaging with digital healthcare community**

- Connect key innovation drivers in healthcare for an open and inspiring exchange of ideas, insights and solutions – including science, industry, VCs, start-ups, payers and policy makers.

VC=venture capital
Roche Capabilities — Roche Science Infrastructure (RSI)
Modernising scientific data and compute capabilities

Roche Science Infrastructure is a dedicated science IT infrastructure and services to enhance the company’s scientific capabilities and enable Personalized Healthcare (PHC)
Go-to-market Model

Roche Capabilities

Roche Response to COVID-19
Roche IT Infrastructure and Capabilities

**IT Performance in response to COVID-19**

### Service Desk
- Incidents Created
  - Increase by 79% of incidents created for 1st line of support. Slight increase this week

### Onsite Requests
- Tasks Created
  - Increase by 28% of request tasks handled by onsite teams. Slight increase this week

### Remote Collaboration
- Meeting Duration (Hours)
  - Increase by 200% of virtual meetings, strong Zoom increase.

### Remote Collaboration
- Meet Participants
  - Increase by 375% of Meet Participants, strong increase this week

### Non-VPN Apps
- Cloudflare / WAF enabled Apps
  - Enabled 72 additional enterprise systems to be available outside Roche network

### Non-VPN Apps
- Cloudflare / WAF Connections
  - Increase to 1300% of users accessing Roche systems via Cloudflare. Strong increase this week

### VPN Connectivity
- Users
  - Increase by 59% of users accessing Roche systems via Pulse Secure. Slight increase this week

### Training & IT Recommendations
- Page hits on IT-Recommendations since Feb 16: 22400
- Virtual COVID-19 related Trainings since March 16: 81
- Users attended the Trainings: 5165
Roche Response to COVID-19
Roche Italy social responsibility story

Problem
- Reached the peak of 25,000 - 35,000 calls per day
- Call Center of 1st Level - 120 agents
- 50% of calls were lost
- Call Center of 2nd Level - 80 doctors

Analysis
- Call with Ministry of Health about COVID Emergency Call Centre
- Call with an internal Infrastructure Team

Solution identification
- Servers, platform, software licences delivered in 1 weekend
- CPUs and memory doubled in the virtual environment

Launch
- 250 volunteers from Pharma (mainly), Diagnostics and Diabetes
- Complete readiness of the infrastructure and volunteers in 2 weeks

Maintenance
- Volunteers serve 2 shifts (9:00-13:00, 13:00-17:00), 5 days per week
- Cover 30% of all national 1st level calls
- Give daily updates to the Ministry of Health
Digitalisation for Roche
Prerequisite to maintain and grow our core business

Leverage digital to enhance stakeholder experience

Differentiate core products with digital solutions

Optimise the internal value chain through digital
Q&A
Doing now what patients need next