Technology Landscape - Wearable Health Monitoring Devices

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INTRODUCTION

Background

- A wearable medical device may be defined as a biosensor that monitors physiological data, usually with a remote/wireless communication, and as a part of any wearable item that is attached to the body.
- These devices measure and analyze various vital parameters such as electrocardiogram (ECG), heart rate (HR), blood pressure (BP), body temperature, respiratory rate, glucose level, blood oxygen saturation etc. and provide medical professionals with comprehensive information while making diagnosis or monitoring a chronic medical condition.
- Wearable medical devices are facilitated with features such as wireless data transmission, real time feedback, alerting mechanism, and more. They transmit data related to any disease marker and organ function to the user or physicians. Thus, offer an efficient care and reduce hospital based expenditure in the process.
- Data generated by wearable devices, enabled with analysis is used by consumers for their better health management. It also helps pharmaceutical companies for conducting efficient clinical trials by gathering data remotely.

History of Wearable Health Monitoring Devices

1788

Thomas Jefferson introduced the first pedometer to the US

Tomish Meter

1921

1st machine to include sensors to measure galvanic skin response, pulse rate and BP

Galvanic Skin Response

1938

Aurex Corp. developed 1st wearable Hearing Aid

Hearing Aid

2003

Vitatron C series, world's 1st fully digital pacemaker

C Series

2008

Activity trackers, wireless-enabled wearable technology devices that measure data such as the number of steps walked, heart rate, quality of sleep, steps climbed, and other personal metrics involved in fitness.

Fit-bit

Contd.

History of Wearable Health Monitoring Devices

2009

Wearable computer launched by glacier computers, designed for those in emergency response situations

W 200

2010

Phillips Lifeline

Autoalert automatic fall detection technology. Homesafe and Gosafe systems

2012

Proteus digital health developed an ingestible digital health feedback system

Wearable In Medicine

2013

Google Glass

Optical head-mounted display designed in the shape of a pair of eyeglasses.

