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Laying the Foundation for a Digital Health Cluster in Cologne-Bonn

Executive Summary

COLOGNE, FEBRUARY 2019

Executive summary: Strengthening a digital health Cluster in Cologne-Bonn

Digital health context

Digital health has huge growth potential with countless applications, but is only at the beginning of its prime for various reasons

- Digital health has experienced limited impact to date due to regulatory hurdles, data fragmentation, data privacy concerns and the complex stakeholder ecosystem

However, digital health is expected to gain significant momentum in the next few years and already surpassed $6B investment in 2016

- This is also evident as large tech companies such as Apple, Google, Microsoft, Amazon and IBM actively invest into this space

Ecosyst. assessment and best-in-class

Cologne-Bonn can build the foundation for a digital health ecosystem based on one of the largest patient catchment areas (>6+M inhabitants) with an excellent provider network (57 hospitals and ~17K beds) including well-reputed university hospitals

- Cologne will need to play its individual strengths, combining a mix of small industry cluster as well as metropole characteristics
- Comparison to best-in-class digital health clusters crystalizes that smaller clusters (e.g., Medicon Valley and Medical Valley) are mainly fueled by the initiatives of large healthcare industry players (e.g., Novo Nordisk, Siemens), who invest into building their ecosystem
- On the contrary, large metropoles attract funding and tech talent to create digital health as a "byproduct" of the overall activity

Potential technology/ research sweet spots

Internationally, Silicon Valley is *THE* digital health powerhouse, while European investment activities in digital health are moderate

- Digital health investment mainly located in large metropoles, typically as "byproduct" of tech clusters
- Data/analytics-driven digital health topics are receiving the most investment in recent years (median investment range of $3-10M)

From a long-list of 20 digital health clusters, the report identifies several potential focus technologies and playing fields

- Identified fields: Precision Medicine & Bioinformatics, Telehealth & Telemedicine, AI & Adv. Analytics, Health Monitoring & Patient Engagement, Data Mgmt. software & Cloud solutions, and AR/VR

Cross-check with Cologne-Bonn's strongest medical research fields indicates an excellent starting position linking to digital health

- Identified hot topics: Oncology, Hematology, Genetics, Neurology and Ophthalmology

Recommendations

To lay the foundation for a successful digital health cluster, Cologne-Bonn should leverage its strengths based on the patient catchment area and a strong provider network besides some typical "must-have" requirements

- This study identifies 12 measures to establish a solid ground to build a digital health cluster clustered along quick-wins, mid-term enablers and long-term ecosystem needs
- An essential starting point is to promote a successful "champion" start-up that has leveraged Cologne's strengths to become a lighthouse project

Context and Objectives

Context

The city of Cologne defined the **“Health and Life Sciences market” as one of seven key sectors for development** in its “Perspective 2030”—second largest market by number of employees for Cologne (~68,000)

The **healthcare region Cologne-Bonn**[1] covers one of the largest **catchment areas** (>6M inhabitants) compared to other urban regions combined with a **strong network of healthcare providers—**57 hospitals, ~17,000 beds and ~686K inpatient care cases within 35km radius (2016)

With more than 650 start-ups, 25 centers, ~9,000 employees and ~€1B revenues, **Cologne is also already home to a respectable start-up scene** and has also brought out several digital health ventures in the last years

Objectives

Identify **typical success factors for digital health clusters** based on international best-in-class examples

Derive **potential white & sweet spots** for Cologne-Bonn that could become a focus area of a digital health cluster

Define **tangible strategic measures** required for the **healthcare region Cologne-Bonn** to evolve the into a digital health cluster

1. Primary geographic focus of the study is the healthcare region Cologne-Bonn

Huge reach of digital technologies today—and spreading ever more quickly

“Digital health” consists of two parts

Prevention → Diagnosis → Treatment and patient care → Health surveillance and monitoring

Electronic use of information along the patient pathway

+

Leveraging a novel digital technology

Equipment and device-heavy digital health	Data, analytics and software
Robotics	Advanced analytics
3D printing	Artificial Intelligence
Augmented reality	Block chain
Social, local, mobile	Cloud computing
Internet of things	Digital platforms
…	…

Large tech companies are actively investing in and targeting health care

Most have employed a partnership model owing to the complexity of the healthcare landscape

Alphabet Google | Microsoft | amazon.com | IBM

Apple

Launching Personal Health records in iOS

Integrating third party apps/devices

HealthKit

Clinical research platform

ResearchKit

Alphabet / Google

Study Watch, diabetes partnerships and more

verily

AI for healthcare—scan interpretation

DeepMind

Calico—drug development for longevity

Microsoft

Platform to store PHI and generate insights

Microsoft HealthVault

Partner w. Cigna to screen BP, BMI, glucose, and chol.

CIGNA BIOBALL

Partnering with Aurora for AI Health chatbot

Aurora Health Care

amazon.com

Redefining of US Health Care with JPM and BH

Berkshire Hathaway J.P.Morgan

AI voice recognition—more user-centric ways of accessing med info

amazon alexa

HIPAA compliant cloud services for Health Care

aws

IBM

Cognitive computing, e.g., Watson for Oncology or Watson for Drug Discovery

IBM Watson

Cloud computing for data integration in personalized care

1. As of June 15, 2017

Huge in-flow
of funds in digital,
data and analytics
in health care
Though none have
scaled to date

Source: CB Insights, StartUp Health

Key takeaways from technology heatmapping

Geographic investment distribution

Silicon Valley is the absolute digital health powerhouse with 2× the total historic investment volume ($5.8B) of 2nd-placed New York

New York, Beijing & San Diego are all above $1.B investment—especially Beijing is catching up very fast with 124.7% investment CAGR (2014–2017)

