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1 Preface

research2guidance is a specialist research organization that focuses on providing insights into mobile market developments. Our aspiration is to provide business leaders with guidance and a fact-base that will assist them in better understanding the most important trends shaping mobile markets today.

This report is already the third analysis of the mHealth market. Research2guidance began monitoring the mobile health solutions market before Apple’s creation of the new app ecosystem. This report emphasizes the changes that the market has undergone since 2009, and makes projections on the direction of the market in the years to come.

To access additional research documents on the smartphone applications market, please visit http://www.research2guidance.com/. research2guidance offers different content and format options to provide you with the information that you need.

A. Reports: Our detailed reports explore the major trends and developments affecting the market. Separate research papers provide both general and specific coverage of the market. The reports contain key insights for companies looking to enter or deepen their engagement in the mobile applications market, providing data and analysis on all relevant aspects of the market to ease investment decision-making.

B. Ready-to-use results (1-50 PowerPoint pages): Take advantage of our broad selection of PowerPoint presentation slides by selecting specific content that can easily be downloaded and incorporated into your presentations.

C. Research projects: Projects are tailored specifically to address your mobile application market information needs. Examples of projects include: developer surveys, mobile application strategy definition, and competitor and country analysis.

As with all research2guidance projects, the research behind these reports has not been commissioned or sponsored in any way by any business, government, or other institution.

research2guidance
2 Management Summary

The market for mHealth applications is developing along three different phases. Currently mHealth players have managed to get exit the initial trial phase and have entered the commercialization phase of the market. This phase can be characterized by a massive increase of offered solutions, the creation of new business models and the concentration on private, health-interested people, patients and corporations as major target groups.

Missing regulations is seen as one of the major barriers for the mHealth market to enter the next market phase: the integrated phase. In this phase, mHealth applications will become an integrated part of doctors’ treatment plans. In this phase health insurers will become the main payer, especially for the more advanced mHealth solutions (2nd generation mHealth applications).

Currently more than 97,000 mHealth applications are listed on 62 full catalogue app stores. The majority of these applications are general health and fitness apps that both facilitate the tracking of health parameters by private users, and provide users with basic health and fitness related information as well as guidance.

The general sophistication of today’s mHealth applications is low to medium, and many of the mHealth categorized applications provide a limited benefit for patients, doctors and health interested smartphone users. Nevertheless, advanced solutions do exist. Twenty such solutions are described and examined later in the report.

Top 10 mHealth applications have managed to generate up to 4 million free and 300,000 paid downloads. There are significant differences in download numbers between countries (US, UK, Germany, Japan and Brazil are analyzed in the report), platforms (Android and Apple) and devices (smartphones and tablets).

The mHealth market will develop in line with the smartphone application market, but there are 10 specific market drivers that will shape the market during the commercialization phase.

Five years from now, the mHealth market will be a mass market with a reach of more than 3,4 billion smartphone and tablet with access to mobile applications. By that time, 50% of these users will have downloaded mHealth applications.

By the end of 2017, the total mHealth market revenue will have grown by 61% (CAGR) to reach US$26 billion. The main sources of revenue will not come from application download revenue itself, but from mHealth services and hardware sales. Applications serve as platforms to sell other health services and hardware.

This growth projection is based on the assumption that private buyers will continue to be the primary spenders in the next five years, but that the integration of mHealth applications into traditional health care systems will become more and more common (integrated phase) during that time.
This report is the 3rd edition published annually since 2010. Besides the detailed description of facts and figures of the market’s early years (2010-2012), market trends, application categories, and market forecasts, the report also provides a comparison of how mHealth application publishers have changed their views and strategies over the course of the last three years (2010-2012).
3 THE EVOLUTION OF THE mHEALTH MARKET

The potential for mHealth solutions has been widely discussed for over a decade. The range of early solutions and go-to-market approaches was broad, but for various reasons the market never emerged from the trial phase.

Fast reading:

- The mHealth market is developing along 3 phases: the trial, commercialization and integration phase.
- Since 2000, the promise of reduced health care costs and improved patient outcomes associated with mHealth has inspired many mHealth solution providers to build their business models around e.g. remote patient monitoring, mobile alerts and reminders.
- These early movers entered the market too early, as market conditions did not support the scaling of existing solutions.
- With the launch of the Apple App Store, the mHealth market entered into the commercialization phase. Ultimately the Apple App Store allowed mHealth solutions providers to reach out to a mass market and grow their income.
- Apple’s innovations transfigured the entire customer and developer experience (not only for mHealth solutions), making mobile applications easy to download and use, as well as easier to develop and distribute.
- The rapid market penetration of the new generation of smartphones will have the biggest impact on existing mHealth market barriers.
- Today’s smartphones offer technology features as standard, further enabling sophisticated mHealth solutions.
- Next generation mobile networks enable up- and download speed that support fast image and video exchange required for many mHealth use cases.

The impact of the new market model on regulation is limited in the next years. Consequently, mHealth applications will have to target the private and commercial health markets, as public and health insurance reimbursement policies will not play a major role in the next 3 to 4 years. Apple’s new market platform for smartphone applications, launched in 2008, injected new life into the mobile content and consequently mHealth industries, ultimately creating a new model for the mHealth market.

As a first definition, this new market model includes:

- A smartphone or other smart device (tablets, game console etc.) that allows the user to easily install and use third party applications.
- A shopping platform (app stores) that allows global application discoverability, purchase and download.
- A developer platform that allows developers to efficiently create native applications capable of reaching a global audience.
An unmatched, end-to-end user experience, from application discoverability to
download, purchase, usage and application update.

Based on this background the mHealth market evolution can be described within the
framework of three distinctive phases:

1. The pilot phase: the traditional mHealth market.
2. The commercialization phase: the new mHealth market model.
3. The integration phase: mHealth apps become part of the regulated health care
   system.

This report concentrates on the commercialization phase which best represents the current
status of the mHealth market.

The report will also concentrate on solutions that run on smartphones and tablets. The
report excludes mobile web pages and feature phones as technology platforms for mHealth
solutions. The findings in later chapters will underscore the fact that smartphone
applications provide the best environment for companies to reach their customers on a
mobile device within the next five years.

3.1 THE PROMISED BENEFITS OF mHEALTH APPLICATIONS

mHealth solutions have been the subject of much conjecture and debate since the late 90s.
This is because the most obvious potential benefits of mHealth address two of the central
issues in healthcare – improving patient outcomes and reducing the cost of healthcare
delivery.

3.1.1 THE PROMISE OF IMPROVED PATIENT OUTCOMES

Improving patient outcomes remains the core objective of healthcare. mHealth applications
have the potential to address and improve multiple patient outcomes, not least because
they ease the lives of doctors and patients. A few examples of such applications include:

Remote monitoring applications will enhance patient mobility, allowing patients to leave
home and still have their condition remotely monitored by healthcare professionals.
Improved quality of life (QoL) can be described as an improved patient outcome.
Furthermore, monitoring applications, because of the immense cost reductions involved in
deployment, will be available to a far larger population, preventing adverse patient incidents
in previously un-monitored, high-risk patient populations both in healthcare facilities and
out. (Patients will not have to stay at home, and many more high-risk patients such as CV
patients and diabetics could be monitored).
Compliance applications provide reminders as well as instructions to patients to take the correct dosages of the correct medications at the right times. These solutions will improve patient outcomes by reducing adverse incidents such as side-effects or overdose, and by ensuring that courses of therapy are completed, thereby avoiding relapse or other complications. *(Patients would not make mistakes that could harm them, and they would be more likely to finish their course of treatment).*

Medical information applications will allow HCPs\(^1\) to access central databases on the go and at the patient’s bed-side, thereby reducing, for example, misdiagnosis or prescribing errors, which are not only a major cost factor in healthcare systems, but also are the cause of millions of adverse patient incidents every year. *(Having a textbook or their colleagues’ expert opinion in their phones makes doctors less prone to error and thus more effective).*

### 3.1.2 The promise of reduced health care costs

Healthcare costs have increased steadily over the last decades and exceed GDP\(^2\) growth in most OECD\(^3\) countries by almost 2%\(^4\). This leads to the fact that an increasingly greater proportion of national expenditure is devoted to maintaining the health conditions of citizens, thereby diminishing the relative value of the rest of the national economy. In the US, for example, expenditure on healthcare has already reached 16% of annual GDP. In other economies the share is lower, but with the ever escalating cost of medical technologies and services, the overall trend of increasing healthcare spending, both in terms of total value and as a function of national expenditure, is consistent internationally. The WHO (World Health Organization) has estimated that global healthcare expenditure reached US$6 trillion\(^5\) in 2011. This equates to an average of approximately US$800 per person. Ageing populations in the developed world and improving healthcare standards in the developing world will increase the pressure to find new solutions that deflake healthcare delivery costs. The promise of mHealth lies in the numerous potentials it offers for cost-reduction in this regard. Some of the areas where these potentials will be realized are:

**Improved patient monitoring:** mHealth solutions will reduce length of stay (LoS) and thus increase throughput, and will allow for remote monitoring and monitoring in often previously cost-ineffective, high-risk areas such as med/surg wards, dramatically decreasing costs as well as reducing patient adverse incidents (which can be expensive). This will result in vastly improved patient outcomes as well as significant cost reductions. Furthermore,

---

1. HCP: Health Care Professional.
2. GDP: Gross Domestic Product.
because direct contact between healthcare professionals and patients would be reduced (e.g. doctors would not have to drive to consult with patients in their homes), the productivity and profitability of healthcare delivery would be improved, with HCPs able to see more patients, or indeed have more leisure time, thus delivering economic benefits. *(Patients can leave hospital earlier, and patients previously not monitored because of prohibitive costs will now be monitored. HCPs would be more productive and therefore more profitable, thus driving down costs).*

**Improved patient compliance**: That improved compliance reduces costs is well established. A Medco study published in 2005⁶ estimated that non-compliant diabetic patients cost the healthcare system twice as much as compliant ones. Not only will improved compliance reduce the cost of medication as patients complete their courses thereby avoiding the needless cost of additional therapy, the cost of hospitalization caused by non-compliance is a major waste factor in most healthcare systems and these and other incident follow-up costs will be reduced.

**Figure 1**: Healthcare expenditure as a percentage of GDP (1980-2009)

![Figure 1: Healthcare expenditure as a percentage of GDP (1980-2009)](source: OECD)

As discussed above, economic developments and the escalating costs of healthcare as a proportion of GDP fuel the need for innovative health solutions with mHealth seen as one of the building blocks of the future healthcare economy. Very positive early predictions from 2005 – 2008 indicated that mHealth would quickly become a billion dollar market.

---

These market estimates as well as the foreseen benefits for users/patients drove first-movers to develop mHealth solutions. Generally designed for PDAs\(^7\), specially designed devices or handheld computers, mHealth providers used SMS\(^8\) platforms, WAP\(^9\) services or simple Java applications to deliver these solutions. Looking back, it is clear that those market estimates have been too optimistic and first-movers had entered the market too early.

The following sections examine the disruptive changes Apple has brought to the mobile (and mHealth) industry, and how these changes have significantly promoted the mHealth industry.

---

\(^7\) PDAs: Personal Digital Assistants.
\(^8\) SMS: Short Message Service.
\(^9\) WAP: Wireless Application Platform.
3.2 **What initiated the mHealth application market**

Ultimately, the chapter discusses how the creation of the Apple App Store either eliminated or reduced barriers characteristic of the traditional mHealth market model, and lends an explanation as to how the creation of this app ecosystem ignited the mHealth market.

The mobile industry had long tried to jumpstart the mobile content business with limited success. Previously, the main content categories were ringtones, wallpapers, themes and music. In 2007 an outsider (Apple) demonstrated how the application business can thrive by creating and controlling all aspects of the value chain: the hardware, the on-device-store, the desktop store, and the developer portal. This integrated platform management strategy has improved the customer experience of discovering, purchasing and using applications significantly. In accomplishing this, Apple was also able to build on the success of their established iTunes Store. By the time the App Store was launched, many iPhone and iPod Touch users had already downloaded content from Apple’s iTunes interface, making purchasing applications an easy next step. In this case, applications were just another content type users could purchase in a familiar market environment.

The Apple App Store managed to expand its offerings to include a broad range of applications in a short time. After six months of operation there were more than 12,000 applications available, a number that other mobile platforms such as Windows Mobile reached only after several years. And while there was no guarantee that applications would function the same on all Windows Mobile devices, iPhone users never had to wonder whether their device was capable of running an application.

5-6 times lower application prices, no hidden costs, and new flat-rate data plans all made users more willing to download and test applications without having to worry about content costs.
**Table 1: Pre- and Post-Apple App Store Launch Application Market**

<table>
<thead>
<tr>
<th>Customer perspective</th>
<th>Apple App Store 2008-present</th>
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<tbody>
<tr>
<td>• Complex exploring, purchase and first-use experience</td>
<td>• Exploration, purchase and first-use made very easy</td>
</tr>
<tr>
<td>• Complicated download options, no updates</td>
<td>• Large number of applications available at lower prices</td>
</tr>
<tr>
<td>• Limited choice due to handset capabilities</td>
<td></td>
</tr>
<tr>
<td>• High prices</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Developer perspective</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fragmented, non-standardized, and unsupported interfaces with distribution portals required to submit and promote applications</td>
<td>• A single development platform to reach all iPhone touch and iPhone customers worldwide</td>
</tr>
<tr>
<td>• Limited reach due to country focus of MNOs and handset capabilities</td>
<td>• No billing and fulfillment needed</td>
</tr>
<tr>
<td>• Need to build up own billing and fulfillment capabilities</td>
<td>• Revenue share 70%</td>
</tr>
<tr>
<td>• Lower revenue share: between 20%-40%</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Supporting drivers</th>
<th></th>
</tr>
</thead>
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<tr>
<td>• Expensive data plans</td>
<td>• Significant reduction in price for data traffic and flat-rates</td>
</tr>
<tr>
<td>• Limited mobile broadband network coverage (in early 2000s)</td>
<td>• Widespread 3G/Wi-Fi coverage</td>
</tr>
</tbody>
</table>

There are two main reasons why developers have rushed to the iPhone platform:

1. **Commercial openness:** Apple streamlined the entire process of placing applications front and center on consumers’ devices, chiefly by eliminating the middle-men (operators, content aggregators and content retailers). Apple centralized all required processes: submission, hosting, delivery, billing, and promotion of applications. Prior to this integrated scheme, developers had to identify and collaborate with partners for each process and for each country in which they intended to sell the applications. Each involved party would then take a share of the revenue, leaving the developer with only a minor share (between 20% and 40%), whereas today’s developers receive 70% of revenues generated through the App Store.

2. **Simplified development:** Prior to Apple’s App Store, other mobile platforms like Palm, Windows Mobile, and Symbian opened up their APIs to developers (2001-2002), but documentation and support were inconsistent. By launching the SDK and the Apple Developer Portal, Apple has provided an easy-to-use programming tool-kit, a single source of support and documentation, and an integrated application management tool.

---

10 APIs: Application Programming Interfaces.

11 SDK: Software Development Kit.
Clearly Apple had the important realization that third-party applications could be a big driver of sales in the smartphone market if leveraged correctly.

**Figure 2: iPhone shipments before and after the App Store launch (in millions)**

![Chart showing iPhone shipments before and after the App Store launch](image)

Source: research2guidance and Apple, 2013.

When the iPhone first went to market in 2007, the App Store had not yet been launched. Nonetheless, for a newcomer in the smartphone market, the shipment numbers in the first year were quite high. With the launch of the iPhone 3G and the App Store, however, device shipments increased by a factor of four over previous levels, clearly indicating that applications had become a primary selling-point for smartphones.

### 3.3 The three phases of mHealth market development

Including the initial years the mHealth market is developing along three different phases. The changes each phase has made or could make to the mHealth market can be clustered around devices, distribution channels, the users (mainly patients, doctors, and nurses), and regulation.
3.3.1 The Trial Phase

This phase lasted until 2008 when the launch of the Apple App Store changed the way mobile services are distributed.

The first notable mHealth solutions date from the early years of the century. They are predominantly carried on feature phones, specially developed devices or, to a lesser extent, PDAs. Ranging from simple SMS pill reminders to complex monitoring systems, the variety of solutions in the mHealth market has been wide. Complex solutions frequently aimed to provide proof-of-concept rather than to achieve business goals.

The variety of health conditions addressed by mHealth solutions developed between 2000 and 2008 were about as broad as they remain today. Most categories of mHealth solutions currently available already existed 5 years ago.