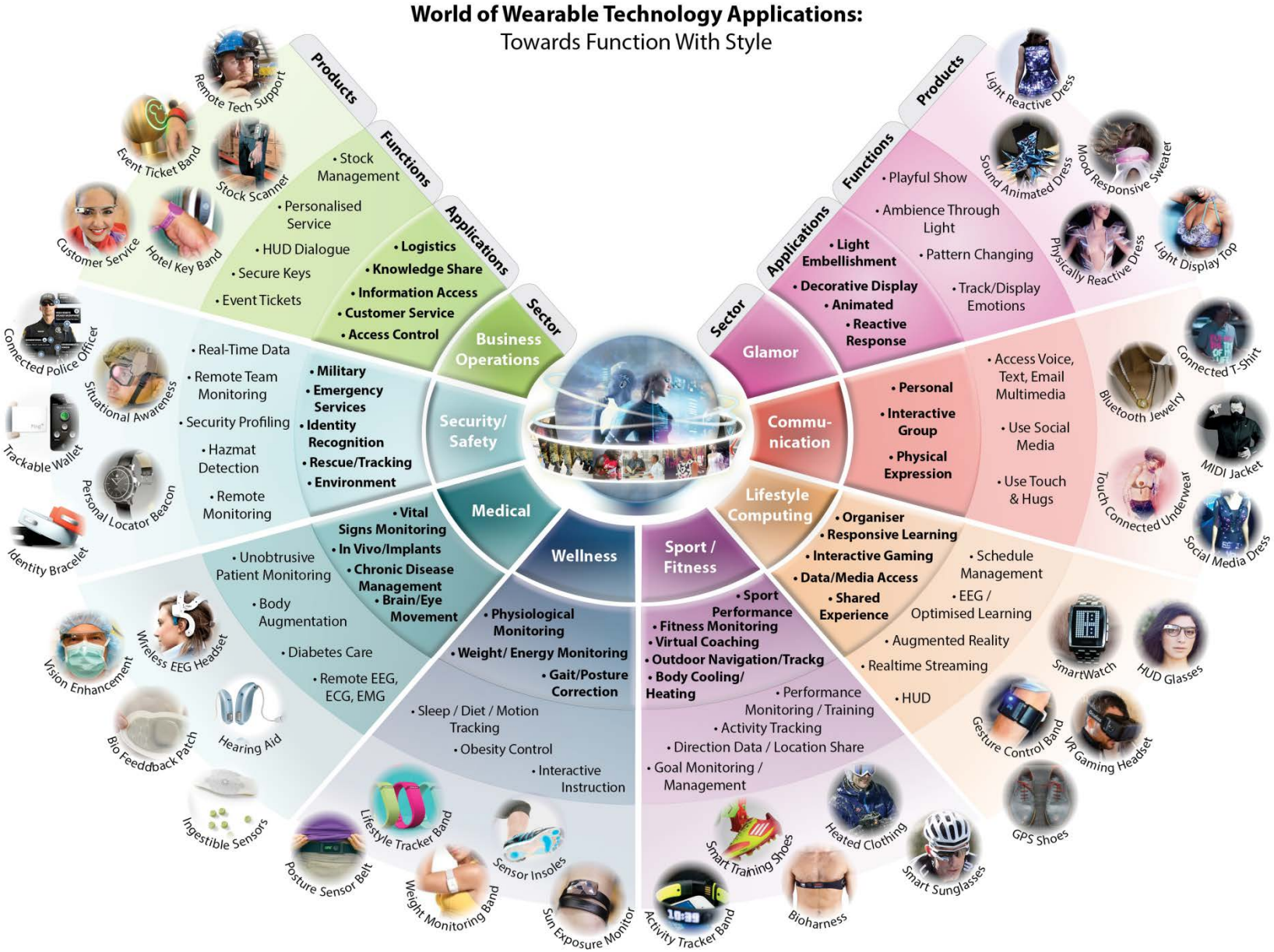
2015

Fitness tracking and health-oriented capabilities with integration with iOS and other Apple products and services.

Apple Watch

Types of Wearable Medical Devices based on site of Application

Technology Taxonomy of Wearable Devices



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Types of Wearable Medical Devices

- **The wearable medical devices market includes products that can be broadly segregated in four segments:**

A. **Lifestyle and Fitness**: The wearable lifestyle and fitness devices segment is the most advanced category of the wearable medical devices market. It includes fitness trackers, activity trackers and sports trackers. Personal health monitoring has been a large contributor to this arena of fitness wearable. Although many of the lifestyle and fitness devices are not technically medical devices; the US FDA has defined them as general wellness devices only.

Nike + iPod Sports Kit

Misfit Shine

Moov Now

Fitbit Charge 2

Types of Wearable Medical Devices

B. Diagnostics and Monitoring: Wearable diagnostic and monitoring devices are non-invasive devices that provide valuable health information. It includes glucose monitoring, cardiovascular monitoring, event recording, pregnancy, obstetrics, fetal and infant monitoring, neurological monitoring, such as electroencephalogram (EEG) tests and sleep monitoring devices.

Dexcom G4

Quardio core

Types of Wearable Medical Devices

C. **Therapeutic**: Wearable systems that monitor disease states and track health activity, store data and deliver feedback therapy are the next frontier in personalized medicine and healthcare. This group of devices include respiratory therapy, insulin management, pain management devices, insulin/glucose monitoring devices, rehabilitation devices, and respiratory therapy devices.

Quell

Minimed 530 G Insulin Pump

Types of Wearable Medical Devices

D. **Injury prevention and rehabilitation:** Wearable injury prevention and rehabilitation devices are the non-invasive devices that provide valuable health information. They include body motion monitoring devices, wearable sensing garments, fall detection devices.[>>]

- ❖ Based on the site of application, the wearable devices market is segmented into handheld, shoe sensors, headband, strap/clip/bracelet, and other areas. Strap/clip/bracelet or wrist-worn devices are expected to hold over 40% of the market share in the domain of wearable medical devices.
- ❖ Wearable Medical Device Market on the basis of application is segmented into remote patient monitoring, sports and fitness, and home healthcare.

Phillips Lifeline

Sproutling Baby Monitor

Patent Landscape

Scope and Consideration of Landscape Search

❖ Objective

To Perform Patent Landscape Study directed towards Wearable Health Monitoring Devices (Worldwide coverage for last 5 years i.e. considering patents published between 2012 and 2016)

❖ Research Methodology

- **Step 1:** Detailed analysis of publically available information to perform understanding of the technology domain.
- **Step 2:** Identification of patent databases and keywords, synonyms and variations thereof, patent classification codes (IPC/CPC/US), Key inventors, Key assignees etc. to formulate search strings.
- **Step 3:** Execution of broad search strings to unearth potentially relevant documents followed by their First-Pass Analysis (preliminary analysis) to remove any false positives. It includes data sanity checks to remove any duplicates (family member duplicates – by checking application numbers, family IDs and publication numbers).