Technology clusters

Historic investment strongest in

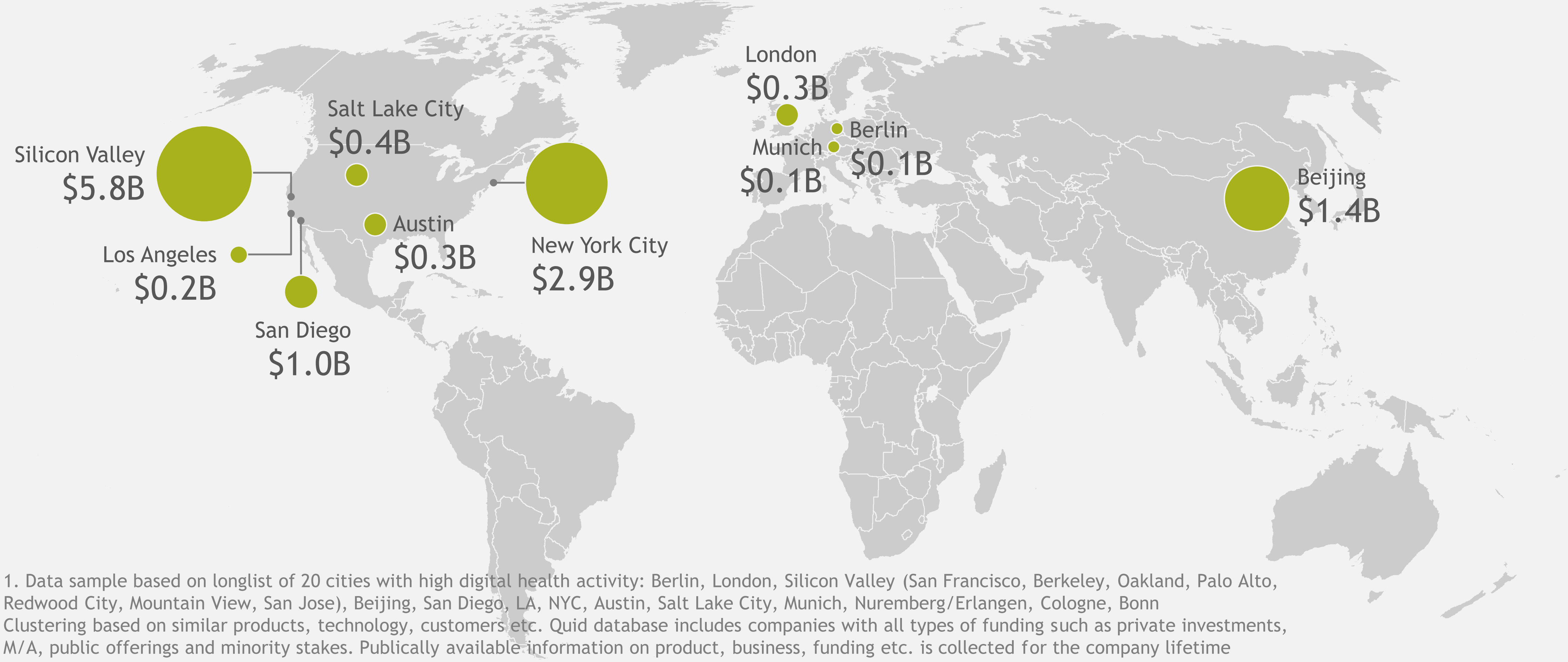
- Online Health Services ($2.2B—purely due to WebMD investment)
- Data Management, Software/Cloud Solutions ($1.6B)
- Digital Clinical Trials & Big Data ($1.2B—mainly due to Verily Life Sciences)

Trending hot topics

In the last 5 years, data/analytics-driven digital health topics received by far the most investment both in total and on average

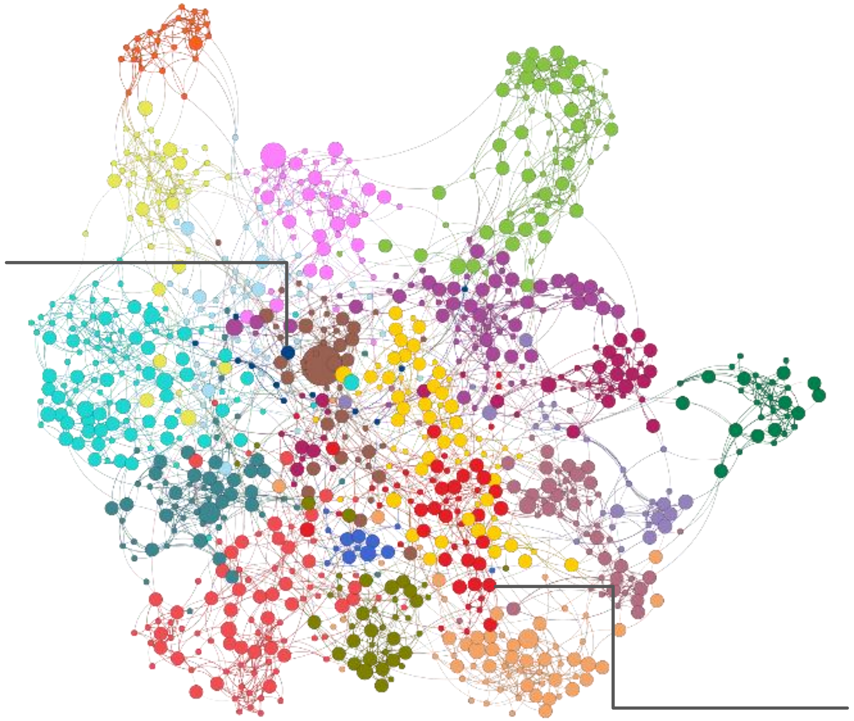
Based on patterns in companies founded over time, four hot topics are currently trending in digital health investment: AI & Advanced Analytics, Precision Medicine and Bioinformatics, EHR, AR/VR

Silicon Valley with 2× as much investment in digital health as other cities[1]



1. Data sample based on longlist of 20 cities with high digital health activity: Berlin, London, Silicon Valley (San Francisco, Berkeley, Oakland, Palo Alto, Redwood City, Mountain View, San Jose), Beijing, San Diego, LA, NYC, Austin, Salt Lake City, Munich, Nuremberg/Erlangen, Cologne, Bonn
Clustering based on similar products, technology, customers etc. Quid database includes companies with all types of funding such as private investments, M/A, public offerings and minority stakes. Publically available information on product, business, funding etc. is collected for the company lifetime
Source: Quid, BCG Center for Innovation Analytics