The market has exhibited significant fragmentation. The industry that somehow stands out is the mobile industry, is the reason being that most mHealth players have had to collaborate with at least one mobile operator in order to access their technology and competence and to gain reach for their solutions. MNOs\footnote{MNOs: Mobile Network Operators.} have viewed mHealth as an additional connectivity revenue driver, as well as an opportunity for new service offerings that might ensure their not being reduced to a bit pipe in the future. Nevertheless, mHealth has always been only...
one initiative among many, and until recently has not raised much awareness internally with most mobile operators.

A great part of the traditional mHealth market has been project as opposed to product related. Projects have typically involved the construction of dedicated solutions for e.g. hospitals or government organizations. These were predominantly unique solutions that did not scale up. Although there have been product vendors, because of the limited reach of their solutions most have not developed into sizable concerns.

The main characteristics of the trail phase are shown in the following table.

**Table 2: Characteristics of the trail phase**

<table>
<thead>
<tr>
<th>Category</th>
<th>Trial phase</th>
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<tbody>
<tr>
<td>Device</td>
<td>• Need for specialized devices to run more advanced services, as standard devices did not offer required features</td>
</tr>
<tr>
<td></td>
<td>• Very low penetration of capable devices</td>
</tr>
<tr>
<td></td>
<td>• Only basic solutions for simple phones possible</td>
</tr>
<tr>
<td>Distribution</td>
<td>• Lack of business incentives for traditional channels like doctors, hospital and pharma distribution</td>
</tr>
<tr>
<td></td>
<td>• Lack of reach: MNOs only provided local reach</td>
</tr>
<tr>
<td>Users</td>
<td>• Opaque markets in which to search for mHealth solutions</td>
</tr>
<tr>
<td></td>
<td>• Inappropriate user experience from solution discovery to usage</td>
</tr>
<tr>
<td></td>
<td>• Little user-awareness</td>
</tr>
<tr>
<td></td>
<td>• Perceived high cost of services</td>
</tr>
<tr>
<td></td>
<td>• Missing incentives to use innovative solutions</td>
</tr>
<tr>
<td></td>
<td>• Missing technology readiness in target groups</td>
</tr>
<tr>
<td>Regulation</td>
<td>• National regulation did not support mHealth solutions to enable refunding</td>
</tr>
</tbody>
</table>

Early solution providers had to live with limited device capabilities and, in order to achieve successful market entry, had to find hardware partners to build the mobile device needed to deliver the mHealth service. These included special features which are now standard on smartphones (e.g. GPS, sensors, high resolution cameras).

Furthermore, reach was very limited for any kind of smartphone. In the “early days” mHealth solutions providers either had to seek partnerships with MNOs for support in distributing services or go it alone. The awareness among patients and HCPs of mHealth solutions was very limited. Due to limited reach, regulators did not pay attention to mHealth applications.

---

13 GPS: Global Positioning System.
During this phase many interesting concepts developed, but due to the listed barriers they remained concepts, prototypes or show cases far away from any economic success.

### 3.3.2 Commercialization phase

The commercialization phase materialized in 2008 with the launch of the Apple App Store. The revolutionary aspect of this new market model is the focus on the smartphone as the primary device delivering solutions to the end-user. Products are sold globally through application stores. Small and specialized application developers are the new drivers of the market, developing simple to medium-complex applications targeting mainly the patient/consumer market in industrialized countries with above average smartphone penetration. Successful applications scale to hundreds of thousands of downloads per application. Although currently mHealth solutions do not rank amongst the most popular categories of applications in the stores, they have started to attract the attention of most significant healthcare industry players globally, ensuring that the market dynamic will not decelerate during the next year.

Regulatory bodies started to set draft guidelines. Still, reimbursements of money spent on mHealth applications is a rare exception.

**Table 3: Characteristics of the commercialization phase**

<table>
<thead>
<tr>
<th>Category</th>
<th>Commercialization</th>
</tr>
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</table>
| **Device** | • Today’s smartphones carry technology needed for mHealth solutions, such as GPS and sensors, as standard features  
• High penetration of smartphone devices  
• New devices, e.g. tablets, enable services which were not possible on smaller screens  
• BOYD increase potential reach for mHealth company solutions |
| **Distribution** | • Possibility to market directly to consumers/patients, HCPs  
• Global reach via application stores  
• Limited access to traditional mHealth distribution channels  
• Bundle and bulk sales possible |
| **Users** | • Increased awareness through higher visibility of mHealth applications in global application stores within smartphone user group, and through increased media coverage  
• Massive improvement of user experience  
• Massive reduction in price-level of mHealth applications, smartphones and data usage  
• HCPs have one of the highest levels of smartphone penetration with regards to occupation |
| **Regulation** | • Awareness changed due to the application hype, but still no major change in regulation policies visible  
• Fear of theft of devices and patient data remains problematic  
• Issues of privacy: should employers have access to employee information |

One of the major changes of the commercialization phase is the potentially high reach in the consumer and HCP target group a mHealth solution can gain.
Companies can rely on employees bringing their own devices and smartphones to the workplace (BYOD\(^{14}\)). The current application market allows for global distribution without having to deal with an MNO. The corporate model has the ability to reach employees who do not know about the mHealth market or those who would not actively participate in the market on their own.

The awareness of mHealth solutions increased significantly amongst all players in the health care system. The hype around smartphone applications brings mHealth applications into the spotlight of its potential users, which will continue to drive market uptake.

The commercialization phase is also built on the improved user experience along the entire value chain: discovery and access, billing and usage.

Within the commercialization phase, 3 different markets have been developed each at a different speed:

1. Consumer/patient market.
2. Health care professional market (HCP).
3. Enterprise market.

Most of the mHealth applications today address the consumer market. This is evidenced by the growth and size of the mHealth app store categories “Wellness” and “Fitness & Nutrition”. These app store categories include applications which primarily address patients and consumers. These categories are the largest category of mHealth applications in today’s app stores.

The mHealth consumer market is fueled by the “self-tracking” and increased “self-information” movement of people in general and patients in particular. mHealth applications are being incorporated into the daily lives for immediate access to health information and personal performance tracking on the go.

Consumer uptake is also supported by the increased willingness to share information about themselves on social media platforms, helping to promote mHealth solutions.

The second largest market segment in terms of number of applications is the HCP market. The main application categories that address the professional market are “CME\(^{15}\)”, “Diagnosis Tools”, “Compliancy” and “Monitoring”. Besides standard and public available solutions there are unnumbered individual applications that were specifically developed for hospitals, doctors and car giving organizations over the last 3-4 years.

Companies have only recently discovered the benefits of using mHealth applications for their workforce. Early adopters have started to sponsor the usage of mHealth applications amongst their employees, primarily through corporate wellness and fitness programs. In the United States, employer-sponsored healthcare has begun to become of the employee’s benefits package, and is a staple of their national healthcare plans.

\(^{14}\) BYOD: Bring your own device. This term describes the use of personal, employee smartphones for work.

\(^{15}\) CME: Continuing Medical Education.
The main categories in focus of the company programs are very much the same as in the consumer market.

Goals cited by companies that launched mHealth supported wellness and fitness programs are: reduce injury and infection rates as well as absenteeism, increase productivity and morale, promote company sustainability, culture, and brand value, all of which can enhance recruitment potential and give a company a competitive edge.

- The growth of the company mHealth market will be supported by a number of drivers: a growing number of employees make use of mHealth applications for private use already.
- A growing number of employees own a capable device that is also used for business purposes (BYOD).
- A growing number of inexpensive “off-the-shelf” mHealth applications that support the particular interests of companies’ health objectives.
- The launch of the group buying program of Apple in 2012 to reduce costs for mHealth applications.

The speed of growth will depend on the publication of company results with respect to their internal mHealth programs.

### 3.3.3 Integration Phase

This phase marks the integration of mHealth applications by doctors into patient treatment plans, as well as insurer coverage of mHealth applications. There is no exact date to project when this phase starts, but assuming that the leading regulatory body FDA\(^\text{16}\) will publish their guidelines in 2013, it is most likely that other regulatory bodies will follow suit and establish regulations so that mHealth applications can become an integrated part of the normal health system.

The integration phase can be drafted like this: mHealth applications will eventually become part of normal treatments and processes of the health care system. After having been tested in clinical trials, mHealth solutions will prove to be effective in reducing costs and improving patient outcomes.

Hundreds/thousands of mHealth applications will gain regulatory approval. Physicians will begin to prescribe mHealth applications to their patients, who will, in turn, look to their healthcare systems to cover the costs. These applications will offer interconnectivity between devices, sensors, hardware, and software, thus facilitating mass adoption. Ultimately the industry will be regulated for security and safety purposes.

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\(^{16}\) FDA: US Food and Drug Administration.
TABLE 4: CHARACTERISTICS OF THE INTEGRATION PHASE

<table>
<thead>
<tr>
<th>Category</th>
<th>Integration phase</th>
</tr>
</thead>
</table>
| Device    | • Medical infrastructure will be interconnected via the cloud  
|           | • Solutions will be created to adapt to the existing as well as future infrastructure |
| Distribution | • Medical professionals, hospitals, pharmacies will become the main distribution channels |
| Users     | • Cost of solutions covered by insurers  
|           | • Tailor-made treatment plans based on biological data collected from mHealth solutions |
| Regulation | • Most regulations in developed countries will have published guidelines  
|           | • Hundreds / thousands of mHealth applications will have regulatory approval. |

Health professionals will serve as the primary distributors of solutions. After having been proved clinically effective, doctors and patients will demand that treatments involve these solutions and that they are covered by their insurers/incorporated into the existing health infrastructure.

The pace of progress in smartphone technology development over the last three years has led to standardization of previously “custom” features. These features can easily be accessed via open APIs and developer SDKs. Smartphones have become powerful computers that weigh less than 150g and fit into every pocket. The following table provides an overview of commonly implemented technology features and gives examples of potential use-cases for mHealth applications.
### Table 5: Potential use cases of smartphone features in mHealth

<table>
<thead>
<tr>
<th>Technology features</th>
<th>Typical implementation</th>
<th>Potential use case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Connectivity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluetooth</td>
<td>Version 2.1/3 + EDR/A2DP 11 Mbit/s</td>
<td>Enables direct synchronization with external sensors</td>
</tr>
<tr>
<td>Web Browser</td>
<td>HTML5 browsing</td>
<td>Convenient and efficient access to mobile mHealth information web pages</td>
</tr>
<tr>
<td>USB</td>
<td>USB 2.0 480 MBits/sec – 10Gbits/sec</td>
<td>Archiving of tomographic images</td>
</tr>
<tr>
<td>Wi-Fi</td>
<td>802.11 b/g/n up to 7000 MBits/sec</td>
<td>Data sync for medical videos</td>
</tr>
<tr>
<td>Network</td>
<td>3.5 HSDPA/EDGE</td>
<td>Fast medical image sharing over long distances</td>
</tr>
<tr>
<td><strong>Screen/display</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Smartphones 640*1136px, Tablets 2048x1536px</td>
<td>Provides access to medical images on the move</td>
</tr>
<tr>
<td>Screen resolution</td>
<td>Up to 326 ppi</td>
<td>Display of X-Ray images</td>
</tr>
<tr>
<td>Text/Image Zoom</td>
<td>With pinch feature</td>
<td>Enlarge text/view to make it more accessible for vision-impaired users or provide efficient medical image review</td>
</tr>
<tr>
<td>Touch screen</td>
<td>Multi-touch</td>
<td>Simulate simple easy to use keyboard for elderly</td>
</tr>
<tr>
<td><strong>Capacity &amp; speed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage capacity</td>
<td>4GB to 64GB on deck</td>
<td>Unlimited application size (images, video containing educational applications)</td>
</tr>
<tr>
<td>Processor and RAM</td>
<td>Up to 1.3GHz with 1Gb RAM</td>
<td>Efficient data-heavy application playback, e.g. large image, video review</td>
</tr>
<tr>
<td><strong>Environmental sensors and geo-location</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accelerometer</td>
<td>1/10^6th of a degree accuracy, 3-axis gyroscope</td>
<td>Track users’ workout movements or In-app measurements of the backbone</td>
</tr>
<tr>
<td>Pedometer</td>
<td>Step-counter</td>
<td>Track users’ running distance</td>
</tr>
<tr>
<td>Internal GPS</td>
<td>1-10 meter accuracy</td>
<td>Mapping of nearest hospitals, or location tracking in case of accident</td>
</tr>
<tr>
<td>Map features</td>
<td>Route planning, turn-by-turn directions, locational tracking in relation to destination</td>
<td>Navigation instructions for nurses and doctors</td>
</tr>
</tbody>
</table>
### Table 5 (Continued): Potential use-cases of smartphone features in mHealth

<table>
<thead>
<tr>
<th>Technology features</th>
<th>Typical standard</th>
<th>Implementation</th>
<th>Potential mHealth use case (examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Audio/video features</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camera</td>
<td>Up to 12 mega pixel, with geo-tagging and autofocus</td>
<td>Patients can take images of their injuries and send to physicians for immediate recommendations</td>
<td></td>
</tr>
<tr>
<td>Front facing camera</td>
<td>1.2 Mega Pixel</td>
<td>Video conferencing for remote consultation</td>
<td></td>
</tr>
<tr>
<td>LED torch, flash</td>
<td></td>
<td>Can be used for signaling. There are apps that enable LED to send Morse code signals in case of emergency</td>
<td></td>
</tr>
<tr>
<td>Audio/video player and recorder</td>
<td>HD video recording Supports most common media files, such as mp3, mp4, mov, waw, MPEG-4…</td>
<td>Enables sophisticated medical reference information including high quality video and audio material</td>
<td></td>
</tr>
<tr>
<td><strong>Input</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keyboard</td>
<td>Virtual or external full-QWERTY keyboard</td>
<td>Easy data entry for medical trial results</td>
<td></td>
</tr>
<tr>
<td>Voice recognition</td>
<td>Command and dial functions</td>
<td>Command entry for impaired people, or hands free device management</td>
<td></td>
</tr>
<tr>
<td><strong>E-mail and messaging</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-mail</td>
<td>HTML/IMAP/POP3 emailing with push features</td>
<td>Enables doctors to send instant recommendations to patients or share important information</td>
<td></td>
</tr>
<tr>
<td>Push notifications</td>
<td></td>
<td>Enables cost-effective alert and reminder solutions, e.g. in medication compliance applications</td>
<td></td>
</tr>
<tr>
<td>Hearing aid compatibility</td>
<td>Mono audio, closed captioning, digital TTY/TDD</td>
<td>Accommodates hearing-impaired users</td>
<td></td>
</tr>
<tr>
<td><strong>Other features</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3rd party applications</td>
<td>Preinstalled app stores and a set of apps</td>
<td>Easy access to main mHealth application distribution channels</td>
<td></td>
</tr>
<tr>
<td>Multi-tasking</td>
<td></td>
<td>Medication reminder apps can run in the background while user performs other phone tasks</td>
<td></td>
</tr>
<tr>
<td>Social networking</td>
<td>Integrated major social networking tools and IM applications</td>
<td>Allow patient and doctor networking</td>
<td></td>
</tr>
<tr>
<td>Calendar/task list</td>
<td>Most sync with desktop software, such as Outlook or Google calendars</td>
<td>Physicians/Patients can schedule their appointments</td>
<td></td>
</tr>
<tr>
<td>Document review and editing</td>
<td>Mobile Adobe Reader, Pocket Microsoft Office, copy-paste features</td>
<td>Physicians can manage their work files on the go</td>
<td></td>
</tr>
</tbody>
</table>

Besides device technology features which have become standard, the advances in the mobile network also allow mHealth solutions to include fast-share images and, in the future, video conferences. The following figure shows the impact of today’s different mobile network technologies on uploads and downloads speed. The new generation of smartphone supports 3G and HSDPA network connections. 3G and HSDPA networks are available worldwide, especially in cities.

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17 HSDPA: High-Speed Downlink Packet Access.
The time needed for downloading an image of 1MB on a 3G network takes around 20 seconds, which seems to be an acceptable speed compared to traditional 2G networks (3:20 minutes). Next network generations will even allow the download of videos within an acceptable time-frame.

The mHealth application market will develop on the back of the total smartphone market. To understand the context in which the mHealth market will evolve, the next chapter provides an overview of the current status of the smartphone application market.
4 THE SMARTPHONE APPLICATION MARKET PHENOMENA

The smartphone application market as we know it today is only four years old but has impacted our daily lives in an unforeseen pace. Players from all industries are exploring the new opportunities for reaching their customers on the go via their mobile phones.