Note: All graphs are prepared based on details of one representative member per INPODAC family, and numbers in graphs, therefore, indicate the number of INPADOC patent families.

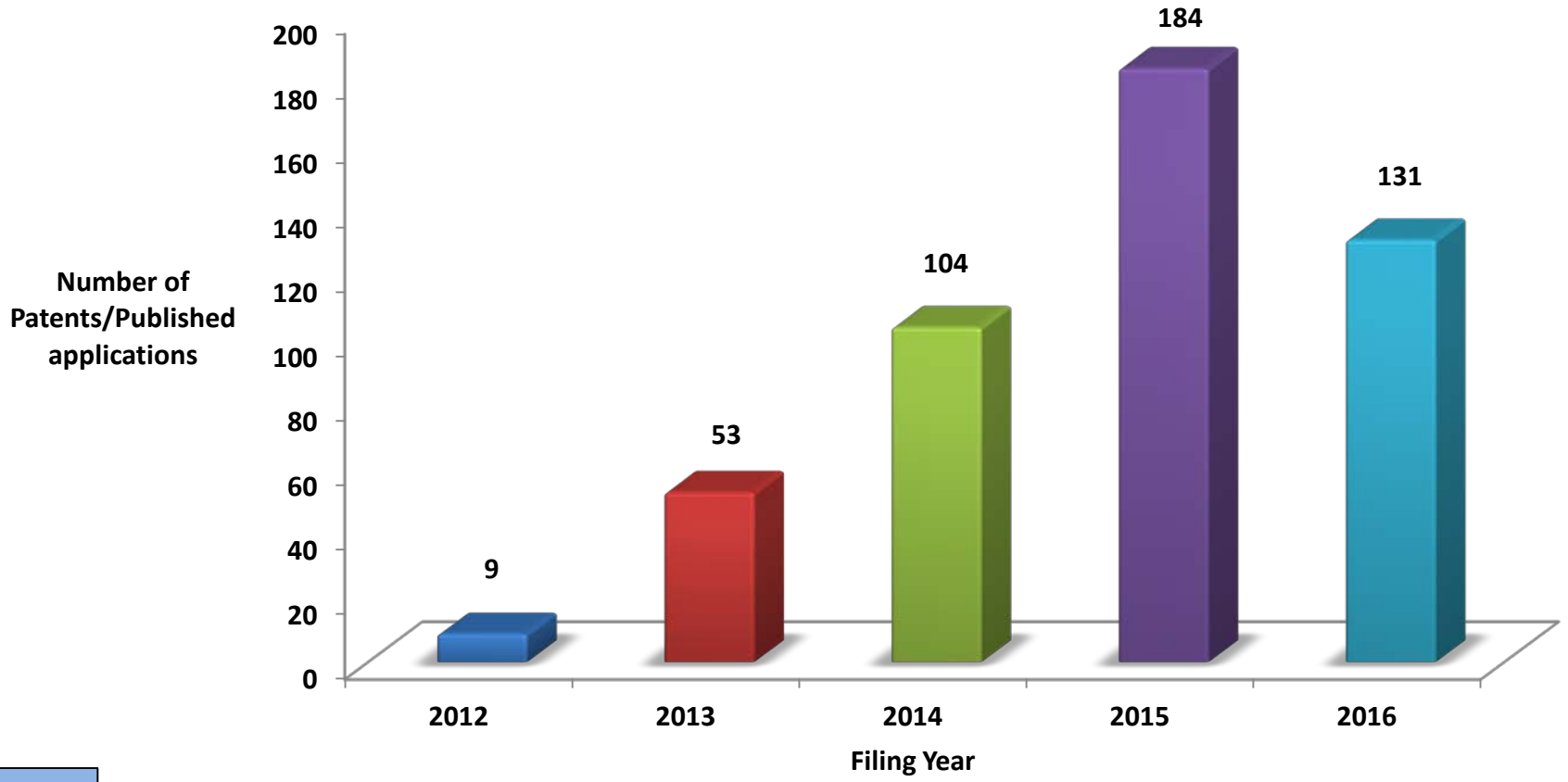
Scope and Consideration of Landscape Search