Quid network overview: ~$12.5B invested in 992 companies[1] related to digital healthcare ecosystem distributed across 20 key themes



Healthcare Communication, PR & Marketing
25 Co. | $14.3M PI

Digital Advertising & Marketing
44 Co. | $423.1M PI

Healthcare Workforce Solutions
44 Co. | $25.5M PI

Digital Health Plans
12 Co. | $15.8M PI

Online Health Services
46 Co. | $2.2B PI

Data Mgmt., Software/Cloud Solutions
103 Co. | $1.6B PI

IOT
61 Co. | $877M P

Dental 3D Printing
13 Co. | $173.2B PI

Electronic Health Record
88 Co. | $470.8M PI

Telehealth & Telemedicine
39 Co. | $337.5M PI

Wearables & Sensors
62 Co. | $894.5M PI

Digital Clinical Trials & Big Data Solutions
49 Co. | $1.2B PI

Precision Medicine & Bioinformatics
73 Co. | $900.2M PI

AI & Advanced Analytics
68 Co. | $787.5M PI

Population Health & Predictive Analytics
64 Co. | $771.2M PI

Cloud Medical Imaging & Speech Recogn. Platforms
42 Co. | $456.5M PI

AR/VR
30 Co. | $65.8M PI

Robotic Surgery
28 Co. | $236M PI

Behavioral Health & Digital Health Platforms
49 Co. | $583.5M PI

Health Monitoring & Patient Engagement
52 Co. | $434.8M PI

Each node represents a company

Bubble size represents total dis-closed lifetime private investment a company has received

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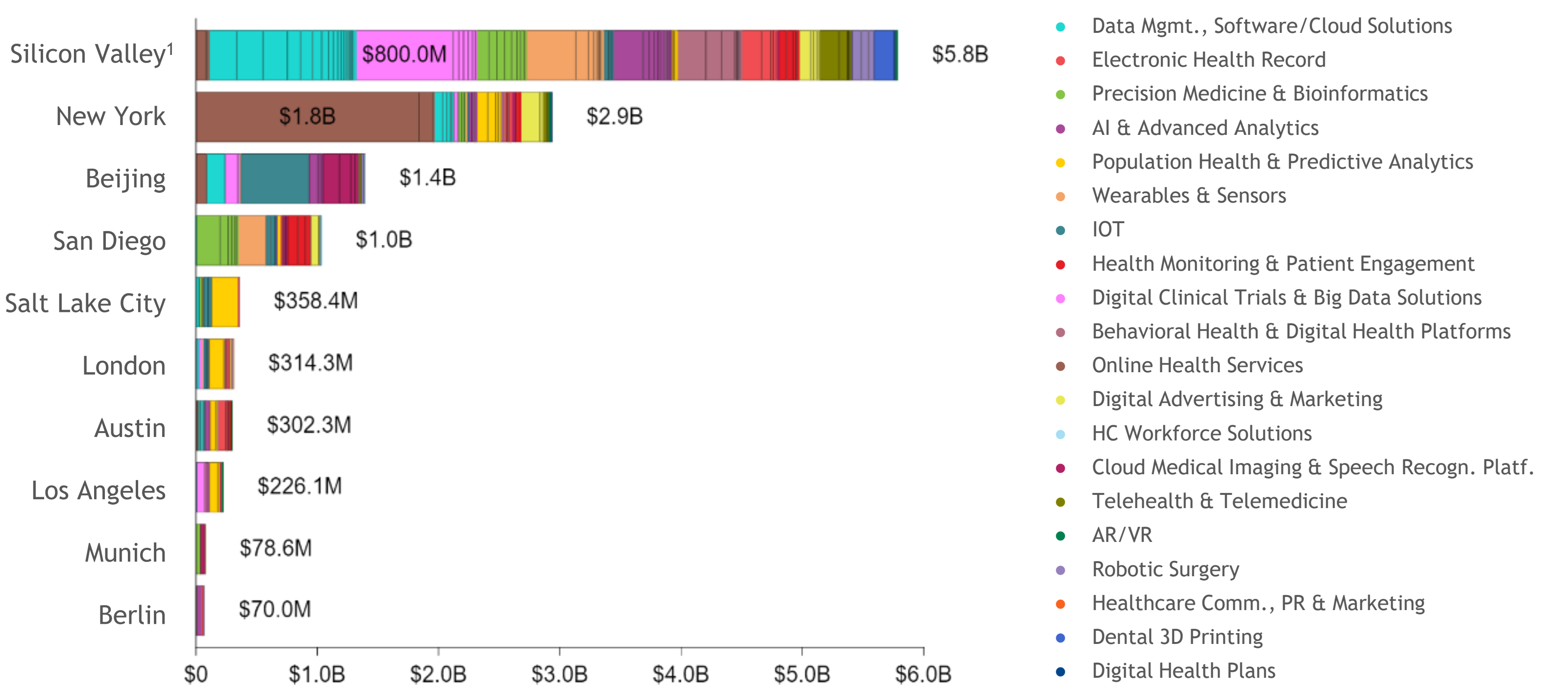
Source: Quid, BCG Center for Innovation Analytics

City view: About €80M of investment capital necessary to put Cologne on the map as a Digital Health hub