Fast reading:

- Growth of capable devices and user base has led to an application download market of significant size.
- In 2012, the paid app download revenue exceeded US$11 billion (Q1 - Q3 2012)
- The number of smartphone applications displayed in the first-tier application stores grew to almost 1.9 million (Q3 2012)
- The market has seen a big drop in average prices. The average price for a smartphone application fell from US$5.43 (Q3 2009) to US$2.82 (Q3 2012).
- The number of full catalogue app stores is stagnating at around 58.
- In contrast, the number of niche app stores is growing.
- Downloads from the top five application stores represent 90% of all downloads in the market (Q3 2012).
- Android overtook Apple in terms of download numbers in 2012.
- Apple’s market share dropped from 77% in 2009 to 36% in Q3 2012.

This chapter provides a brief overview of the smartphone app market and its key players.

4.1 THE INCREASING NUMBER OF APPLICATIONS AND APP STORES

The launch of Apple’s App Store created hype within the mobile industry and beyond. Before long, companies all over the world were scrambling to publish their first iPhone applications. In the beginning, the hype was fuelled mainly by a large number of small “garage” developers who took the opportunity to easily sell a product to a worldwide customer base. In 2009 larger corporations made their first significant steps into the applications market, with the main intention of becoming familiar with this new customer channel. As of October 2009, less than 10% of Fortune 2.000 companies worldwide were active in the Apple App Store. Within the next few years, most major organizations will have a mobile application, making publishing a corporate mobile application as essential as having a company website.

This increased corporate interest in mobile applications is reflected in the total number of applications being published across the most successful app stores. As of the end of Q3 2012 the available number of applications had reached almost 3 Mio. on all platforms. This

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18 Original vendor application stores, including Apple App Store (for iPhone and iPad), Google Play, BlackBerry App World, Nokia Ovi Store, Windows Phone Store.
19 Based on total downloads number.
number includes applications sold on more than one store. The overlap counts for approximately 36%, indicating a true count of approximately 1.9 Mio. discrete live smartphone and tablet applications sold in original OS&OEM stores in September 2012.

**Figure 5: Number of applications published in marketplaces (2007–2012 Q3)**

The growth in app numbers is primarily driven by two major app stores, namely Apple App Store and Google Play. These two stores together added between 100.000 and 170.000 new applications to their store fronts each quarter. At the end of September 2012, the Apple App Store had 687.000 applications (and almost 265.000 apps on its iPad store) instead Google Play had 454.000 applications.
Unsurprisingly, the biggest stores added the most apps. Like large entities in other markets, the sheer size of these stores pulls in users and developers to create a self-reinforcing loop: more users attract more developers, more developers publish more apps, and more apps attract more users.

**Figure 7: Newly added applications per platform (2008 Q3–2012 Q3)**

Note: Dotted line indicates total number of apps in Apple’s App Store for iPhone and iPad. Source: research2guidance, 2013.
This growth has been accompanied and supported by a parallel growth of application store numbers. More and more handset manufacturers and mobile operators are rushing to open up their own application stores.

In 2009 new app store launches came mainly from handset manufacturers and mobile operating system providers. 2010 was clearly the year of mobile operators launching their app stores. Those players rushed into the market and displaced independent full-catalog stores which were the first to offer marketplaces for smartphone applications but had no strength to compete against the big names of the telecom industry. In 2012 the app store race slowed down as all major vendors and operators have already launched their stores. There have even app stores that left the market in last twelve months.

**Figure 8: New app store launches (2000–2012 Q3)**

<table>
<thead>
<tr>
<th>MNOs</th>
<th>Independent</th>
<th>OEM/OS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: X indicates when the store was closed down.
Source: research2guidance, 2013.

The remaining stores constantly improve their services offering by changing their user interfaces, introducing better app discoverability features, enabling more app ranking lists to improve visibility, etc. However not all experimental business models turn out to be successful. Introduced in 2010, LG’s concept to distribute only free apps and integrate social community features, including differentiation of content and users by levels of activity, was not effective. LG World! terminated activity points and membership levels and restored the support for paid apps starting July 2011.

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20 In the context of this report full-catalog stores are application stores which offer applications for various mobile platforms. The most common ones are Symbian, Palm WebOS, Windows Mobile, BlackBerry, Android, Java and iOS (iPhone OS).
New niche stores also seek creative approaches and target either particular industries or offer creative app filtering and tracking features (changes in app price, rank, etc...), thus empowering users to choose the best apps, and giving developers alternative ways to stand out.

At the end of Q3 2012, the number of full catalogue smartphone app stores stands at 58. MNOs still represent the biggest group of app store operators with 31 full catalogue stores, followed by independent app store operators (13).

**Figure 9: Number of smartphone application stores (2007–2012 Q3)**

Since all major OEMs\textsuperscript{21}, OS\textsuperscript{22} providers and MNOs run their app stores, future growth will come mainly from second tier MNOs and niche stores that target specific customer groups. The options for application publishers to distribute their product will continue to increase and therefore remain one of the main drivers for growth in demand for mobile applications.

### 4.2 The growth of smartphone shipments and mobile platforms

Another factor supporting market growth is the increasing penetration of smartphones. Share of smartphones in mobile device shipments retain steep growth. In the third quarter of 2012 almost one in two mobile devices sold was a smartphone. In developed countries, such as the United States, Japan, and Western Europe, users rapidly transition to smartphones; this ratio exceeds 60%.

\textsuperscript{21} OEMs: Original Equipment Manufacturers.

\textsuperscript{22} OS: Operative System.
Overall worldwide smartphone sales to end users reached almost 180 million units in the third quarter of 2012, 56.5% increase from Q3 2011. Although Apple made record-breaking shipments; Android remained the big winner in the race for mobile operating system dominance. Shipping 134.6 million handsets, Android counted for 75% of the smartphone market in Q3 2012.

All other OS providers suffered a decrease in shipments and market share in Q3. Although Nokia remained the leader in the feature phone market, its position in the smartphone
market deteriorated further. Indeed at the end of September 2012 Nokia dropped off from the top 5 smartphone vendors.

4.3 The decline in application prices on mobile platforms and app stores

Average application prices are declining as market competition rises. In 2007, the average application price was almost US$20. With tens of thousands of new applications introduced to the market, the average price\(^23\) dropped by 71% to US$5,73 within two years and finally stabilized at around US$3,00 in 2012.

**Figure 12: Average displayed paid application price in official OEM&OS application stores (2009 Q4–2012 Q3)**

Price differences between the platforms have decreased over time. Generally all application prices go down.

Even formerly high price independent app stores showed a steep price decline over the last years. Application users do not accept to pay higher price for an application, they can get cheaper in an original store. Therefore there are a variety of discount models offered in these stores. For example GetJar, the largest free application distribution platform, now offers a number of paid Android apps for free. The benefits go both to developers and to customers. The customers get premium content off-cost, and the developers get additional exposure that helps to generate sales in original store.

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\(^{23}\) Average price refers only to paid apps.
4.4 Market shares and growth of Application market revenue

Application store market shares, measured by downloads per quarter, showed some changes since last year. Two of the largest app stores, Apple and Android, generate nearly ten billion downloads every quarter. Their overall dominance is increasing. The duopoly is not threatened by growing shares of niche platforms. In 2012 Android became the number one download platform for mobile applications and managed to overtake Apple.

**Figure 13: Application store share of total application downloads per period (2008–2012 Q3)**

Google Play users downloaded 55.5 million applications per day in Q3 2012 followed by the Apple App Store with 49 million downloads per day.
Although app stores are offering more and more free, quality content, the share of paid downloads remains approximately 15%. On average users spend US$2.82 per every paid download, in total generating US$11 billion – the total revenue spent on paid application downloads within the first three quarters of 2012.
Average user expenditure for paid content is slowly decreasing. In-app advertisement has been hyped over the last years but has yet to have a significant impact on the application market in total.
5  Status of the Mobile Health Application Market. The Initial Years 2010-2012

The mHealth market continues to grow on the back of the smartphone and application markets. From 2010 onwards mHealth became a notable market segment in the app market by number of applications, industry players involved and sophistication level of at least some advanced mHealth applications.

With the experience gained during the initial years of 2010-2012, mHealth publishers became more confident about the future potentials of mHealth solutions. The picture sharpened on how the future of the mHealth market will be.

This chapter gives a detailed view of the early years of mHealth app market in terms of mHealth application market figures and the mHealth publisher strategies.

mHealth publisher strategies are based from a regular global survey conducted every year to track the changes on how mHealth publishers view, the mHealth market is going to develop.

Fast reading:

- The number of mHealth applications has increased from 17,000 (2010) to 97,000 (2012) displayed in 62 major application stores.
- Apple App Store, Appitalism, Android, and FastApp offer the largest number of mHealth apps amongst full catalogue stores.
- The largest category of mHealth applications is “Fitness & Nutrition” (38%), followed by “Health tracking tools” (21%) and “Wellness” (13%).
- Educational mHealth applications remain the most expensive.
- The most successful applications in the Health & Fitness section of the Apple App Store were able to generate up to 4.3 million free and 300,000 paid downloads.
- Download numbers in the US App Stores are the highest for successful mHealth applications.
- Paid download model for mHealth applications works best in Japan.
- mHealth application publisher strategies and views on how the mHealth market have changed slightly over the initial years 2010-2012.
- Chronic diseases remained on top of the agenda of mHealth publishers throughout the last 3 years.
5.1 mHealth facts and figures 2010-2012

The early years of the smartphone application based mHealth market underwent major changes in breadth of the offer, the pricing, the distribution channels as well as downloads of the applications. This chapter highlights the key trends over the period 2010 and 2012.

5.1.1 Growth of mHealth application numbers and proliferation into today’s app stores

The number of mHealth applications has grown at the same pace as the average of all applications. Since 2010 their number has increased from 17,350 (2010) to 97,120 (2012). The acceleration of the growth rate is due to an increasing number of application publishers but also due to multi-platform publishing.

Figure 16: Number of mHealth Apps Between 2010 and 2012

In the last three years, the share of mHealth applications as a percentage of the total of all applications fluctuates around 3%. With the increasing number of mHealth applications, discoverability becomes more and more of an issue. This is one reason for the increasing number of app stores that opened specific mHealth application categories during the course of the last 3 years. Now more than half of the app stores that do have mHealth applications have a special category or subcategory to aggregate mHealth applications.
There are only 10 aggregators (of full catalogue stores, excluding niche stores) that offer a broader assortment of more than 1,000 mHealth application today. Apple App Store is the biggest aggregator for mHealth applications, counting almost 28,000 applications. Paid and free applications numbers are similar. Appitalism, a mobile application aggregator and newcomer to this year’s count, offers the second highest number of mHealth applications, followed by Google Play and FastApp. mHealth applications make up anywhere from 1.8% to 10.5% of a store’s mobile applications – no major store has to date focused on mHealth applications.
The ratio of paid/total mHealth applications varies between stores, with some stores offering only paid apps and no free apps (Handmark), or vice versa (Mobango) In most cases the mHealth paid/total application ratio is higher than the average ratio for all applications.

Fitness, Tracking and Wellness applications represent 72% of the existing mHealth application offer. They mainly target consumers or patients. Applications for HCPs like CME, diagnosis or monitoring tools are still only a fraction of the market.
The majority of mHealth applications are being built for the iOS platform. They represent 54% of the market. Android has improved its market share significantly, having experienced a doubling in number of apps developed since 2010. Their success has come at the expense of Windows, and, even more so, from Blackberry. Symbian has all but disappeared thanks to the Nokia Ovi Store. Palm on the other hand is out of the developer race after its store closed in 2011.
5.1.2 mHealth business model changes and price decline 2010-2012

mHealth publishers still rely on the pay-per-download business model for their applications, although the share of paid mHealth apps has steadily decreased year after year, representing just 42% of all apps (74% in 2010 and 67% in 2011). The decline in paid application share is misleading, because, as is seen in the general application market, mHealth publishers make more and more use of in-app purchase or offer a second free version of the application with less functionality thus relying on a single business model.

Figure 21: Share of Free and Paid mHealth Apps Between 2010-2012

Across different platforms, the free/paid ratio varies. Although Android originally was the only platform to present more free mHealth applications than paid ones, it is no longer the case. In 2012, free applications comprised of just 30% of all mHealth applications on the Android platform, down from 53% in 2011. The iOS platform, however, has done the exact opposite of Android, offering now more free mHealth applications (50,5%) than paid ones.
The prices of mHealth applications in stores, as evidenced below, are leveling out and are beginning to approach those of other application categories, suggesting that publishers are exploring other revenue models used by non mHealth application publishers.

For each store, the average price of paid mHealth applications is higher than the average price of total applications. Nevertheless, the mHealth applications market is undergoing price consolidation as the average price of mHealth apps decreases over time. Since 2010, the average price of a mHealth application has dropped from US$13,48 to US$5,17.
Price consolidation has also occurred with respect to price differences between categories. Applications targeting the academic and professional markets are more expensive than applications that are patient/consumer facing, yet the cost for CME applications (the most expensive category) has plummeted from US$29,67 to US$7,89. This category is followed by medical reference with an average price of US$6,11 (US$27,51 in 2011). At the other end of the price scale are the patient-facing apps of wellness (US$2,86), fitness & nutrition (US$2,77), and health tracking applications (US$2,54).
To summarize, the attractiveness the mobile application channel has on mHealth solution providers is still unchanged. The number of mHealth applications has more than doubled from year to year, suggesting that smartphone applications are seen as an attractive channel to deliver medical information and solutions to both patients and professionals.

Still, the maturity level of mHealth applications remains low to medium. There are advanced mHealth solutions, but they represent only a minority share. Several are described in the app category section later in the report.
5.2 Downloads for Top 10 mHealth Applications Publishers (USA, UK, Japan, Brazil, Germany)

Although mHealth applications do not belong to the most popular applications, top 10 applications are able to achieve substantial download numbers. There are two main app store categories that aggregate mHealth applications on the most popular app stores from Apple and Android: Health & Fitness and Medical. Applications that are listed in the Health & Fitness section of those two stores are more in the focus of today’s users. Applications ranked amongst the top 10 in December 2012 generated 10 times more downloads than their counterparts of the Medical app sections.

The following analysis shows the cumulated download numbers of the top 10 ranked applications in December 2012. It provides a good indication of what has been possible in terms of download numbers during the initial years of the mHealth application market for a successful mHealth application.

5.2.1 Top 10 mHealth App Download Number on the Apple App Store

The most successful applications in the Health & Fitness section of the Apple App Store were able to generate up to 4.3 million free and 300,000 paid downloads. Applications that are ranked high in the US market generate the highest download numbers of all countries on average. This applies to applications that take a charge for the download and free once. The ratio between free and paid downloads varies significantly per country. In Japan, the top 10 paid applications generated almost the same cumulated download numbers than their paid counterparts. By contrast, the leading free applications in the US market show almost 10 times more downloads than the most successful paid applications.

Figure 26: Cumulated downloads of top 10 apps in Health & Fitness category by country and device type on Apple App Store

Base: December 2012.
Source: research2guidance, 2013.
Due to the lower penetration rate of tablets (iPad) compared to smartphones (iPhone) the number of downloads a successful iPad Health & Fitness application generates is significantly lower than their iPhone counterparts. Figures indicate that paid iPad applications in the US market do have a greater chance to be downloaded compared to the other markets. Successful iPad paid applications in the US generate more than 1/6 of the download numbers of top 10 iPhone paid applications. All other countries show a significantly lower iPad/iPhone download ratio.

Top 10 applications that are listed in the Medical section of the Apple App Store generate only a fraction of downloads compared to the top 10 applications in the Health & Fitness category. Applications that are listed in the Medical sections tend to address more the smaller target group of HCPs rather than private users. Most of the remote monitoring and consultation, CME and diagnosis tools are listed in this category. Throughout all countries, the gaps between iPhone and iPad downloads are much smaller. In Japan the cumulated download numbers of top 10 paid iPad application exceed download numbers of the most successful iPhone download numbers.

**Figure 27: Cumulated downloads of top 10 apps in Medical category by country and device type on Apple App Store**

Source: research2guidance, 2013.
5.2.2 Top 10 mHealth app download number on the Google Play Store (Android)

Top 10 free applications in the Health & Fitness section of the Google Play Store generate similar cumulated download numbers compared to top 10 applications on the Apple App Store. There are also major differences in download numbers between countries but successful free applications of this category can plan to generate hundred thousands or millions of downloads for their free applications.