- **Step 4:** Detailed analysis and categorization of shortlisted documents into one or more categories provided in the proposed taxonomy

❖ Databases Used

- Thomson Innovation
- Google Patent
- ESPACENET

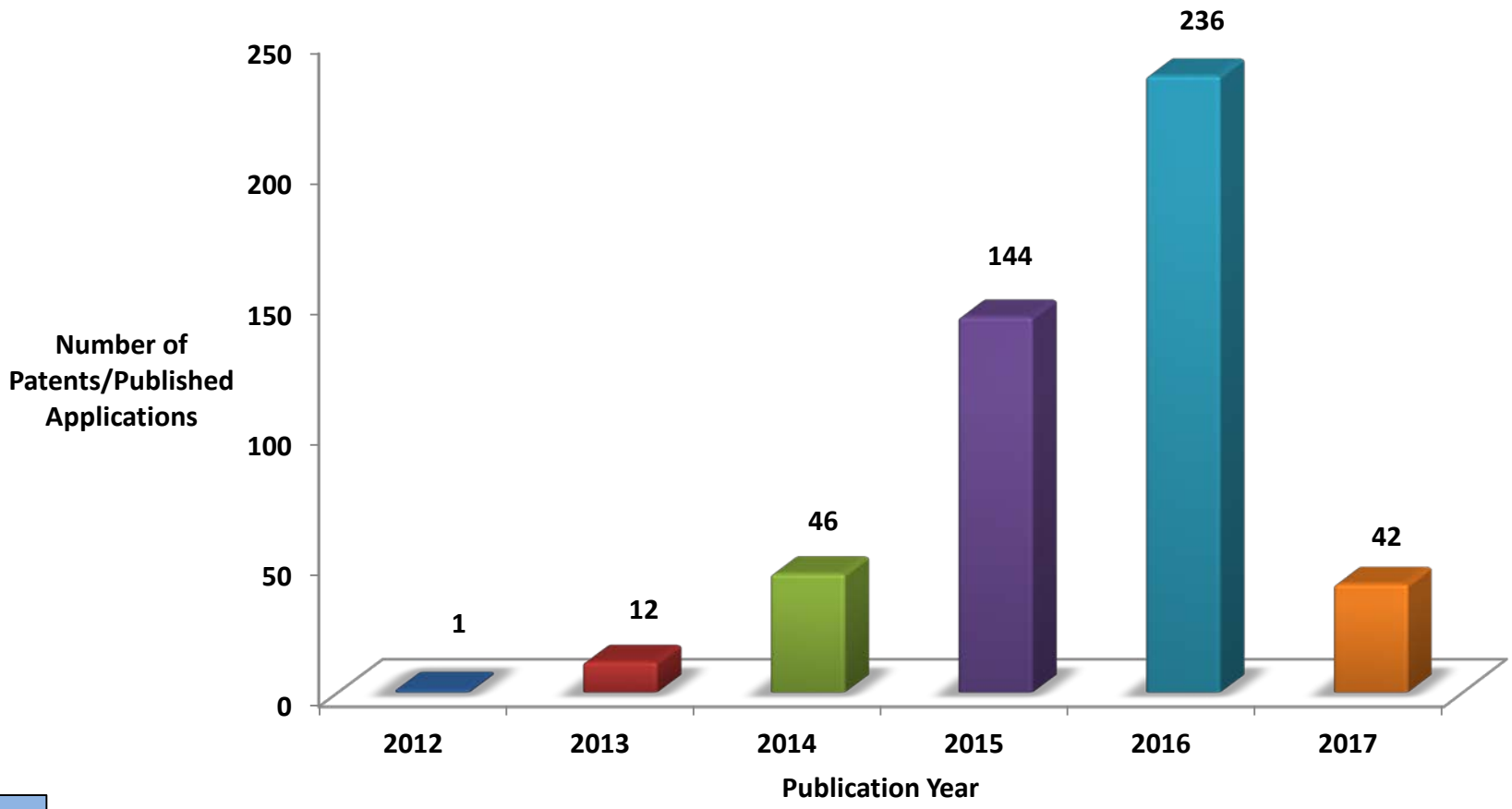
Filing Trend



Insight

Patent filing trend for the last 5 years (published between 2012-2017) indicates a burgeoning filing pattern with maximum number of patent applications filed in 2015 (**184**) followed by a subtle decline in 2016 (please note that filing trend for year 2016 may be higher than that reflected in the graph, attributed to unpublished patent applications).