Investment received amount



Average investment per start-up in Berlin/ Munich €2/5M

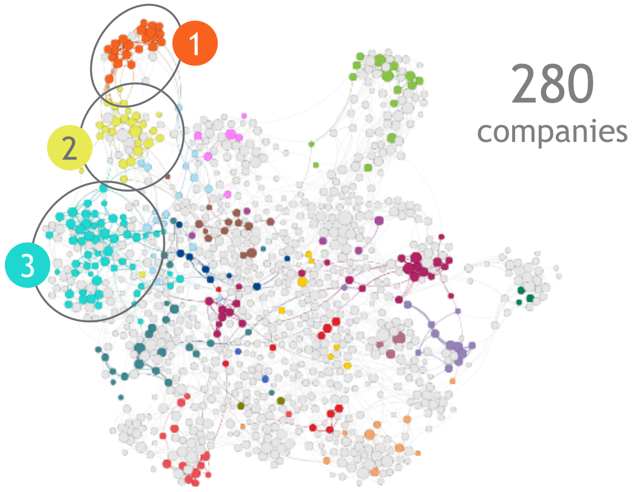
€80M investment would finance about 16-40 start-ups in Cologne

This investment would put Cologne ahead of Munich and Berlin

1. Silicon valley is a cluster of following cities: San Francisco, Berkeley, Oakland, Palo Alto, Redwood City, Mountain View & San Jose
Analysis uses Quid analytics on 992 companies in dataset to identify digital health in major cities and cluster based on similar products, technology, customers etc. Note: PI = Published investment
Source: Quid, BCG Center for Innovation Analytics

“AI and Advanced Analytics” and “Precision Medicine and Bioinformatics” growing fastest

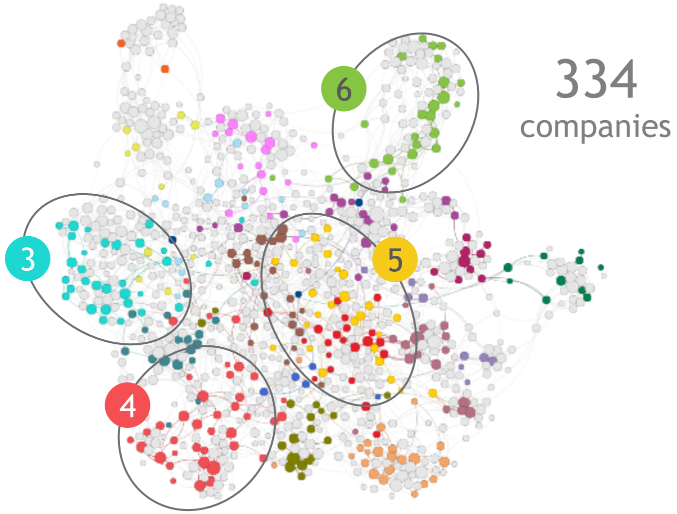
Companies founded until 2005



Traditional offerings:

1 Healthcare Comm., PR & Marketing
2 “Digital Advertising and Marketing”
3 Data Mgmt., Software/Cloud Solutions

Companies founded 2006 to 2013



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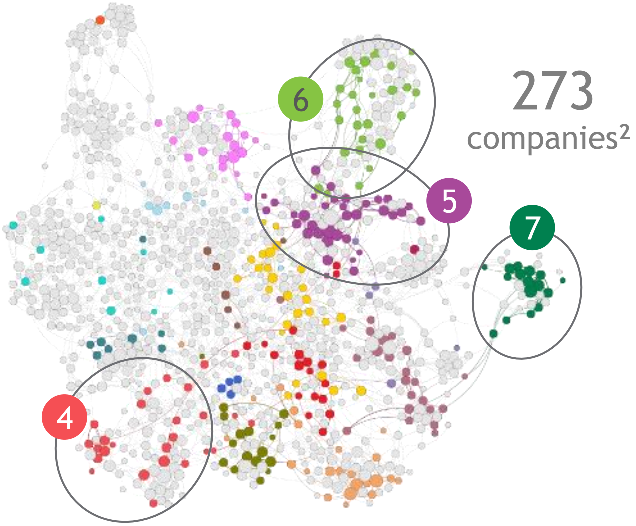
4 Electronic Health Record
3 Data Mgmt., Software/Cloud Solutions
5 Population Health & Predictive Analytics
6 Precision Medicine & Bioinformatics

Companies founded 2014 to today[1]



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5 AI & Advanced Analytics
6 Precision Medicine & Bioinformatics
4 Electronic Health Record
7 AR/VR

Top 4 clusters—by the number of companies founded within each time period

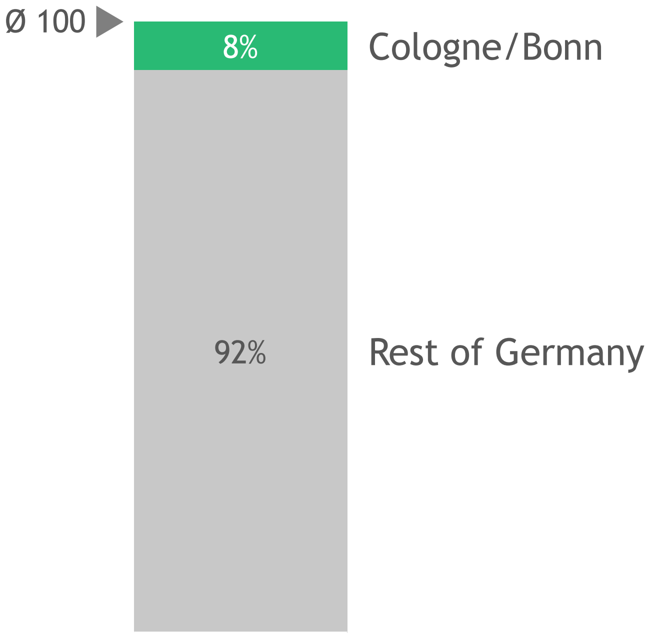
1. Date of study: July 2018 2. Founding year data for 105 companies is not available
Note: 992 companies are discovered using Quid for digital health in the major cities (provided by case team) and allowed to cluster based on similar products, technology, customers, etc.
Source: Quid, BCG Center for Innovation Analytics