Android still attracts mainly users that do not want to pay for the content. Numbers indicates that this applies also to the users of mHealth applications. Download numbers are significantly lower for paid applications compared to free once.

Paid download numbers are also lower compared to successful applications on the Apple App Store.

Similar to the Apple platform, the US market offers by far the highest download opportunity for successful applications in that category.

Figure 28: Cumulated downloads of top 10 apps in Health & Fitness category by country on Google Play

All of the findings mentioned above also holds true for the successful applications that are listed in the Medical section of the Google Play Store.

Top 10 applications generate up to almost 600,000 free and a few thousand paid downloads.

Applications that are specifically build for Android tablet computers are still a niche within the Google Play eco system. Download numbers are not of any significant size to be recorded.
5.3 mHealth Application Publisher Strategies 2010-2012

Attracted by the overall market hype around smartphone applications, independent application developers and, to a lesser extent, traditional healthcare industry players have started to develop and market mHealth applications on the various smartphone application stores. Recently insurance companies and healthcare systems began to develop their own applications for their customers as a means of becoming a “preferred” provider.

This chapter looks at mHealth application publisher strategies, lessons, and forecasts over the course of the last 3 years. The insights are based on the assessment of more than 1,000 mHealth applications publishers who participated in research2guidance’s yearly mHealth expert survey.

5.3.1 Business Potential

mHealth application publishers view applications which address chronic diseases as the market segment that offers the highest business potential.

Diabetes is clearly the number one therapeutic area that offers the highest potential for mHealth solutions, followed by Obesity and Hypertension. The order has not changed over the course of the last three years.
Mobile applications are seen as the perfect tool to support medical compliance of patients. Pill reminders and diaries are examples for simple but effective mobile use cases for this category. Medical compliance applications are the top application category in terms of business potential. Health tracking tools and fitness applications rank second and third. Interestingly, remote consultation and monitoring applications account only for a fraction of today’s mHealth applications, yet are attracting more and more attention from today’s mHealth application publishers.
The business potential of mHealth applications that addresses HCPs is more balanced between the different application categories. Over the last three years remote monitoring is seen as the application category that offers the biggest market potential in the B2B segment. Other solutions ranging from CME to EHR applications show comparable business potentials. With the exception of remote monitoring and consultation, there is a clear separation of mobile use cases that addresses the private and professional health care market. Applications that rank high in terms of business potential in the private market rank low in the HCP market and vice versa.

**Figure 32: Business potential of different mHealth solutions (professionals)**

![Figure 32: Business potential of different mHealth solutions (professionals)](image)

N = 1.032

Smartphones are the primary device to carry mHealth solutions. Tablets rank second. The figures in the following table indicate that mHealth publishers needed some time to realize the benefits of bigger screen size to their mHealth solutions. Tablets and smartphones, however, have very much so a place in the market, but serve opposite functions. Tablets are suitable devices for physicians and other healthcare professionals because of their display capabilities (e.g. larger screen) which are conducive to viewing x-rays and other medical images as well as for media rich applications for CME. Tablets are also thought of as superior for referencing both information and health records at the point-of-care. Smartphones, on the other hand, are better equipped for providing more patient-centric functions such as health tracking and health and fitness apps. Smartphones are also lighter and less conspicuous, making them easier to incorporate into everyday practices like tracking blood sugar levels.

---

There are almost as many cell phones (feature phones) in the world as there are people. These phones were the first devices to be used in mHealth and continue to be used as mHealth-specific devices in the developing world as a means of sending alerts and news updates, and ensuring compliance.

**Figure 33: Business potential of devices for mHealth today**

The main difference between the device preferences of today and of the near future is that mHealth specific devices and game consoles will become more important in the business planning of today’s mHealth solution providers. The assumption is that even with technology advances of standard smartphones and tablets, a growing part of advanced mHealth features could not be served by devices not built for patients and doctors.

Senior phones are also becoming more attractive for mHealth publishers but to a lesser extent.
iOS and Android are the preferred mobile platforms for mHealth developers. BlackBerry, Symbian and Windows Phone lost mind share of application publishers over the course of the last three years. In the initial years, almost by rule, developers chose iOS as the first platform with the Android version coming out shortly thereafter. Other platforms did not play a significant role for mHealth solutions.

**FIGURE 35: BUSINESS POTENTIAL OF DIFFERENT SMARTPHONE PLATFORMS TODAY**
According to the judgment of mHealth solution providers, the duopoly of iOS and Android as preferred platforms will remain intact for the next 5 years.

Windows Phone is seen as the only platform apart from iOS and Android that will have a chance to offer enough business potential for mHealth developers to gain significant mind share in the developer community.

BlackBerry will have to put a lot of effort into regaining trust of their platform; otherwise no developer will elect to write applications for Blackberry devices.

**Figure 36: Business potential of different smartphone platforms in 5 years**

![Graph showing business potential of different smartphone platforms](image)

$$N = 1.032$$

### 5.3.2 Main Target Groups and Distribution Channels

During the initial years, the chronically ill were identified as being the primary target group followed by healthcare interested people. The importance of these two groups derives from the prevalence of chronic diseases and the popularity of the quantified-self technologies. Chronically ill patients in many cases require a caregiver, typically a relative or friend. Over the last three years a constant share of around 35% of mHealth solution providers rated caregivers as the target group offering the highest business potential for mHealth applications.
In 5 years, the chronically ill will become the main target group for mHealth. The underlying assumption is that applications will be a more sophisticated and an integrated part of the therapy plan of chronically ill patients, and ultimately will be accepted by health insurances (Integration phase). Health care interested people will remain a primary target group for e.g. health tracking applications but mHealth publishers will focus more on traditional health topics targeting caregivers and sick people.

**Figure 38: Main target groups of patients in 5 years**

*Individuals who are highly interested in fitness, nutrition and other related issues.
**Other was not given as an option in 2010 and 2011.
N = 1.032*
Among HCPs, clinical doctors are the main target groups for mHealth application developers followed by independent general practitioners, nurses and medical students. Solutions exist for every group of HCPs. Doctors, for example, consult mobile applications to check health parameters remotely. Nurses use mHealth to manage health records and read lab results. Pharmacists fill electronic prescriptions and keep track of adverse reactions to medications using mHealth, while health administrators manage the supply chain of their clinics from information gathered from mHealth solutions.

**Figure 39: Main target groups of healthcare professionals for today**

![Figure 39: Main target groups of healthcare professionals for today](image)

* Independent general practitioners refer to doctors working outside of a hospital.

*Healthcare Administrators* and “Others” were not given as options in the 2010 and 2011 surveys. N = 1.032

The main target groups in the professional health care market will not change in the next 5 years. Change will instead come in the form of increased mHealth solution developer confidence that professionals and laypersons will offer interesting business opportunities within the mHealth industry.

**Figure 40: Main target groups of healthcare professionals in 5 years**

![Figure 40: Main target groups of healthcare professionals in 5 years](image)

* Independent general practitioners refer to doctors working outside of a hospital.

*Healthcare Administrators* and “Others” were not given as options in the 2010 and 2011 surveys. N = 1.032
App stores are the dominant distribution channel for mHealth applications. The perceived importance of app stores has even increased during the initial years of the mHealth application market. Other distribution channels like web pages and physicians are used as well, but with decreasing importance. MNOs, the primary distribution channel within the trial phase, do not play a major role today.

**Figure 41: Current distribution channels of mHealth solutions**

The dominance of app stores as the number one distribution channel will give way to a set of channels that are ranked as equally important in the near future. The confidence mHealth companies put in this judgement has decreased year after year. Nevertheless market players assume that mHealth applications will, in line with the development of the mHealth market, included in treatment plans and therefore prescribed by physicians or provided by hospitals. Pharmacies will fill these prescriptions and will also offer “over-the-counter” apps. mHealth applications that aid in the prevention of illness and disease will be made available by health insurers.
Overall, mHealth companies are increasingly optimistic about the penetration mHealth solutions will achieve within the professional and private target groups. The expectation is that 60% of HCPs and 52% of patients will make use of mHealth applications in 5 years.

*Figure 43: Use of mHealth among medical professionals and patients in 5 years*  

*Percentage of medical professionals and patients in developing countries only. Includes North America, Europe, Australia, New Zealand, Japan, South Korea.*
The optimistic view is supported by mHealth players’ agreement with the following hypotheses about the future development of the market.

An increasing share of 74% they hypothesis that mHealth applications will be used by the majority of HCPs in 5 years. 67% agree that mHealth applications will be widely accepted by patients to support their well-being and health.

The relevance of niche stores that address the specific needs of the mHealth market is less supported by today’s market players. Nevertheless, 45% agree that niche stores will play a significant role the future.

**FIGURE 44: MAJOR HYPOTHESIS ABOUT THE DEVELOPMENT OF MHEALTH INDUSTRY**

What is more uncertain is to what extent traditional healthcare payers will cover the costs of mHealth solutions. Still, 45% of the mHealth companies believe that the major share of mHealth will be covered by health insurances.
6 THE mHEALTH APPLICATION CATEGORIES

The mHealth application landscape today presents a broad range of use-cases. This chapter describes and clusters applications that are currently available. Examples are selected to illustrate either a typical application or an application that demonstrates current state-of-the-art in mHealth application publishing.

**Fast reading:**

- mHealth applications fall into four main categories: general healthcare & fitness, medical information, remote monitoring & consultation, and healthcare management.
- General healthcare and fitness is by far the biggest application category.
- Sophistication level of the major share of mHealth application is low to medium.
- The elements that make a mHealth application successful (best practice) are similar to other application categories: true mobile value add, gamification, social network linkage, interoperability, advanced business concepts and superior user experience “wow” factor.
- Sensor support will be common for advanced mHealth applications.

mHealth applications fall into four main categories: general healthcare & fitness, medical information, remote monitoring & consultation, and healthcare management. Overlap is typical, with most use-cases falling into more than one category. Although generally the sophistication of today’s applications is low to medium, advanced solutions do exist. Most applications are designed recognizing that the smartphone is a very personal device. This allows for patient-data-centric solutions that utilize users’ personal health information, rather than more general non-personal health information.

**TABLE 6: mHEALTH APPLICATIONS CATEGORIES**

<table>
<thead>
<tr>
<th>Category</th>
<th>General &amp; fitness</th>
<th>Medical information</th>
<th>Remote consultation &amp; monitoring</th>
<th>Healthcare management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main use cases</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>provide general health related information</td>
<td>provide medical information to both professionals and laypersons</td>
<td>provide remote access to professional medical staff</td>
<td>manage patients’ data and insurance information both at the point-of-care and on-the-go</td>
<td></td>
</tr>
<tr>
<td>track and manage health and fitness metrics</td>
<td>educate</td>
<td>continuously monitor health conditions</td>
<td>video consultation and/or consultation via image sharing</td>
<td></td>
</tr>
<tr>
<td>manage mental wellness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main target group</td>
<td>Private</td>
<td>Professionals, students and caregivers</td>
<td>Professionals</td>
<td>Professionals, healthcare administrators</td>
</tr>
</tbody>
</table>
These application categories are broken down into subcategories. These subcategories have expanded with the creation of new mHealth markets, specifically the HCP and Corporate markets. Subcategory apps overlap, generally targeting both the consumer (patient) and either HCPs or Corporations.

1) **General healthcare and fitness**: More than 2/3 of all applications presently available in major app stores fall into this category. These applications make it possible for private users to take a more active role in improving or maintaining their own health through the tracking and monitoring of various health and fitness metrics including weight, calories consumed, blood sugar, etc. These applications gather health information and then present it in a way that non-professionals are able to understand. Few of these applications are complex, relying mostly on the user’s manual input of data or basic technology such as pedometers. Presently, however, devices such as blood glucose readers are able to connect to and sync with a smartphone. Also possible is the wireless transfer of data from sensors and patches to smartphones and tablets via Bluetooth.

2) **Medical information database**: The advantages of having medical information available at the point-of-care, primarily via hand-held devices, were realized very early, and the medical PDA market has thrived since the 1990s. At the same time, patients began using the Internet to become more involved in their own health. Websites such as Web.md are continuously — and have been for some time — among the most visited. Many major textbooks are available for smartphones and PDAs, as are many educational and reference books for e-readers such as Amazon’s Kindle. The current consumer mHealth market model, as mentioned earlier, is a result of the advent of 3G technology and the smartphone. Now not only can patients and HCPs connect directly to the mobile web, and download information at a high speed, but they can even refer on-the-go directly to panels of experts and specialists, patient and clinician forums, central data-bases for drug information, best-practice guidelines, education material (e.g. flashcards, videos), care pathways, etc. This category addresses the needs of professionals, students, patients and care-givers. In 2011 this category made up the largest group of applications, but is — as of 2012 — second behind the general Health & Fitness category.

3) **Remote consultation and monitoring**: The primary functions of applications that fall into this category provide ad hoc or continuous access to HCPs, and to collect and send
health information to a medical monitoring server. Monitoring solutions generally track health parameters specific to the patient’s chronic condition using sensors or manual data entry of professionals, caregivers or the patient him/herself. Health information is, either automatically or on demand, sent to the remote monitoring center where data and actions are then processed and assessed. Current monitoring solutions are typically used to track patient conditions and assist with the management of chronic diseases like diabetes, hypertension and CHD27.

i) **Personal security monitoring** applications represent a sub-segment of the monitoring applications category. These solutions offer emergency call and location features for such diverse target groups as children, Alzheimer’s and dementia patients, and field workers. Typically these solutions are sold as both projects (nursing homes, schools, hospitals) and products (in-home care) and are monetized as services.

ii) **Remote consultation** allows medical professionals to observe and consult cases remotely with the use of video conferencing and audio/image sharing. As for remote consultation for diagnostic purposes, it is currently possible to send information (images, data inputs, etc.) which is then read by either a professional or by software that relies on an algorithm. An educated diagnostic opinion is then generated and sent to the patient.

iii) **Remote collaboration** involves the interaction (records annotations and remarks) and sharing (patient files, images, etc.) between professionals typically for use in remote and rural areas, or areas with limited resources and personnel. Only a few solutions and applications that provide for remote monitoring, access and consultation are available in major app stores.

4) **Healthcare management** applications generally support the management of patient records and lab results (either by the patient or HCP), and assist patients with scheduling and billing. Solutions are also available for HCPs and healthcare administrators to help keep track of tasks, availability, and supplies/resources. The main purpose of these applications is to increase process efficiency whilst reducing treatment costs and time. They target medical care organizations as well as private people who wish to have their medical health records permanently available. This category represents a minor share of the total number of mHealth applications currently available in application stores.

The following examples illustrate current state-of-the-art as well as commonly used features. Each application included in the report showcases typical functionalities of that category. The listed application also illustrates elements of a “best practice” application.

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27 CHD: Coronary Heart Disease.
“Best Practice” elements represent concepts and functionalities which help to make mHealth applications successful. Five “best practice” elements can be extracted from successful mHealth applications.

- **Advanced mHealth value add**: Successful mHealth applications concentrate on supporting a specific mobile use case. These use cases create a value add for users that goes beyond surfing “on the go”. Examples of these advanced value adds are diabetes applications which replace specific medical devices that allow patients to test their blood sugar level with the help of a test strip. Another example is health record applications that allow patients and doctors to access patients’ history treatments, medicines and therapy results when needed. Successful mHealth applications support a mobile use that truly is beneficial for the HCPs or patient’s life.

- **Gamification**: Gamification is the use of game mechanics and thinking in activities that normally do not involve play or games so as to foster participation and engagement. Ultimately, gamification makes things fun that aren’t typically thought of as such. This principle has recently been incorporated into mobile health applications so as to spur continuous usage. Applications that rely on gamification range from fitness apps to apps that encourage users to manage their medical conditions.

- **Social networking linkage**: Social networking sites like Twitter and Facebook are, for all age groups, among the World Wide Web’s most visited websites. Each day more and more people are sharing personal information, including information regarding their health, via these websites. Applications which integrate social networking sites ultimately create a community of users who share a common experience, goal, lifestyle, etc. Social network users trust the information posted by their friends and contacts, having used these sites to get recommendations of, for example, specialist doctors or over-the-counter medications to treat their children’s illnesses. Successful mHealth applications make use of the network effect created by linking to social networks.