BCG analysis suggests six technology sweet spots for Cologne-Bonn

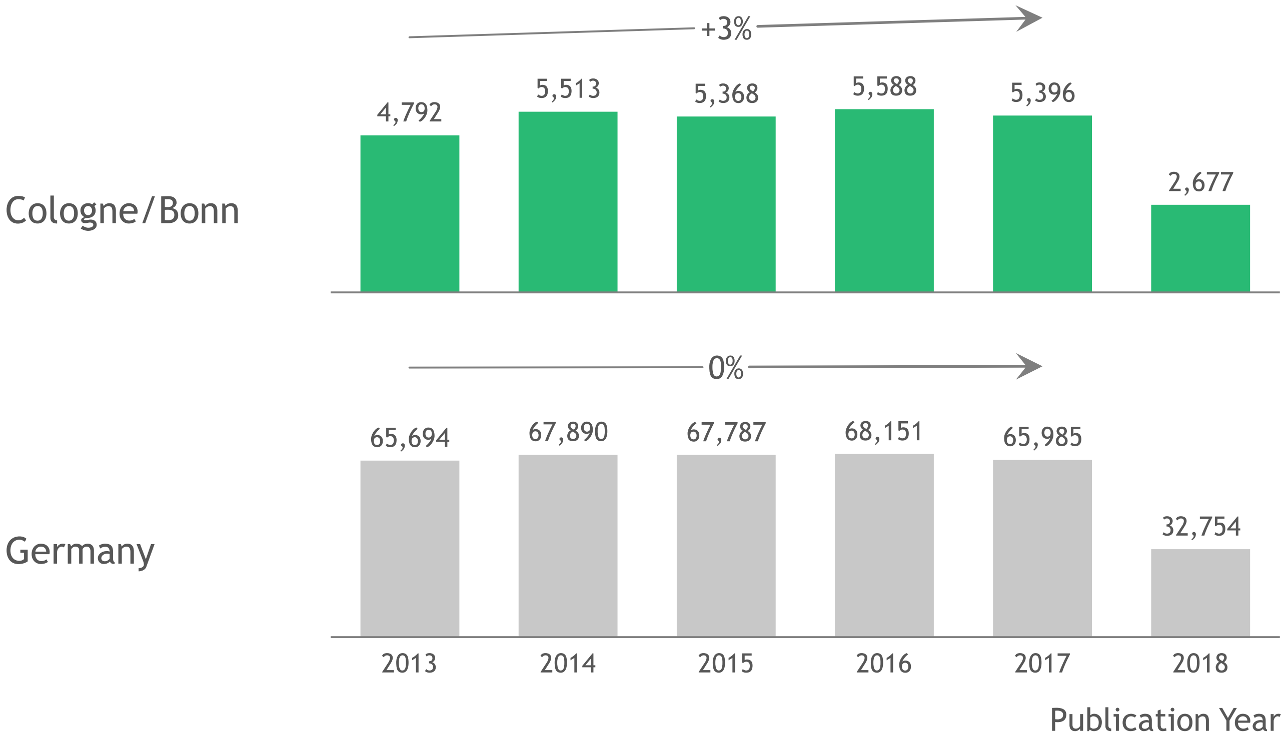
Precision Medicine and Bioinformatics	• Academic expertise (e.g., Oncology) as strong starting point with significant (medical) talent base • Large investment field with high median investment
AI and Advanced Analytics	• Strong IT industry prevalent in Cologne-Bonn that would be able to provide required talent • Numerous touchpoints for optimization potential with large local providers available at the doorstep
Data Mgmt. software and Cloud solutions	• Forms basis for data & analytics driven precision medicine solutions • Second-largest overall investment volume • Some players already based in Cologne
AR/VR	• High level of activity in e.g., gaming industry (Cologne Gamehouse, Cologne Gameforum) • Gamification: AR for decision-support (e.g., of non-experts/generalists), VR for robotic surgery
Health Monitoring and Patient Engagement	• High level of activity, basic product versions often low in complexity (e.g., no need for registration of medical device) • Possible link to adjacent industries (e.g., insurance)
Telehealth and telemedicine	• Building on foundation of strong provider network • Ideal for becoming a digital health cluster that extends beyond its immediate physical/geographic borders • Access to medical talent to customize innovation

Medical scientific publications from Cologne and Bonn have risen to ~5,400 in 2017 and are growing at 3% CAGR while Germany overall remains constant