- **Integration and platform interoperability**: The more an application can connect with and sync to another databases and devices, the more valuable it is to its user. Hospitals and clinics will be more likely to adopt mHealth solutions when they can be integrated into the existing infrastructure and interact with existing hardware. Diabetics will prefer an application that can read and download information from their glucose meters, thereby eliminating the need to manually input data. Applications, in the future, must also provide interconnectivity across device platforms. Cross platform optimization and device agnosticism ensure that functionality exists across all platforms, meaning that a doctor can use the iPad application to send a chest scan to the patient’s Android, smartphone version of the
Successful mHealth applications are able to be easily connected to a devices and databases as well as run on multi mobile platforms.

- **Advanced business concept:** The majority of mHealth application developers rely on the pay-per-download revenue model. More enabling technologies, however, are being developed and incorporated into these applications, and are in turn allowing developers to diversify their business models. Sensors and special devices that are designed to take advantage of the smartphone interface will create new service offerings. As the market develops, applications will facilitate the sale of products (e.g. sensors) and services (e.g. remote consultation). Products that provide users a continuous benefit can be monetized by charging a subscription fee, while other applications can generate revenue through in-app or health-specific advertising. Successful mHealth applications most likely rely on other business concepts than pay per download.

- **“WOW” factor:** This criterion is the most subjective but everybody who has opened an application and was astonished that “this” is possible, know what the “wow” factor means. Application that surprise the user by new functionality, content, design or business concept have more chance to be successful as a “I have seen this already” applications. Successful mHealth applications do surprise their users and make them show the application around.

### Table 7: Specifications for quick reference of mHealth application categories (Legend)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Gamification</th>
<th>Social Networking</th>
<th>Integration</th>
<th>Business Concept</th>
<th>“WOW” Factor</th>
<th>Added Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Icon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

#### 6.1 General Healthcare and Fitness

#### 6.1.1 Fitness & Nutrition

The largest sub-group in the mHealth market is comprised of fitness and nutrition applications. Such applications target healthcare interested people. Some applications include tracking abilities such as distance covered (relying on GPS or pedometer), and heartbeat. The majority of apps concentrates on providing information and instructions for exercise routines, and is typically free or sells for a few dollars. Gamification and social
media aspects have been added to these applications as a means of increasing engagement (competition) and support. Nevertheless applications are typically limited in terms of functionality. Some of these solutions may have advanced versions which are either offered as a separate paid app, or can be purchased as an add-on through in-app purchasing. Sophisticated applications range in price anywhere up to US$12,99 or are purchased at a lower price but require a weekly, monthly or yearly subscription. Nutrition applications, however, are generally less expensive (typically free or sell for a few dollars) because they are less complex as they rely even more so on the user’s manual input of data.

Primary use-cases:

- Provide instructional images or videos demonstrating for example the correct way to do a workout.
- Provide details on various exercises or yoga poses, guides on how to train for a 10k, as well as information on many other fitness related topics.
- Include GPS and mapping features to track exercise routes, distances, speed, etc.
- Manage schedules, exercise workouts, trainers, etc.
- Provide databases containing nutritional value and calorie content of food items.
- Calculate and log metrics.
- Provide easy-to-read and sharable graphics containing personal data.

Example: VirtuaGym (Digifit.eu)

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
<td>8/2012</td>
<td>1.1</td>
<td>9,000</td>
<td>16</td>
<td>4,8</td>
<td></td>
</tr>
<tr>
<td>Android</td>
<td>6/2012</td>
<td>2,41</td>
<td>&gt;2 million</td>
<td>9,239</td>
<td>4,4</td>
<td></td>
</tr>
</tbody>
</table>

VirtuaGym is an application that targets users’ habits to promote healthy activities and eliminate unhealthy ones. The app offers a collection of 500+ exercises and 100+ workouts each with a 3D demonstration provided by a personal trainer avatar by the name of Brad Fit. Also included in the app is a digital dietician system. Users can unlock achievements and can share their success via social networking sites like Twitter and Facebook. Users can also compete with one another via these social networks, challenging each other to various activities and competitions. Presently the app boasts 2 million “members” around the world and is available in both English and Dutch languages for Android and Apple platforms. Digifit.eu has cleverly monetized its app, offering the app for free, but selling “gym” membership subscriptions to users who wish to unlock all of the app’s capabilities. Users can purchase membership subscriptions within the app for various lengths of time: subscription for 4 weeks (US$21,99), 3 months (US$44,99) or a year (US$99,99).
Example: Healthy Heroes (WarmBreeze Studios AB)

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
<td>2/2012</td>
<td>3.1</td>
<td>19,000</td>
<td>61</td>
<td>4.4</td>
<td></td>
</tr>
</tbody>
</table>

*Healthy Heroes* is a fitness app for iOS that relies on gamification and social interaction. Users check in and out of activities to level their characters. Through real life exercise, sleep & relaxation, and good diet, users can add to their character to make them stronger, faster, more agile, smarter, and more protected. Users can choose among both “heroes” and “villains”. With this app, you can share your accomplishments on various social networks, attach pictures to activities, challenge foes and invite friends, and unlock achievements.
6.1.2 Health tracking tools

Health tracking tools are the next largest subgroup of healthcare and fitness apps. These apps serve as logs for exercise, food and drink consumption, weight loss, calorie loss and intake, and much more. A majority of these apps is geared towards female health (pregnancy and ovulation trackers). Health tracking tools range in both capacity (from extremely basic to moderately advanced) and price (free to several dollars). Because these applications serve fairly basic functions, it is difficult for developers of these apps to distinguish their products from competitors. To attract downloads, developers focus on creating an optimized user experience through ease of use and aesthetics.

**Primary use-cases:**

- Manage biological schedules: ovulation and pregnancy.
- Track intake of food and drink.
- Log and track symptoms.
- Generate easy-to-read and sharable graphics of personal health data over specific periods of time.
- Compare personal data with those of others.

**Example: Thryve (Thryve, Co.)**

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
<td>10/2012</td>
<td>1.1</td>
<td>12,000</td>
<td>30</td>
<td>4.5</td>
<td></td>
</tr>
</tbody>
</table>

Thryve is an application that visually tracks users’ meals and their physical and mental states afterwards. The majority of calorie trackers and nutrition apps expect users to be able to measure portion sizes in grams and ounces. Unlike typical calorie trackers, however, Thryve users take a photo of their meal, enter the ingredients, and then adjust a sliding bar graph to measure the amount of each ingredient. A few hours later the application sends the users a prompt asking them how they feel since their last meal. Users can check the nutritional breakdown of their meals for that day or previous days. Users can also compare their dietary habits to those of Thryve’s other users as well as the Harvard recommended diet. Ultimately the app provides suggestions for what to eat more of and what to eliminate from its users’ diets.
6.1.3 Managing Medical Conditions

More and more applications are being developed to assist individuals with chronic medical conditions or in special states like pregnancy. These applications are meant and designed to be used by the patients themselves. Although many of these solutions require manual input, some are able to attach to medical devices such as glucose readers. Eventually the ubiquity of sensors will lead to real-time data acquisition and transmission, further empowering the user. Applications exist for several conditions including: asthma, cancers, eating disorders, Crohn’s disease, diabetes, cardiovascular disease, hypertension among others.

Primary use-cases:

- Users keep track of their particular health condition in a log or journal.
- Allow integration with or manual input of data from an external medical device. Tracking for example blood-pressure, heart-rate, glucose-level, etc.
- Provide various medical references related to a disease or condition.
- Include healthcare related data and contacts.
- Enable patients to send messages or graphic data to their physicians.
- Applications send alerts to caregivers, HCPs and family in the event of an abnormal condition.
- Integrate with EHR/PHR systems.
**Example: mySugr (mySugr GmbH)**

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
<td>4/2012</td>
<td>1.4.1</td>
<td>N/A</td>
<td>19</td>
<td>4.3</td>
<td></td>
</tr>
</tbody>
</table>

mySugr is the only diabetes app in the European App Store that was developed in accordance with the EU regulations for medical devices. The application incorporates gaming, sound, graphics and humor to encourage diabetics to continuously track their sugar and insulin levels. Users input their personal diabetes data into the app in order to appease the application’s “Monster”. Users can also track injections, meals and activities, and can keep a photo log. The creators have developed the app for the Apple App Store and charge a monthly fee of 4,99€ per month or 39,99€ per year. The company’s goal, however, is to make the app free for all users through the formation of partnerships. At present, the European pharmaceutical company Sanofi offers free yearly subscriptions to those mySugr users who are able to consecutively “tame the monster” 5 days a week for 20 weeks, whilst A1 Austria makes the application free for all employees who suffer from diabetes.
6.1.4 Medical Compliance

Current medication compliance applications are generally simple reminders to help patients remember to take their medication or supplements on time. Amongst others are applications that remind women to take their birth control pills, and reminders for asthma patients to adhere to their inhaler routines.

Primary use-cases:

- Contain general drug information.
- Provide reminders to users to take their medication.
- Send push and local notifications that help users track how many pills they have taken, how often, and how many they have left.
- Allow ePrescription writing.
- Track medication intake and send results to physicians or family members.

Example: Helius (ProteusDigitalHealth)

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
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<td></td>
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</tbody>
</table>

*Helius* is the first FDA and EU approved ingestible sensor used to track health data. The main function of the system is to measure medical compliance. A sensor the size of a grain of sand is embedded in a pill. The patient’s stomach fluids power the sensor, which then sends a signal through the body to a patch worn on the patient’s skin. The signal indicates that the patient has ingested the proper medication as well as the time of ingestion. The patch collects physiological data such as temperature and heart-rate, and then sends this information to the patient’s mobile phone. Information is then presented within the smartphone application. Proteus has yet to launch the application, although it has already gained approval for sale in the United States and European Union. UK-based retail pharmacy chain Lloyds pharmacy has entered into a partnership with Proteus Biomedical to launch their own version of the *Helius* technology. The pharmacy chain will make Proteus Biomedical’s technology available to its customers through the sale of a personalized adherence “pack”.

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Single User License
**Example:** *mscripts Mobile Pharmacy Solutions (mscripts LLC)*

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
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<tbody>
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<td>N/A</td>
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<td></td>
</tr>
<tr>
<td>Android</td>
<td>N/A</td>
<td>N/A</td>
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<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Blackberry</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

*mscripts* LLC develops tailor-made solutions for pharmacies to offer to their customers (Navarro, WinnDixie). Solutions allow customers to refill prescriptions, receive notifications, set dosage and refill reminders, and keep track of their prescription history. Customers can refill their prescriptions by scanning the prescription barcode, send a text message to the pharmacy with the prescription number, or by clicking refill button within the app. Users can decide on a frequency and time of day for pill reminders, and will receive refill reminders from the pharmacy. Pharmacies can advertise weekly deals and send medication-specific coupons that are delivered to customers’ smartphones. Ultimately customers benefit from better drug adherence and convenience, while pharmacies gain a competitive advantage and build brand awareness. Apps are available to customers for free for iOS, Android and Blackberry.
6.1.5 Wellbeing (Traditional and Corporate)

**Traditional wellness** applications seek to improve primarily users’ mental health but also aim to help users quit certain behaviors such as smoking. Most of the applications out there within this category promote sleep and relaxation, and reduce stress by providing guides and media content (music, positive quotes and images). For people who suffer from depression and other mental disorders, there exist a few applications for users to track their mental states and record the effects of prescribed medications on their moods.

**Primary use-cases:**

- Increase mental health by providing information and curing content for emotional and mental disorders.
- Improve quality of life by reducing stress and promoting healthy habits.

**Example: Zeo Sleep Manager (Zeo, Inc.)**

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
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<tr>
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<td>144</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Android</td>
<td>12/2011</td>
<td>2.1</td>
<td>17.100</td>
<td>146</td>
<td>3.4</td>
<td></td>
</tr>
</tbody>
</table>

This FCC\textsuperscript{28} certified app is to be used in conjunction with the Zeo SoftWave™ headband, a sensor-based accessory for users to track their actual sleep stages. The sensor measures brainwaves, eye movements, and muscle activity, and tracks how long a user spends in REM and deep sleep. The information gathered from the sensor is transferable via Bluetooth to the user’s smartphone. The app then displays graphically the user’s sleep statistics,

\textsuperscript{28} FCC: Federal Communications Commission.
summarizes that night’s sleep in a single number (the user’s ZQ score), and makes suggestions on how to improve sleep quality. The SmartWake™ Alarm, a key feature of the app, gently wakes users at the optimal point in their sleep cycle so that they awake refreshed. The app is available for the iOS (both iPhone and iPad2) and Android platforms for free. The headband, online tools, and a sleep coaching program can be purchased as a bundle on the company’s website for $129,00. The headband itself is available in major electronic retail stores for $99.00.

**Corporate wellness** was explained in the previous chapter. Companies are offering solutions to their employees in order to save costs, and increase productivity among other benefits. These applications typically encourage employees to live healthier lives by eating healthily and exercising regularly, and attempt to lower stress levels both within and outside of the workplace. These solutions are geared more towards encouraging physical activity and healthy eating and can be tailored to develop a wellness strategy specific to the company.

**Primary use-cases:**

- Increase company-wide employee health.
- Empower employers to get involved.
- Increase efficiency and productivity of companies.
- Improve quality of working conditions.
- Improve company morale and develop company culture.

**Example: HeiaHeia (H2 Wellbeing Ltd.)**

HeiaHeia is an online tool for logging and sharing exercise with colleagues and friends through social media. The company offers two solutions, one for individuals and a tailor-made solution for corporations to improve employee and company wellness. Experts at SATS, a leading European fitness chain, created HeiaHeia’s online training program. Programs are individually customized to each employee’s inputs: fitness level, needs, and preferred program type, and are fully integrated to the user’s personal account. Employees can then choose activities from their program, HeiaHeia, or from Twitter and Facebook.
Within HeiaHeia, users can comment and encourage colleagues with virtual ‘Cheers’ similar to Facebook’s ‘Like’ feature. Employers are provided by HeiaHeia with statistics and a summary of activity levels (further broken down by subgroups and even geographies) so as to view company and employee activity levels. Furthermore, HeiaHeia allows companies to set up contests and challenges. HeiaHeia, however, does not offer an in-house mobile application. Instead, it has created a mobile touch-site that runs on iOS, Android, Windows Phone, Symbian and Blackberry. Users, via their internet browser, can then add the touch-site to their home screen via the shortcut icon. The company has nevertheless developed an API for app developers to create HeiaHeia compatible solutions. These apps are able to “plug into” HeiaHeia and its social, community, and statistics features. Heia2Go, Heiatracker, and HeiaSports are just a few applications developed from the company’s API, and are available at different costs in major application stores such like the Google Play and Apple App stores.

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**GetHealth (GetHealth Ltd.)**

GetHealth is a mobile and online platform for encouraging employee health and happiness. By checking-in to categories and earning points, GetHealth provides its users with an easy metric by which to assess their health improvement. Users simply go to the home screen to update their Move (physical activity), Munch (diet) and Mind (mental health) levels. Points are added to users’ overall health scores, and the goal is to beat a rolling 7-Day best. In turn, users are rewarded with stars of achievement for improvement, consistency or performance. A leaderboard displays fellow employees’ and friends’ health scores to encourage competition. Employers can track engagement through the GetHealth admin dashboard, interpret data against business metrics and measure their return on investment. The solution is available in both premium and basic, and is priced based on company size ranging from $60 to $1,700+ per month.
6.2 Medical Information

6.2.1 Reference

The category comprises of mobile solutions that provide medical information to HCPs at the point-of-care as well as to patients and caregivers. Databases that support these applications are the most comprehensive and sophisticated in the mHealth industry and provide access to information resources including but not limited to anatomical atlases, medical dictionaries, textbooks, reference works on clinical practice, peer-reviewed articles, journals, EBM\textsuperscript{29} guidelines, and just about anything that constitutes healthcare information and can be published in any medium.

Primary use-cases:

- Search topics by keyword.
- Provide expert opinion, and best-practice guidelines.
- View images and 3D animations.
- Bookmark selected material.
- Provide news feeds.
- Identify drugs.

\textsuperscript{29} EBM: Evidence-Based Medicine.
Example: ePocrates (ePocrates, Inc.)