Total count of
medical scientific publications

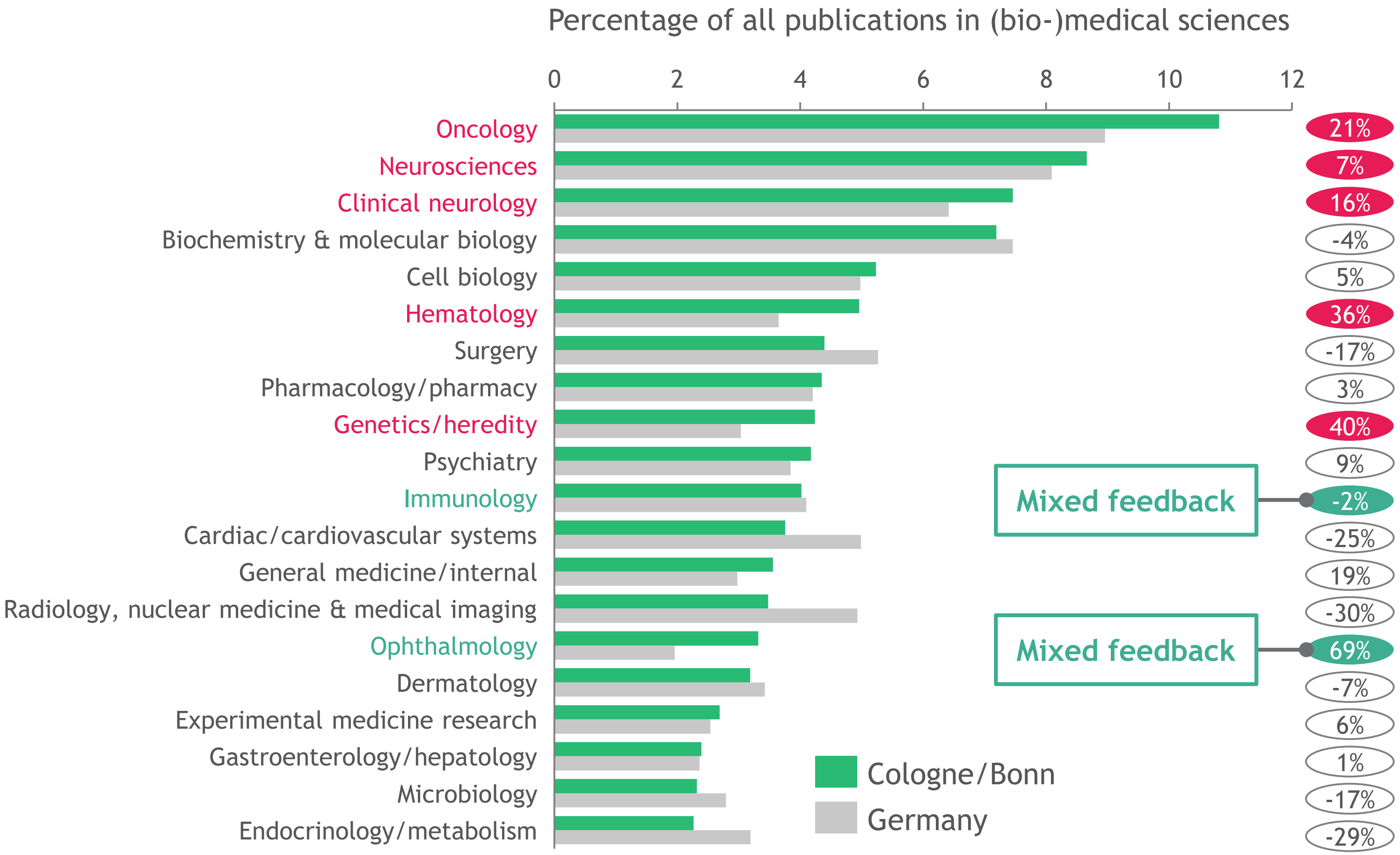


Count of
medical scientific publications



Note: Analysis based on 368,261 scientific publications published since 2013 in Germany and 29,334 in Cologne/Bonn restricted to health/medical domain (restricted by WOS health/medical categories)
Source: Web of Science, BCG Center for Innovation Analytics

Top 20 medical research areas in Cologne-Bonn



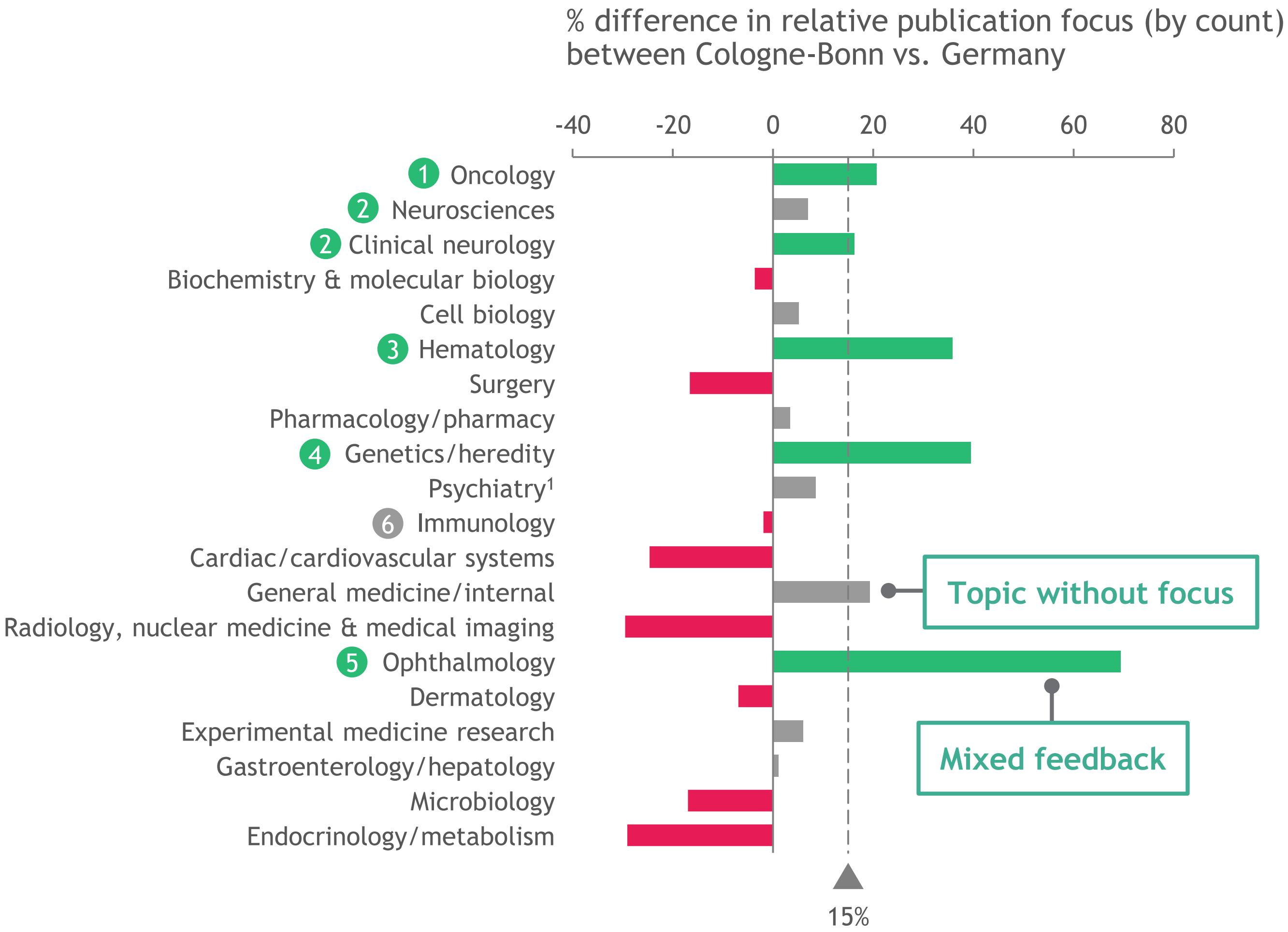
Publications were clustered by research area according to Web of Science classification

The amount of publications per research area was divided by the total amount of publications in the region

Indicated research areas are significantly overrepresented in the research portfolio of Cologne-Bonn (at least 15%[1])

1. Exception: General Medicine/internal due to lack of focus. Please note that Neurosciences was clustered together with Clinical Neurology
Note: Analysis based on 368,261 scientific publications published since 2013 in Germany and 29,334 in Cologne/Bonn restricted to health/medical domain (restricted by WOS health/medical categories) Source: Web of Science, BCG Center for Innovation Analytics

Possible focus areas for Cologne-Bonn



Note: Analysis based on 368,261 scientific publications published since 2013 in Germany and 29,334 in Col./Bonn restricted to health/medical domain (restricted by WOS health/medical categories)
Source: Web of Science, BCG Center for Innovation Analytics

Potential linkages of "strong" research fields to digital health

1. Oncology
   Genomics-driven big data studies
   Personalized medicine supported by AI
   ...
2. Neurology
   Analytics/AI to simulate neural networks
   Wearables recognizing epileptic episodes
   ...
3. Hematology
   AI-support for imaging-based diagnosis
   Apps to ensure medication adherence
   ...
4. Genetics
   Analytics-driven population studies
   Strong link to oncology
   ...
5. Ophthalmology
   Imaging-based diagnosis with AI support
   Robotics in eye surgery
   ...
6. Additionally: Immunology
   Cluster of excellence centered around University of Bonn ("ImmunoSensation")

Starting point for Cologne-Bonn ecosystem

Catchment are of >6M people,
57 hospitals ca. 17,000 available beds and ~686K treated inpatients per year

Large pharma players (e.g., Bayer, UCB, Lanxess) with global footprint

Strong university offering: 19 academic institutions in Cologne with ~100K active students, ca. 10 institutions in Bonn

Healthy start-up development with numerous incubators but very limited activity in digital health

Three typical root causes for the evolution of digital health clusters

1

Large metropoles that are rich in start-up activity and VC funding; digital health almost a by-product of other entrepreneurial activity (e.g., London, Berlin)

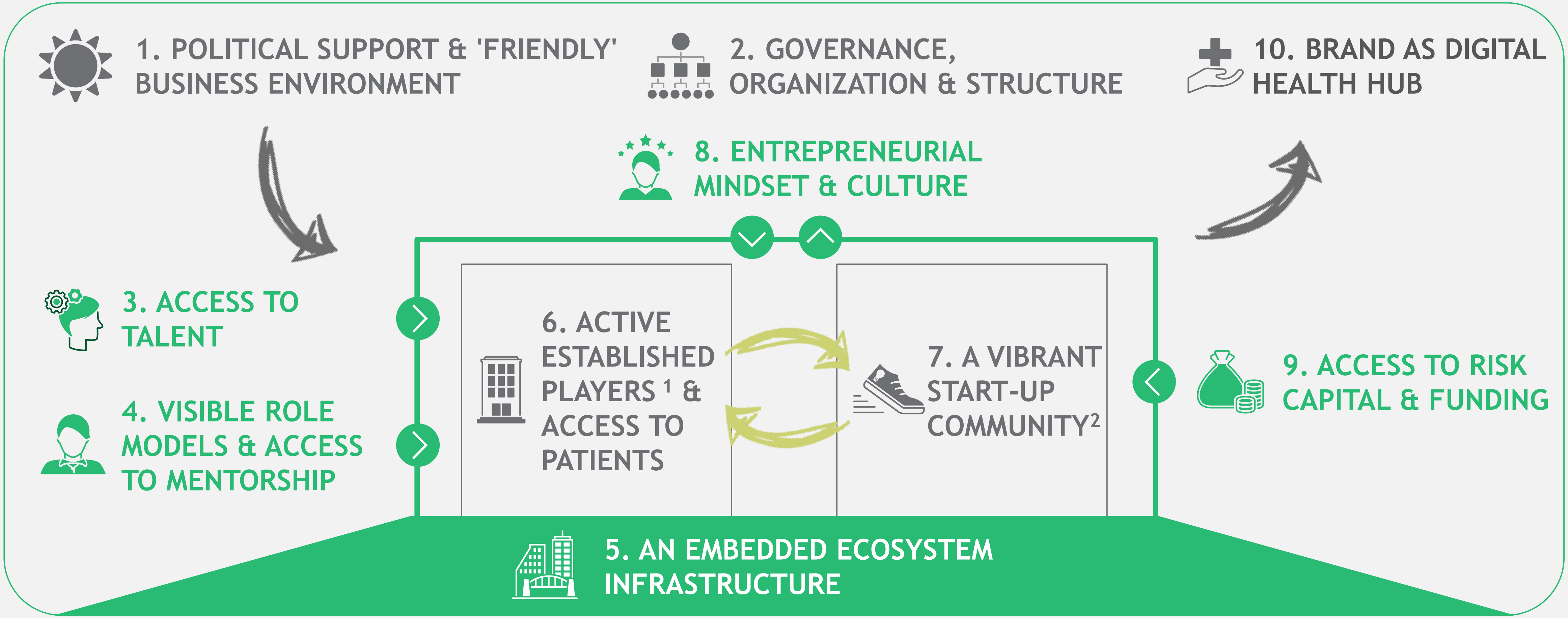
2

Academic institutions as source of innovation creating spinoffs; typically more focused on biotech/ life sciences (e.g., Boston area, Cambridge/Oxford, Medicon Valley, Silicon Valley)

3

Strong industry support of digital health clusters; typically 1-3 major industry players can be identified as key driver of progress (e.g., Medical Valley, Medicon Valley)

Successful health clusters balance 10 success factors in their ecosystems



1. Includes established private companies as well as R&D institutions, associations/networks and public/private health providers
2. Includes accelerators/incubators
Source: CGN Insurtech Hub 2016, BCG