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
<td>7/2008</td>
<td>5.1</td>
<td>3 million</td>
<td>55.381</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Android</td>
<td>3/2010</td>
<td>1,1042</td>
<td>1,4 million</td>
<td>15.506</td>
<td>4.2</td>
<td></td>
</tr>
</tbody>
</table>

This application makes a return to this year’s report. Among the most mature mHealth reference applications, ePocrates provides an extensive database of drug information. The information contained within the application reference guide is developed by HCPs and is specially formatted for medical devices. The free version of the application provides clinical information on thousands of prescription medicines and pharmaceutical products, an in-depth formulary, Pill ID (identification of pills through entry of a description of the physical characteristics and imprint code), a drug interaction checker, dozens of calculators, as well as the most relevant medical news and information. The premium version includes, among a host of useful features, an integrated disease database with conditions, treatment guidelines for hundreds of infectious diseases, a database of over-the-counter medications, and hundreds of diagnostic and laboratory tests with a guide to interpretation of results. It also provides access to the ICD-930 codes as well as a medication dictionary with over 100,000 medical terms.

International Classification of Disease 9th Revision.
### 6.2.2 Diagnostic Tools

Applications that can be categorized as diagnostic tools typically provide diagnoses based on a manual search in which the user describes signs and symptoms, or based on the input of less subjective data such as photographs or test results by the user. Less common are applications that are able to conduct measures to support or confirm a diagnosis, or to further analyze test results. Diagnosis tool applications include dermatological evaluation, optometric tests, ultrasound checks, and pneumonia and blood oxygen measurements. Most of these products are still under trial and are mainly targeted at professionals, who increasingly demand more portable and easy-to-use devices as well as faster and more direct means of communication, in order to share information with patients and peers immediately.

**Primary use-cases:**

- Search for diagnoses based on signs and symptoms.
- Suggest treatment based on diagnoses.
- Provide tools to access patient diagnostic data that:
  - Integrate with PACS and facilitate access to institutions’ servers.
  - Include digital imaging solutions for medical image review and management.
  - Provide medical reference resources containing various medical images (e.g. radiology images, roentgenograms, electrocardiogram previews, videos, etc.).
- Provision of measuring tools that assist in the diagnosis of certain body conditions or interpretation of test results.

**Example: Isabel (Isabel Healthcare)**

<table>
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<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
<td>3/2012</td>
<td>1.3</td>
<td>9,000</td>
<td>30</td>
<td>4.3</td>
<td></td>
</tr>
</tbody>
</table>

Isabel is an iPhone app designed to guide medical doctors in formulating a patient’s diagnosis by entering — either by free or predictive text — the patient’s signs, symptoms, and test results, and by specifying for age and gender. A list of possible diagnoses then appears from a database of 6,000+ diseases, with the “don’t miss” diagnoses being flagged. Users can read more information about each possible diagnosis by clicking on each result. Information is taken from textbooks, journals, and other web resources. Furthermore, the

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31 PACS: Picture Archiving and Communication System.
Isabel technology can be either operated as a stand-alone tool, be integrated into the patient’s EMR, or be customized for institutions to include specific resources, guidelines, and protocols. The mobile application can be downloaded for free, but in order to unlock the app’s functionalities, users must pay an in-app purchase subscription fee of $2.99 (weekly), $10.99 (monthly), or $119.99 (yearly).

**Example: Handyscope (sensor + app)**

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<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
<td>8/2010</td>
<td>1,9,8</td>
<td>&lt;1000 (U.S. only)</td>
<td>17</td>
<td>4,8</td>
<td>$</td>
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</table>

*Handyscope* dermoscope and its application are a good example of a portable diagnosis tool for professionals. The principle behind the solution is simple, but together, with the application, the result is a practical and sophisticated mobile medical instrument. The device costs US$730 and the application costs US$11,99. *Handyscope* for iPhone was developed by skin/body mapping device provider Fotofinder. This is a very classical case to see how traditional device providers extend their data output through smartphones and gain extra market share.
6.2.3 Continuing Medical Education (CME)

CME in many developed as well as developing countries is a regulatory requirement for all physicians in practice so as to maintain and acquire skills. It is becoming standard that nursing staff also engage in CME. Applications falling into this category generally provide access to prepared didactical medical information. Self-learning and testing are common features within CME applications. These applications are generally rich with images, sound, and video. CME applications can also be used for medical students, with testing materials included (flashcards, quizzes, etc.).

Primary use-cases:

- Deliver CME programs to HCPs.
- Provide mobile access to extensive databases of medical information to support their self-education.
- Provide learning and testing tools, such as quizzes, flashcards, dictionaries, and educational games.
- Provide tests that allow the user to complete assessments, send them to accredited CME providers, and obtain CME credits.
Example: Brain S3D HD (Citec-b)

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<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
<td>6/2012</td>
<td>1.1</td>
<td>&lt;1000</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
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</tbody>
</table>

Citec-b is a biomedical technology imaging company that creates highly advanced educational materials for hospitals primarily in Spain, meaning that in some cases healthcare professionals can receive academic credit through Citec-b’s education solutions. The Brain S3D HD iPad app was developed by Citec-b and is available to anyone via the Apple App Store for $5.99 (an iPhone version of the app exists, and costs $1.99). The application features 3D animation and provides users with several functionalities including zoom and annotation capabilities. Currently, Citec-b is busy with developing more applications that will feature augmented reality aspects, as well as practice components for e.g. ultrasound technicians.
6.2.4 Alerts and Awareness

Applications that provide HCPs with tools to stay updated on medical news, clinical advances, regulatory changes, recalled products etc. are categorized as Alerts and Awareness applications. This information is sourced from governmental bodies, medical publishers, pharmaceutical companies, medical associations, social networks and the like. They generally target physicians and other HCPs that need to keep abreast of the latest developments in their own field and in the field of healthcare in general.

Primary use-cases:

- Provide tools to stay updated on current medical information from news networks.
- Follow up the government or related medical institutions’ alerts and notifications.
- Provide basic newsfeeds and readers.
- Send location-based alerts about recent epidemic outbreaks or other medical information.

Example: myHealthbox (Youbiquitous Mobile Solutions)

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<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
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<tbody>
<tr>
<td>iOS</td>
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<td>6,000</td>
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<td>$</td>
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<tr>
<td>Android</td>
<td>8/2011</td>
<td>1.0</td>
<td>1,500</td>
<td>6</td>
<td>3.8</td>
<td>![Light Bulb]</td>
</tr>
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</table>

The majority of medical drug information is presented to the patient/consumer in the form of printed leaflets. myHealthbox charges pharmaceutical and health companies an annual subscription fee (ranging from 1,000-5,000€ depending on complexity) to digitize these leaflets (e-leaflet). End-users (HCPs and patients) can then access, free of charge, the company’s e-Leaflet database (500k+ products) via the myHealthbox application for Android, iOS and Windows. The application also allows users to create a portfolio of all their current medications and products. What makes this application special, though, is its facilitation of two-way communication. Users receive immediate news updates and alerts regarding their medications when, for example, a medication is recalled. In turn, companies receive notifications of users’ adverse reactions and other product-related comments. Ultimately companies are able to digitize (eco-friendly and easily updated product packaging) and receive customer feedback, while consumers benefit from portability, convenience, and awareness.
6.3 REMOTE MONITORING, COLLABORATION, AND CONSULTATION

The wireless monitoring of patients is one of the areas of mHealth that offers some of the biggest benefits to reducing hospital and clinical burdens and improving the quality of life of outpatients. The mHealth market has allowed monitoring technology to become available as an option at minimal cost, and promises much in terms of allowing HCPs to monitor patients with chronic disease remotely while on the go using such technologies as personal, unobtrusive sensors. In case of emergencies HCPs can receive alerts, obtain location-based information, and make instant treatment decisions without even having to see the patient (for example, a diabetic with dangerous levels of glucose could be sent directly to the hospital without being seen by a physician, furthermore based on the patient’s location, the closest facility could be selected, all by means of a mobile application). Remote consultation and collaboration allows for health professionals to formulate diagnoses and review cases more efficiently and effectively through the exchange of video and audio as well as images.

6.3.1 REMOTE MONITORING (SAFETY)

Applications in this area primarily allow for the tracking of disease progression. The most notable monitoring applications measure heart-rate, blood-pressure, glucose-level, stress-level, and sleep diagnostics. Monitoring applications can also be used to track newborns in hospitals as well as people suffering from Alzheimer’s and dementia who are prone to wondering.

Primary use-cases:

- Enable the remote monitoring of patients with chronic conditions or in rehabilitation in their homes or even while on the move.
- Maintain contact between patients, caregivers, and physicians.
- Synchronize patients’ data from their personal medical devices, beside machines and institution servers, with the physician’s handset.
- Synchronize and update patients’ EHR/PHRs based on their monitoring results.
- Send alerts to responsible people in case of emergency.
- Enable physicians to provide recommendations and advice remotely.

**Example: BodyGuardian (Preventice)**

The FDA approved *BodyGuardian* sensor detects records and wirelessly transmits physiological data to support the remote monitoring of non-lethal, cardiac arrhythmias in patients. The sensor is located in a patch worn by the patient on the skin. Data collected by the sensor is then wirelessly transmitted to the Preventice mobile platform, where it is stored for up to 30 days. The platform is accessible online or via an iPhone and iPad application. Physicians can view platform generated reports and receive alerts based on changes in “select biometrics”. Preventice developed this solution with its partner the Mayo Clinic, and although the system is not yet commercially available, it is currently being sold to hospitals and clinics and will soon be prescribed by physicians for diagnostic and post-procedural monitoring of outpatients.
6.3.2 Remote Consultation

These applications allow users to access physicians in a timely manner to resolve medical issues either through video, patient data, or images delivered to their smartphones. These apps are used either by people living in remote locations with limited access to physicians, by those who wish to save money on a regular doctor’s visit, or by those embarrassed by their condition (e.g. sexually transmitted disease).

Primary use-cases:

- Give feedback via internal messaging, email, video or phone call.
- Provide diagnosis support tools.
- Display images or videos.
- Send information and pictures of patients to remote experts.

Example: iDoc24 (iDoc 24 AB)

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
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<tr>
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<td>&lt;1.000</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Android</td>
<td>10/2012</td>
<td>1.04</td>
<td>3.000</td>
<td>7</td>
<td>3.4</td>
<td></td>
</tr>
</tbody>
</table>

*iDoc24* is a free application for the iPhone and Android phones developed to help people get answers about dermatological issues such as sexually transmitted diseases, discolored moles, and insect bites. The user simply snaps and sends a photo of the skin area in question using their smartphone, and completes a short form. Licensed dermatologists will then review the photos and give an expert opinion as well as diagnostic information particular to the user’s query all in less than 24 hours. The service is compliant with EU laws and regulations, completely anonymous, available 24/7, and costs 25€ per consultation debited to the user’s Apple App Store or Google Play account as an “in-app purchase”.
6.3.3 Remote Collaboration

These solutions facilitate collaboration between colleagues that are in different locations, providing HCPs with access to expert knowledge, and have proven especially useful in providing healthcare in remote or rural areas with a shortage of trained medical staff. They typically allow the sharing of medical imagery, and patient health records.

Primary use-cases:

- Input data by keyboard, camera or USB.
- Send information and pictures of patients to remote experts.
- Display images or videos.
- Provide diagnosis support tools.

Example: MedicalExchange Medting (MEDTING Ltd.)

Medting is a collaboration and knowledge sharing web and mobile platform. Medting’s solutions allow clinicians to upload and download medical images, share case files, store data, and participate in virtual conferences. Ultimately the platform is meant to serve as a social site for medical professionals to work together in developing diagnoses and obtain second opinions. Currently the Medting app is available for the iPhone and iPad 2, with a second version to be released in the coming months. The latest count shows that 15,000 clinical cases and 22,000 multimedia files have been shared via Medting. Although the solution is free of charge for any individual clinician, Medting has developed a business model based on sales to “Collaboration Groups” (50 clinicians or less) and “Enterprises” (50+ clinicians). Collaboration groups, generally clinical committees that need a private space to share clinical cases, purchase a subscription to Medting for a cost of $195 monthly or $2,100 yearly. Enterprises, generally hospitals or healthcare systems, can purchase Medting
products as either a standalone, on-site platform or as a service hosted by Medting (a SaaS\(^{32}\) solution). Enterprises are able to personalize their Medting platform, create subgroups and communities, send messages within these communities, and create personalized case workflows.

6.4 Healthcare Management

Healthcare management applications assist in the management of logistical information like contacts, appointments, scheduling of procedures, as well patient information and other health data. The applications target individuals as well as healthcare providers, both private and public, as well as HCPs, and to a lesser extent, healthcare administrators. These applications are few in number and remain among the most expensive of all mHealth solutions.

\(^{32}\) SaaS: Service as a Software.
6.4.1 Logistical & Payment Support

Applications in this category are designed to maximize efficiency in healthcare processes. Mobile logistical solutions were among the first mHealth related mobile solutions—some of them have found their way onto the smartphone platform, and the consumer mHealth market much like applications in other industries such as apps for the tourism (Tripadvisor) and restaurant (Yelp) industries.

Primary use-cases:

- Schedule appointments and tasks.
- Read and write reviews of HCPs and healthcare systems.
- Provide access to medical procedures and services.
- Support reporting and billing for healthcare services.
- Provide facility locations mapping, route-planning and turn-by-turn directions.
- Send and receive confirmations.

**Example: ZocDoc (ZocDoc, Inc.)**

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
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<td>7/2011</td>
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<td>50,900</td>
<td>207</td>
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<td>€</td>
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</tbody>
</table>

ZocDoc is a free service that allows patients to find and instantly schedule an appointment with a HCP based on location, insurance coverage in real-time. Users can use peer reviews to browse doctors, dentists or specialists either on the ZocDoc website or on their smartphone with one of the ZocDoc free apps for iPhone, Android, or BlackBerry. The company’s most recent product, ZocDoc Check-In, allows patients to complete paperwork online before their appointment. Instead of charging the user, ZocDoc charges HCPs a monthly subscription fee of US$250 to be included in ZocDoc’s database. In turn, doctors are able to use ZocDoc as an advertising and marketing tool, and simplify booking and billing processes.
6.4.2 Patient health records

EHR/PHR applications make it possible for patients and HCPs to share and manage health-related data easily. Solutions range in complexity (and cost) from simple personal record maintenance tools which are free, to sophisticated service-based solutions that facilitate the integration of institution servers and smartphones so as to synchronize patient data. Many of the current mobile electronic health record applications are extensions of existing desktop solutions. Meanwhile Microsoft’s HealthVault has expanded its personal health record solution service offering having made this data management tool available via Windows smartphones. A handful of PHR solutions are available in application stores, and include solutions published by major health insurers such as Aetna and Kaiser Permanente.

**Primary use-cases:**

- Enable physicians and patients to access and update electronic records, images, and test results.
- Manage personal or patients’ health records.
- Allow communication, appointment scheduling, and recommendations between patients and doctors.
- Support ePrescriptions.

33 EHR: Electronic Health Records; PHR: Personal Health Record.
Example: iBlueButton Veterans (Humetrix, Inc.)

<table>
<thead>
<tr>
<th>Platform</th>
<th>Rel. Date</th>
<th>Current Version</th>
<th>Downloads</th>
<th># of Ratings</th>
<th>Rating</th>
<th>Best Practice Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>iOS</td>
<td>1/2012</td>
<td>3.9</td>
<td>6,000</td>
<td>14</td>
<td>3.5</td>
<td></td>
</tr>
</tbody>
</table>

The iBlueButton Veterans gives Americans military veterans the ability to download and review their online health records from their respective health insurance companies’ portals. Blue Button EHRs contain information regarding a patient’s medications, allergies, medical conditions and procedures, lab results, and emergency contact information. Furthermore, patients can share their personal records along with other health information with their HCP’s iPad running the iBlueButton Professional App. The HCP in turn can keep a number of patients’ records, import and export medical images as well as other file types, and share patient instructions. Ultimately these apps are meant to be used in conjunction at the point of care to foster the interaction between healthcare professional, insurer, and patient. Both the professional iPad app and the patient iPhone app are available for free in the Apple App Store. An in-app purchase of $US49.99, however, unlocks the full potential of the iPad app, while several in-app purchases of various prices can grant the user access to many more functionalities and customization based on health insurer.
7 TRENDS THAT WILL SHAPE THE COMMERCIALIZATION PHASE OF MHEALTH APPLICATIONS

The commercialization phase of the mHealth market will be formed by 10 main drivers and trends. These drivers and trends will enable mHealth players to offer their solutions within a market environment, allowing for commercial success.

Fast reading:

- Smartphone user penetration will be the main driver of mHealth uptake.
- mHealth applications will be specifically tailored for smartphones or tablets.
- mHealth applications will be native rather than web-based applications.
- mHealth niche stores will become the home for the 2nd generation of mHealth apps.
- Missing regulations are the main market barrier during the commercialization phase.
- Buyers will continue to drive the market during the commercialization phase.
- Traditional healthcare channels like hospitals and doctors will become equally important as app stores for distribution of mHealth applications, especially to health care professionals by 2016.
- Applications will enter traditional health distribution channels, but app stores will remain important.
- The 2nd generation of mHealth applications will focus on chronic diseases.
- Business models will broaden from applications downloaded to service and device sales.
7.1 Smartphone user penetration will be the main driver for the mHealth uptake

The increase in smartphone and tablet penetration within the population has and will continue to be the main driver of the mHealth market. As access to capable devices increases, so too does the number of mHealth applications downloaded. Shipment numbers for smartphones and tablets will almost triple in the next 5 years. In 2012 810 million application capable devices were shipped. In 2017 this number will increase to 2.3 billion units\(^3\). The share of tablets will increase from 15% (2012) to 21% (2017). Despite smaller and decreasing shipment numbers, iPod Touch users, too, represent an interesting target group for mHealth applications, especially for solutions that address young adults and kids. iPod Touch users are often not included into the plans of mHealth solutions providers, which for some use cases will lead to an exclusion of an interesting niche target group.

Enhanced reach to patients and HCPs via mini computers (i.e. smartphones and tablets), is also seen as the main market driver by today’s mHealth players.

**Figure 45: Driving forces of the mHealth market according to mHealth players**

User and patient demand, as well as the growing importance of patient centric models will, according to the mHealth market players, also have a positive impact on the mHealth market. mHealth applications are understood as tools which create a value that patients (and HCPs) are aware of and thus fit into any projects centered around patients health.

\(^3\) Gartner and research2guidance, 2013.
7.2 **mHealth applications will be tailored specifically for smartphones or tablets**

Tablets have created a new platform for hosting specific mHealth use cases. There is a clear distinction between the mHealth use cases that works on a small screen and those that require a larger screen.

Today’s most popular mHealth categories, such as fitness and general health tracking, are mainly built for smaller, pocket-sized devices with equally small screens.

The following graph illustrates the preference of mHealth application publishers for tablets or smartphones in relation to the mHealth use case.

**Figure 46: Suitability of tablets and smartphone for mHealth app categories**

mHealth applications that concentrate on explaining, demonstrating or organizing health related information are better hosted on a tablet.

With the increased penetration of tablet computers among HCPs and patients, and the increased sophistication level of mHealth applications, these applications will be more and more tailored towards a specific device.
7.3 MHEALTH APPLICATIONS WILL BE NATIVE RATHER THAN WEB-BASED APPLICATIONS

Most mobile applications as well as mHealth applications today are natively installed, and therefore must be built for a specific device or platform. These native applications make use of device-specific hardware and software features such as the camera, magnetometer, GPS, and accelerometer. Web applications, on the other hand, run mainly on web servers, and may or may not require a lightweight access client to be downloaded to the device. Changes to web-applications can be applied more quickly, and compatibility across a variety of handsets is much simpler than that of native applications. Regarding the relative dominance of native and web applications in 2017, there are three main factors to consider:

1. **Current user experience**: The market’s uptake is also motivated by the advanced usability of native applications. Although not all applications require all the technology features characteristic of the typical smartphone, it is clear that future user expectations will be based on the standards set by today’s applications.

2. **Performance**: mHealth applications like tracking and monitoring applications make extensive use of internal and external sensors. The integration of sensors demands direct access to the API on the device, which makes native application development mandatory. Web-based applications require a constant data connection in order to function consistently. More advanced mHealth applications must guarantee that they work without internet connection so as to ensure promised service.

3. **Status of standardization of HTML5**: Despite the hype revolving around HTML5, the technology is still far away from having agreed standards. HTML5 features can be aggregated into categories like graphics, sensor and hardware integration, etc. Within these categories, features can be rated for stability and reach.
   - **Reach**: defined as the degree of implementation by the following major browsers: Safari, Android, Internet Explorer, Blackberry, Firefox and Oracle. In this report, reach was quantified by counting how many of the aforementioned browsers implemented each of the features in the given category.
   - **Stability**: defined as the probability that a standard will not be changed in the near future. For evaluating the stability of each category, the relative number of standards at least stabilizing was observed. The more stable and widely implemented a category’s standards are, the higher its ranking.

As of today only three of the 12 features run stable and work on the majority of today’s browsers. Only these features are elaborate enough to attract commercial utilization in mHealth, and therefore, to be regarded as competitive to native development. For all other features, HTML5 either lacks of stability and/or reach. In summary, companies can rely on HTML5 technologies that make use of the network to connect to a server, require input from the owner, and incorporate advanced graphical elements. On the other hand, apps that need to interpret personal information (e.g. the address book of a smartphone user) or share information (e.g.
SMS, MMS, email) are clear candidates for native application development. For a detailed evaluation of HTML5, please have a look at the “Multi-Platform App Development Report”35.

4. **Distribution:** App stores will remain the main distribution channel for mHealth applications over the course of the next few years. The main app stores demand for native applications, build on provided development platforms. To be launched on these app distribution platforms, applications must have at least a native frame.

In summary, native smartphone applications will remain dominant through 2017. This does not mean, however, that there will be no web-based elements incorporated into these applications. Today there are already tens of thousands of hybrid applications which access content dynamically from developer servers, nevertheless customer interfaces and application logic are built for specific devices to meet customer expectations.

7.4 **mHealth niche stores will become the home of the 2\textsuperscript{nd} generation of mHealth apps**

Today, the smartphone application market is structured as an oligopoly\textsuperscript{36}, with a large proportion of smartphone users making use of only a few dominant application stores. The market share of the top five applications stores is 91\% (based on download numbers in Q3 2012). The main structure of the market will not change in the next years, but with the growing number of applications, niche stores will have a chance to capture some market share.

Today’s application stores are built to host games and simple applications, which require no detailed product and company description, references or link to any outside service, meaning that mHealth applications built to e.g. predict the likelihood of a tumor are displayed next to a simple pill reminder, and described in the same format. The first app stores opened during the early years of the market.

The most prominent is *Happtique*. Launched in 2000 with more than 7,000 mHealth applications running on iOS, Android and BlackBerry, *Happtique* has established its own set of guidelines to determine the quality of healthcare-related applications.

**Figure 47: Happtique: niche store for mHealth applications**

For improved discoverability, applications are being sorted by disease and medical profession and in the future by subspecialty.

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\textsuperscript{36} Oligopoly: A market situation where many customers are facing only a few dominant suppliers.
*Happtique* also offers healthcare enterprises—like hospitals, continuing care facilities, and physician practices—the ability to create individually branded, secure sub stores that support employee and patient mobile technology use.

*Happtique* is creating a system to allow doctors to prescribe apps, which would be one of the main steps towards the integrated market phase.

*How are you* is another niche store that concentrates on mHealth applications. The store lists only a few hundred applications. The supported platforms are Apple iOS, Android and Blackberry.

**Figure 48: How are You: niche store for mHealth applications**

This app store is open to members of the NHS (the UK’s National Health Service) who are over the age of 18 and residents of the UK.

A defining characteristic of the commercialization phase will be the development of aggregators like the ones mentioned above, because of their ability to reach more HCPs and patients. The demand for a trusted sourcing environment will lead to a growing number of mHealth app stores.
7.5 Missing regulations are the main market barrier during the commercialization phase

Regulators are often overwhelmed by the speed of innovations in becoming significant in daily life. mHealth clearly is one such innovation. The publication of mHealth applications by public health agencies, big pharmaceutical companies, and start-ups has outpaced regulators.

The problem faced by the mHealth industry is entrepreneurial in nature. mHealth app publishers must decide how to allocate their budgets when developing costly, advanced solutions. Currently, developers have little guidance from national regulatory bodies as to safety and privacy requirements. Gaining approval for applications can range from relatively inexpensive to extremely costly. The lack of guidance thus makes planning the finances of mHealth application development extremely difficult.

mHealth’s true potential would be realized by a globally harmonized approach to regulation, but such harmonious regulation is far off.

Although different national health markets around the world have their own rules and regulations, many national officials are looking to the US to set an industry precedent with regards to regulation. Countries will, in turn, base their approaches to the mHealth market upon the regulatory conditions in the US.

The FDA (US regulatory authority) published several draft guidelines in July 2011, and is incorporating the feedback received from industry players regarding its regulatory agenda. The FDA had earlier promised to release its final set of regulations by the end of 2012. As of February 2013, however, the agency has yet to release any new guidelines regulating the mHealth industry.

The 2011 FDA draft guidelines mainly define when a mHealth application becomes a medical device, and developers’ obligations in gaining market clearance.

The following categories of mobile applications will be subject of regulation:

- Mobile apps that are an extension of one or more medical device(s) by connecting to such device(s) for purposes of controlling the device(s) or displaying, storing, analyzing, or transmitting patient-specific medical device data. Examples: remote display of data from bedside monitors, ECG waveforms, and medical images generated by picture archiving and communication systems (PACS).
- Mobile apps that transform the mobile platform into a medical device by using attachments, display screens, or sensors, or by including functionalities similar to those of currently regulated medical devices. Examples include apps that turn mobile devices into electronic stethoscopes, glucose meters, or accelerometers for capturing sleep data.
Mobile apps that allow the user to input patient-specific information and—using formula or processing algorithms—output a patient-specific result, diagnosis, or treatment recommendation to be used in clinical practice or to assist in making clinical decisions. Examples include mobile apps that provide a questionnaire for collecting patient-specific lab results and compute the prognosis of a particular condition or disease, perform calculations that result in an index or score, calculate dosage for a specific medication or radiation treatment, or provide recommendations that aid a clinician in making a diagnosis or selecting a specific treatment for a patient.

The FDA also oversees the “intended use” of a mobile application. The following guidelines have been released:

- If the product is intended to aid in the cure, mitigation, treatment or prevention of disease, the FDA is likely to consider it a device.
- Software that performs library functions such as storing, indexing and retrieving information not specific to an individual patient is not considered to be a medical device.
- Labelling and promotional materials of the products and the consideration of how the company promotes the products will also be considered to define whether or not the application is a medical device.

Once a mobile application is defined as a medical device, it is subsequently grouped into three classifications to determine further action:

- Class 1 devices represent the least risk. Many of these devices are exempt from pre-market clearances and other regulatory requirements.
- Class 2 devices require filing a premarket notification with the FDA.
  - These submissions are manageable documents that compare the new device to those lawfully on the market.
  - Independent third parties will review devices for a cost, and will submit the market clearance to the FDA on behalf of the developer.
  - Manufacturers must ensure their products meet quality system requirements in correspondence to the risks associated with using the device.
- Class 3 is the highest risk device-class, and usually requires premarket approval (PMA) from the FDA which can cost millions of dollars.

The draft guidelines are just a starting point for the discussion that will take place in each country. Other, more detailed guidelines must follow so as to provide a secure framework for investment decisions in mHealth. In the meantime, established health players will cautiously wait before entering the mHealth industry. Nevertheless, those willing to and those who can afford to take the risk can establish themselves as industry pioneers.
Due to the aforementioned non-existent framework, regulation is seen as the number one barrier to the commercial success of mHealth applications today.

**Figure 49: Barriers of Commercialization mHealth Applications**

The uncertainty revolving around regulation of mHealth solutions will subside with the publication of final guidelines by official bodies, and will give way to more discussion regarding the challenges of mHealth business models.

### 7.6 Buyers will continue to drive the market

The regulatory environment in every country is different, and consequently the way the health industry manages matters such as reimbursement is related directly to local circumstances. This fragmentation is characteristic of the healthcare industry, and will ultimately affect mHealth’s development. Insurers, government bodies, and other payers will reimburse patients for mHealth application purchases because they are “cleared” and recognized therapeutic tools. Coverage of mHealth applications, however, will not be common for at least the next five years. Private individuals will thus remain the main driver of the market, and applications will be purchased out of individuals’ own pockets.

Sponsorship will serve as another form of this “buyer market”. Companies within the healthcare industry such as pharmaceutical companies, device manufacturers and medical associations will see the potential of providing sponsorship as a service to healthcare, patients, and HCPs, which of course is how products and corporate brands are marketed in the healthcare sector. mHealth applications will fit very well into both marketing and educational initiatives as they allow companies to place their marketing messages in physicians’ pockets. Consequently, more and more mHealth applications will be made available.
available free of charge, with the healthcare industry picking up the costs of developing and maintaining the applications.

The views of mHealth application developers (with respect to mHealth market drivers) are supportive of the “buyer market” argumentation. They envision smartphone penetration and patient demand as the main drivers of market growth, as opposed to any support from regulatory bodies, which would have the potential to turn the market into a “payer market”.

7.7 APPLICATIONS WILL ENTER TRADITIONAL HEALTH DISTRIBUTION CHANNELS

The growing awareness of mHealth in the medical community, as well as the growing proportion of patients using smartphones, will encourage HCPs to exploit the possibilities rendered by smartphone technology and incorporate applications into their patient management plans. Specialized distribution providers will find business models that allow doctors to participate in application downloads. (The pharma industry will publish apps for every treatment in creation and encourage doctors to use those apps in conjunction with their products!)

**FIGURE 50: MAIN DISTRIBUTION CHANNELS FOR mHEALTH SOLUTIONS AS OF TODAY AND IN FIVE YEARS’ TIME**

This trend projection is supported by mHealth application publishers who believe that hospitals, physicians, and healthcare websites will take over the role of main distribution channels for mHealth applications.
7.8 mHealth market will grow mainly in countries with high smartphone penetration and health expenditure

In 4-5 years, most industrialized countries will have reached a smartphone penetration rate of more than 80%. In some of these countries private healthcare spending lies well above US$2,000. Countries with high smartphone penetration and private healthcare spending are the best markets to grow mHealth business during the commercialization phase. The figure below indicates which countries belong to this mHealth premier league. The North American and West European markets clearly stand out, demonstrating the optimal matrix for new mHealth market model uptake—above average private health expenditure, and high smartphone penetration and user numbers. Other countries like Russia, China and India lag considerably, but still have markets of sufficiently significant size to support a vibrant mHealth industry.

**Figure 51: Primary mHealth countries according to smartphone penetration vs. private health expenditure per capita in 2012**

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Vertical: 37% benchmark line for smartphone penetration in 2012; Horizontal: Average private yearly healthcare expenditure per capita for these selected countries in 2012.

* Data are harmonized by WHO for international comparability; they not necessarily match the official statistics of the countries, which may use alternative methods. Expenditure given at average exchange rate from national currency to US$.

**SP penetration data is based on 18+ year old population (Ipsos MediaCT online survey, conducted in Q1 2012).**

*** Bubble size indicates expected number of total mobile subscribers in 2012.

Sources: research2guidance, WHO, OECD, Ipsos MediaCT.
In developing countries with low smartphone penetration, traditional mHealth projects will remain the predominant market model. These projects will concentrate on providing mHealth solutions for simple phones (mainly SMS and Java based). Local MNOs will remain the key drivers within these markets.

7.9 2ND GENERATION MHEALTH APPLICATIONS WILL FOCUS ON CHRONIC DISEASES

The entry of traditional health industry players into the mHealth market will lead to the increasing sophistication of applications. At the same time, application publishers will focus on solutions that offer the maximum benefits for patients and HCPs.

Chronic disease is a major cost-driver in developed countries. In the US, for example, the cost of treating chronic disease constitutes 83% of total Medicaid and 96% of total Medicare expenditure\(^\text{37}\). In some countries healthcare expenditure on a person with one chronic condition is double that of expenditure on someone without a chronic condition. mHealth solutions promise to bring significant advances in the management of chronic disease. With the potential for sophisticated monitoring, compliance, time-management and a host of other applications to improve healthcare delivery to chronically ill patients, we will see a focus on chronic disease applications in the next years. Among chronic diseases, diabetes and obesity are ranked highest by mHealth application developers in terms of business potential.