Identified digital health start-ups in Cologne

Non-exhaustive

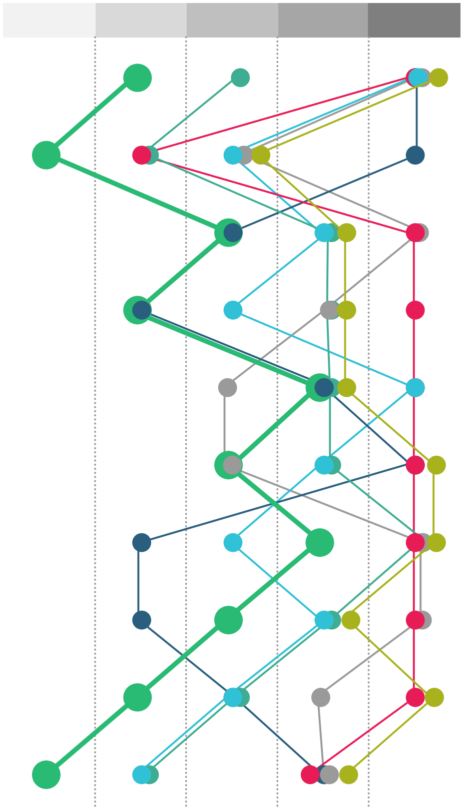
m.Doc	Patient-centric mHealth/telemedicine, making unstructured data accessible with support from analytics and AI	Platform-based
NEODOC	Videoportal providing information on conditions, prevention options, symptoms, diseases and treatment options	Platform-based
Better DOC	Web-based platform to identify medical experts as targeted/individualized as possible within 48 hours	Platform-based
visidoo	Automated patient scheduling system to facilitate appointment coordination between patient and clinic	Platform-based
radbonus	Platform to reward biking in urban areas by offering incentives e.g., discounts in e-shops, revenue model via corporate partners	Platform-based
UVIS	Sterilized solution via UVC disinfection for germ-free handrails to avoid infection risk on e.g., escalators	Platform-based
RIMASYS	Manufacturer of life-like fractures in human specimen with closed soft tissue to help improve practical skills of trauma surgeons	Tech-based
cynteract	VR-glove that detects motion and can be used for accelerating rehabilitation by playing video games (watch video)	Tech-based

Digital health start-ups identified mainly centered around platform solutions, few cases are very "techy"

As the next wave of start-ups is expected to be more complex and technology-driven, a stronger tech-foundation (e.g., advanced analytics for platforms) will need to be built and integrated when building a successful digital health start-up landscape

Source: Cologne Bay July 2018, Pitchbook

Assessment of Cologne-Bonn's success factors vs. best-in-class



1 Political support and friendly business env.
2 Governance, organization and structure
3 Access to talent
4 Visible role models and access to mentorship
5 An embedded ecosystem infrastructure
6 Active established players and access to patients
7 A vibrant start-up community
8 Entrepreneurial mindset and culture
9 Access to risk capital and funding
10 Brand as digital health hub

● Cologne-Bonn ● Berlin ● Silicon Valley ● Silicon Valley ● Medical Valley ● Medicon Valley ● Salt Lake City

- Poor preconditions for digital health cluster, significant improvement need
- Basic preconditions for digital health cluster given, moderate improvement need
- Ideal preconditions to foster digital health cluster

Key strengths and gaps

Good starting position in
- Vibrant start-up community
- Embedded ecosystem infrastructure

Improvement especially important in
- Political support and friendly business environment
- Funding
- Governance organization
- Political support
- Brand as digital health hub

Detailed ecosystem profiles for all benchmarked cities available in Appendix

Learnings and success factors

No cluster is successfully working without funding—strong mid- to long-term financial backing is absolutely essential

Start-up metropoles usually do not need to rely on over-arching governance, but specialized clusters typically coordinate and facilitate navigation actively

Large industry players need to be attracted to actively participate in a health cluster in order to scale long-term

Talent is essential—metropoles are typically rich in digital talent while specialized clusters often develop their own industry talent pools

Cologne-Bonn needs to position itself slightly differently than today's strong digital health clusters to leverage its competitive strengths (e.g., provide access to strong provider network), especially its large patient pool

Digital health introduction

Technology heatmap

Focus of medical research in Cologne-Bonn

Cologne-Bonn ecosystem assessment & best-in-class

Recommendations

Contacts

Study identifies potential sweet spots for Cologne

Potential technology sweet spots	Precision Med. & Bioinformatics	AR/VR
	AI & Advanced Analytics	Health Monitoring & Patient Engagement
	Data mgmt. software & Cloud solutions	Telehealth & telemedicine
Potential sweet spots by medical research field	Oncology	Genetics
	Neurology	Immunology
	Hematology	Ophthalmology
Highlighted strengths of ecosystem	Respectable established start-up scene	
	Largest patient catchment area in DE	
	Dense provider network & large patient pool	

...

Study identifies potential strategic plays for Cologne-Bonn

Head-to-head race with other clusters	✗
Leverage provider network and patient catchment to focus on data platforms	✓
Focus on medical research area	✓
Focus on niche digital technology	(✓)

✗ Not recommended
✓ Recommended—suggested identification of focus fields
(✓) Recommended—but not necessary to focus heavily on explicit fields

12 recommended measures to trigger the development of a digital health cluster

Quick wins	1 Establish a central network for digital health
	2 Create e-ship panel to support medical/healthcare experts
	3 Setup medical expert panel to support digital talent
	4 Create "Healthcare Navigator" role to assist start-ups
	5 Develop success story for digital health hub Cologne-Bonn
Mid-term enablers	6 Create a dedicated digital health fund
	7 Profile digital health at cross-industry events/occasions
	8 Engrain digital health stronger in academic curricula
	9 Attract large industry player(s) to invest long-term into cluster
	10 Found dedicated accelerators & commercialization programs
Long-term ecosystem needs	11 Invest into building database to use provider/patient data
	12 Build strong connection between academia and industry

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