**Figure 52: Therapy fields that offer the best market potential for mHealth solutions**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Business potential for mHealth applications (%)</th>
<th>Number of patients (worldwide)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes</td>
<td>56%</td>
<td>220 million</td>
</tr>
<tr>
<td>Obesity</td>
<td>41%</td>
<td>400 million (1.6 billion overweight)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>35%</td>
<td>~1 billion</td>
</tr>
<tr>
<td>CHD *</td>
<td>29%</td>
<td>15 million p.a. have a stroke</td>
</tr>
<tr>
<td>Asthma</td>
<td>29%</td>
<td>300 million</td>
</tr>
<tr>
<td>COPD **</td>
<td>30%</td>
<td>210 million</td>
</tr>
<tr>
<td>Depression</td>
<td>30%</td>
<td>121 million</td>
</tr>
<tr>
<td>Chronic Pain</td>
<td>27%</td>
<td>-</td>
</tr>
<tr>
<td>Sleep distortion</td>
<td>27%</td>
<td>-</td>
</tr>
<tr>
<td>Alzheimer</td>
<td>30%</td>
<td>35.6 million</td>
</tr>
<tr>
<td>Cancer</td>
<td>14%</td>
<td>7.4 million p.a. die</td>
</tr>
<tr>
<td>Multiple sclerosis</td>
<td>16%</td>
<td>300,000 in US</td>
</tr>
<tr>
<td>Other ***</td>
<td>14%</td>
<td>-</td>
</tr>
</tbody>
</table>

* CHD refers to coronary heart disease.
** COPD refers to chronic obstructive pulmonary disease.
*** Other chronic diseases such as HIV, Aids, epilepsy, infectious diseases, other less serious illnesses.
Source: research2guidance, N = 374, WHO, OECD.

\(^{37}\) CDC.gov (Centers for Disease Control and Prevention).
The graphic above illustrates that the assessment of today’s market players is supported by the size of the overall addressable market for patients suffering from chronic disease today. According to the OECD and WHO, there are more than two billion patients with chronic diseases worldwide.

7.10 **mHealth business models will broaden**

Traditional mHealth solutions during the trial phase of the market have typically been sold in bundles that include connectivity charges, a device, and the application and/or service charge.

In order to illustrate how traditional mHealth service offerings generated revenue, the following table shows examples of mHealth solutions available in Europe in 2007 (a year before the launch of the new mHealth market model).

**Table 8: European examples of traditional mHealth business models**

<table>
<thead>
<tr>
<th>Solution type</th>
<th>Connectivity</th>
<th>Device</th>
<th>Service &amp; Application Charge</th>
<th>Comments</th>
<th>Solution / provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance</td>
<td>A</td>
<td>EUR 24,- p.a.</td>
<td>EUR 24,- p.a.</td>
<td>Push SMS service</td>
<td>Pillboy / Pillenzeit</td>
</tr>
<tr>
<td>Emergency calls</td>
<td>S</td>
<td>EUR 12,- p.a.</td>
<td>EUR 4,- p.a.</td>
<td>Solution for emergency services</td>
<td>AlarmRuf</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>EUR 54,- p.a.</td>
<td>EUR 150,- to 250,-</td>
<td>EUR 540,- p.a.</td>
<td>Solution for Alzheimer patients</td>
</tr>
<tr>
<td>Remote consultation</td>
<td>S</td>
<td>EUR 108,- p.a.</td>
<td>EUR 1.000,- to 3.000,-</td>
<td>-</td>
<td>Mobile emergency unit</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>EUR 118,- p.a.</td>
<td>EUR 200,- to 300,-</td>
<td>EUR 210 p.a</td>
<td>Emergency, health and routine consultation</td>
</tr>
<tr>
<td>Logistics</td>
<td>A</td>
<td>EUR 228 p.a.</td>
<td>EUR 70,-</td>
<td>EUR &lt;100,- p.a.</td>
<td>Ambulatory and stationary solutions</td>
</tr>
<tr>
<td>Remote monitoring</td>
<td>S</td>
<td>EUR 108,- p.a.</td>
<td>EUR 210,-</td>
<td>EUR 150,- p.a.</td>
<td>ECG monitoring card; IR-Handset or acoustic fixed-line transmission</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>EUR 125 p.a.</td>
<td>EUR 1.000,-</td>
<td>EUR 252,- p.a.</td>
<td>1/3-channel loop recorder ECG monitoring</td>
</tr>
<tr>
<td>Fitness monitoring</td>
<td>A</td>
<td>EUR 60,- p.a.</td>
<td>EUR 50,- to 200,-</td>
<td>EUR 0,- to 60,- p.a.</td>
<td>Fitness Monitoring with and without personal feedback</td>
</tr>
</tbody>
</table>

S: Simple mHealth service  
A: Advanced mHealth service

Apart from very simple solutions sold on a pay-per-download basis, more sophisticated solutions were sold in bundles that included connectivity, a device, and a service charge that included the price of the application. With respect to more sophisticated traditional mHealth solutions, the price for the application and the application sales revenues were minor contributors to the total revenue generated by the solution. Frequently the price was not even disclosed, as is demonstrated by the examples shown above.

The first generation of mHealth solutions in the new smartphone applications market adopted a narrow range of business models, concentrating on revenues generated from application download sales, and subscriptions for content access over a period of time. In
In very few cases, publishers linked the application to a device/sensor or service, such as the Withing Scales Sync which provides a free application for use with a scale sold through the publisher’s website.

Business models will broaden once more when the enabling technology becomes sufficiently advanced. Sensors and special devices designed to take advantage of the smartphone interface will facilitate more advanced applications, while healthcare industry players with the capability of providing complex service offerings will enter the market. These simultaneous factors will allow revenue generation through multiple sources apart from application downloads, including, for example, through service charges for HCPs remotely monitoring patients’ health condition, or through product sales for special devices and sensors that relate to an application’s functionality.

**Figure 53: Changes of mHealth business models from Trail to Commercialization phase**

As the market develops, applications will facilitate the sale of products and services such as medications through a compliance application or a mobile pharmacy application.

Advertising revenues will become a revenue stream for the entire smartphone application market, and will add to the mHealth providers’ income.

As opposed to the traditional model, connectivity will not be part of the bundle as most smartphone users will already have some kind of data plan.

The new mHealth market model will evolve over the next few years. After a period of dominance, simple applications will give way to more complex solutions and revenue sources, as is the case in the traditional mHealth market.

Smartphone applications will also become the enabler for a wide range of other revenue sources.

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**Source:** research2guidance, 2013.
8 The size of the mHealth market 2010-2017

During the initial years of the mHealth market, the revenue and user base grew steadily albeit from a low base level. Despite the hype mHealth has caused—especially amongst mHealth publishers and mobile operators—the actual market remains a niche market. That will change in the coming years once the market enters the integration phase.

Fast reading:

- The smartphone application market will continue to act as an accelerator for the mHealth market.
- The addressable application user group will reach 3.4 billion users in 2017.
- Of the 3.4 billion almost 50% of these application users will have downloaded a mHealth application at least once before the end of 2017.
- The mHealth application market will grow by 61% (CAGR) to reach US$26.5 billion in 2017.
- During the initial years, paid downloads represented the main source of income for mHealth developers.
- As the mHealth market enters the next phase, service and device revenues will become the main revenue source. (84% of cumulated revenues of the next 5 years until 2017)
- Sensors shipments will reach 61 Mio. in 2017.

The growth of the smartphone application market will have a significant impact on the overall market size and the business potential for mHealth solutions. In essence, the smartphone based mHealth market model will provide the decisive push that the mHealth market needed to exit the trial stage and scale to a significant size.

Smartphone manufacturers claim that in the next five years the majority of handsets shipped globally will be smartphone devices. This claim may already have proven to be accurate in developed countries such as the US and European countries, but this uptake will surely be slower in developing markets such as India, Brazil, and in Africa. With increasing competition between smartphone vendors and a simultaneous drop in the average price of handsets, smartphones will represent 80% of all handset shipments internationally by 2017. Additionally, tablets and specialized devices will also contribute to the total size of the addressable market.

With the growth of devices capable of running a mHealth application, the downloads of mHealth applications will, in turn, increase.

The total number of mHealth applications downloaded will grow from 1.5 billion in 2012 to almost 4.3 billion in 2017. Paid applications will fluctuate, representing approximately 10% of the total over the next 5 years. The paid download ratio varies significantly from platform to platform, with Google Play having the lowest and Apple App Store the highest paid/total ratio.
On average the mHealth user will download between 2.5 and 7 mHealth applications per year. The demand for mHealth applications will decrease on average because the mHealth market will become a mass market with lower engagement levels from the users, and because of application loyalty (once a person finds an application that works for him, he will not shop for others).

**Figure 54: mHealth application download numbers (free and paid) (2010-2017)**

![Download numbers chart](chart.png)

Source: research2guidance, 2013.

**Figure 55: Average mHealth users downloads for mHealth apps per year (2012-2017)**

![Average downloads chart](chart2.png)

Source: research2guidance, 2013.
The growth of the mHealth user base will be driven by the growth of smartphone users. The total addressable market for mHealth application services will increase from 1 billion (2012) to 3.4 billion in 2017. This number includes all smartphone and other capable device users who make use of mobile applications that do not come pre-installed on the device. mHealth smartphone services will capture almost 50% of that addressable market by the end of 2017.

The number of smartphone users that will have downloaded at least one mHealth application will grow at a CAGR of 48% from 243 million in 2012 to 1.7 billion in 2017.

**Figure 56: Installed base of smartphone and mHealth users (2010-2017)**

Within the mHealth user-group, 4.5% will have subscribed to a mHealth service such as a monitoring service or consultation service by the end of 2017. Meaning that in 2017 there will be nearly 78 million subscribers to healthcare services delivered with the help of a mobile application. The majority of them (43 million in 2017) will subscribe to basic mHealth services, but almost 34 million will subscribe to advanced services including, for example, monitoring solutions for Alzheimer’s patients, heart arrhythmia and obesity patients.

The increase in number of advanced mHealth service subscribers will begin to accelerate in 2016, just as the mHealth market enters the integration phase.

---

* Smartphone users are used as synonym for any capable device mainly smartphones but also tablets and special devices which also includes iPods Touch.
There are five major revenue sources that are available to any mHealth market player:

1. **Application download revenue**: This includes the initial application download, subscription, and In-app purchase payments. The revenue relates to the provision of certain application functionality or content which is made accessible to the user.

2. **Service revenue**: All revenue which derives from additional medical services. These services typically involve backend structures of servers and teams of medical staff that monitor and consult with patients and general healthcare interested persons. Revenue plans normally are subscription based but could also be structured as pay-per-use.

3. **Device revenue**: All revenues which are generated through hardware sales linked to an application. These may include sensors or a specific medical device designed to be used together with the applications. Hardware will be priced into the service revenue on a subscription basis or be structured as a one-off charge.

4. **Advertising revenue**: Revenues which derive from renting ad inventory within mHealth applications to advertisers.

5. **Transaction revenue**: All revenues which come from selling drugs and other medical products via a smartphone application.

By the end of 2017, the total mHealth market revenue will grow by 61% (CAGR) to reach US$26 billion. The main sources of revenue will not come from application download revenue itself, but from mHealth services and hardware sales. Applications serve as platforms to sell other health services and hardware.

Market growth will accelerate as early as 2016. By 2016, the mHealth market will have entered the integrated market phase, characterized by integrated solutions and health services, as well coverage of mHealth solutions by health insurance providers.
Application download revenue: This includes the initial application download, subscription, and In-app purchase payments. The revenue relates to the provision of certain application functionality or content which is made accessible to the user. Service revenue: All revenue which derives from additional medical services. These services typically involve backend structures of servers and teams of medical staff that monitor and consult with patients and general healthcare interested persons. Revenue plans normally are subscription based but could also be structured as pay-per-use. Device revenue: All revenues which are generated through hardware sales linked to an application. These may include sensors or a specific medical device designed to be used together with the applications. Hardware will be priced into the service revenue on a subscription basis or be structured as a one-off charge. Advertising revenue: Revenues which derive from renting ad inventory within mHealth applications to advertisers. Transaction revenue: all revenues which come from selling drugs and other medical products via a smartphone application.

Prior to 2016, the number of sophisticated solutions offering e.g. remote monitoring and consultation solutions will become sufficiently numerous so much so that patients and HCPs will be widely aware of them, and will start to use them on a broader scale. Escalating use of a growing number of 2nd generation mHealth applications will trigger subscription sales of monitoring services as well as sales of sensors and other medical technologies. During this commercialization phase of the market, the user will mainly pay for the services out of their own pocket.

Revenues generated from application downloads alone will continue to grow in line with the overall smartphone applications market, and will amount to US$1.3 billion\(^{39}\) in 2017.

Healthcare services delivered through smart devices will become the biggest revenue stream in the mHealth market reaching over US$18,4 billion in 2017. The growth will be based on simple monitoring and compliance applications which currently cost less than US$10 per month, and a smaller number of advanced services which include access to stand-by telemedicine staff that typically cost around US$70 per month.

Stand-alone devices will be used by two main target groups—mHealth service subscribers who need a piece of equipment such as a scale or sensor to use their application, as well as...
the general health and fitness interested group of mHealth users. Applications will trigger medical and fitness device sales that will reach US$5.6 billion in 2017, which corresponds to a total of 61 million unit sales.

Sensor prices will range between US$200 and US$100 per device with a yearly decline in price of 5%.

**FIGURE 59: SHIPMENTS OF mHEALTH SENSORS AND DEVICES (IN MILLION UNITS) (2010-2017)**

Transaction revenue induced through the use of an application will predominantly derive from the sale of pharmaceutical products on-the-go via mobile shopping applications operated by online pharmacies (devices like sensors are counted separately). The total mobile mHealth transaction revenue will reach US$1 billion in 2017.

In-app advertising will not become a major revenue stream. Ad revenues will reach US$150 million in 2017. Although the number of downloads of ad-financed mHealth applications will increase from 463 million in 2012 to 1.8 billion in 2017, growth will be moderate due to the decreasing conversion rates and cost-per-clicks. In addition, restrictive advertisement rules in most Western countries will prevent traditional healthcare companies from investing in major marketing budgets for mobile in-App advertisement campaigns.

mHealth smartphone applications will induce a cumulative US$52 billion revenue stream over the next five years until 2017. 9% of this cumulated revenue will be generated through application downloads, whereas the sale of devices and healthcare services will account for 84% of that overall mHealth market revenue.
Application download revenue: This includes the initial application download, subscription, and In-app purchase payments. The revenue relates to the provision of certain application functionality or content which is made accessible to the user. Service revenue: All revenue which derives from additional medical services. These services typically involve backend structures of servers and teams of medical staff that monitor and consult with patients and general healthcare interested persons. Revenue plans normally are subscription based but could also be structured as pay-per-use. Device revenue: All revenues which are generated through hardware sales linked to an application. These may include sensors or a specific medical device designed to be used together with the applications. Hardware will be priced into the service revenue on a subscription basis or be structured as a one-off charge. Advertising revenue: Revenues which derive from renting ad inventory within mHealth applications to advertisers. Transaction revenue: all revenues which come from selling drugs and other medical products via a smartphone application.

Source: research2guidance, 2013.

To summarize: the smartphone applications market will act as an accelerator for the mHealth market. mHealth publishers will have the opportunity, especially in developed countries with high smartphone penetration, to reach almost 1.7 billion users via this platform by 2017. As a result, the market offers sufficient scale to support substantial business, a characteristic that was lacking in the trial phase as well as in the initial years of the commercialization phase of the market.
9 APPENDIX

9.1 mHEALTH COMPANIES THAT HAVE SHARED THEIR VIEW ON THE mHEALTH MARKET DURING THE INITIAL YEARS

Over the course of the years 2010, 2011 and 2012 more than 1,000 companies have shared their views on how the mHealth market will develop. The following tables list the companies which gave permission to publish their company names.

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9.4 About research2guidance

research2guidance is a market intelligence and consultancy company specializing in the mobile apps market.

Our service offerings

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- **Bespoke research**: custom-made research for your individual needs.
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Our analyst team

Ralf-Gordon Jahns

Ralf is the research director of research2guidance. He has worked for more than 19 years in the telecom and media industry. Prior to research2guidance he worked as a partner for Capgemini Telecom Media & Networks. Ralf is a frequent keynote speaker on mobile industry events, publisher of a multitude of mobile market reports and executive consultant of more than 30 clients in the telecom and media industry.

Patrick Houck

Patrick is a research analyst at research2guidance with a focus on health IT technologies. During the last two years he has evaluated a number of mobile health and “eHealth” technologies. Previously he worked for Health 2.0 LLC. Patrick holds a degree in Public Health at Tulane University.
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