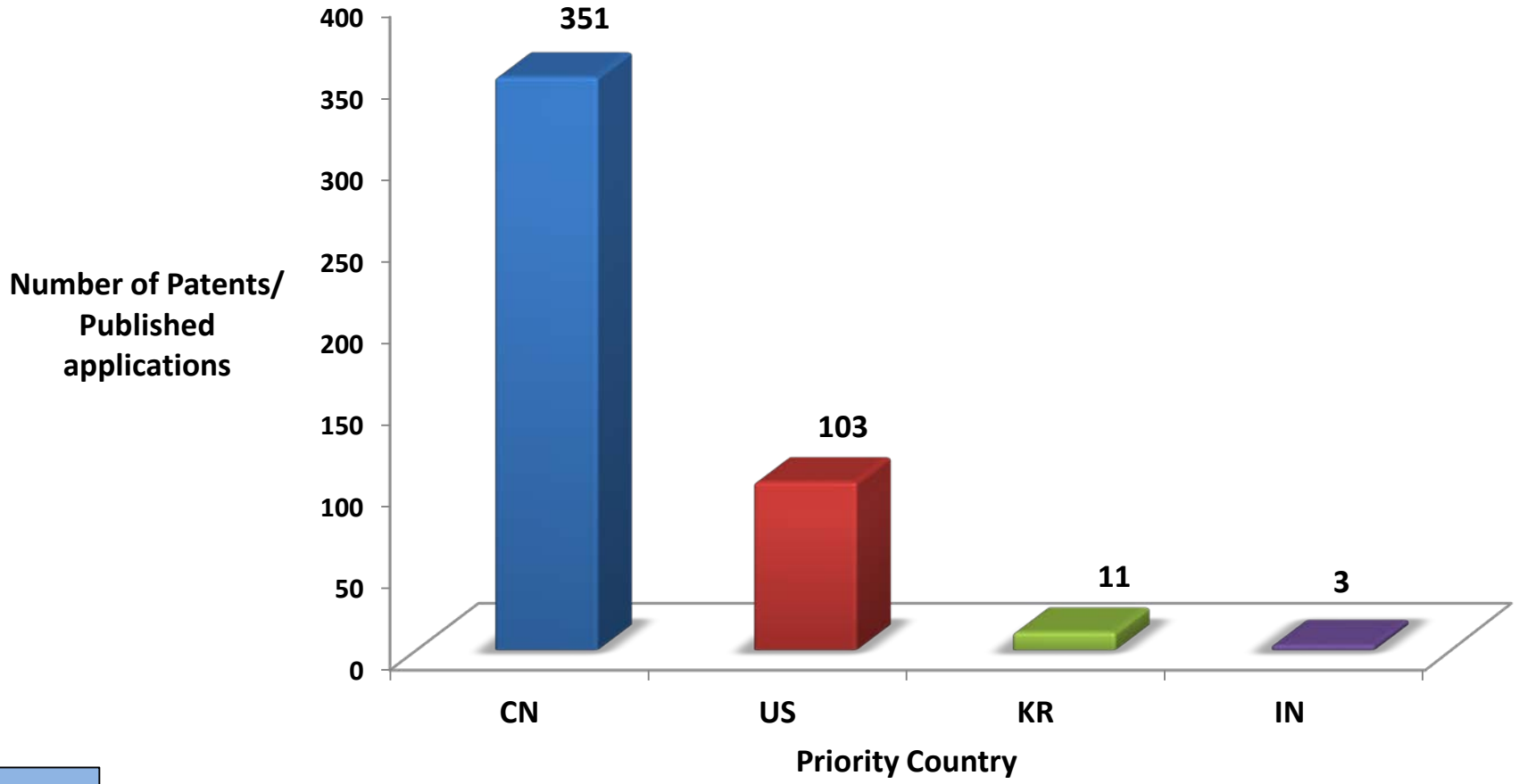
Publication Trend



Insight

As evident from the publication trend depicted above, there has been a steady rise in the number of patent applications published over a period of time. **Maximum number of applications (236)** were published in **2016** (please note that publication trends for year 2017 may be higher than that reflected in the graph, attributed to unpublished patent applications).

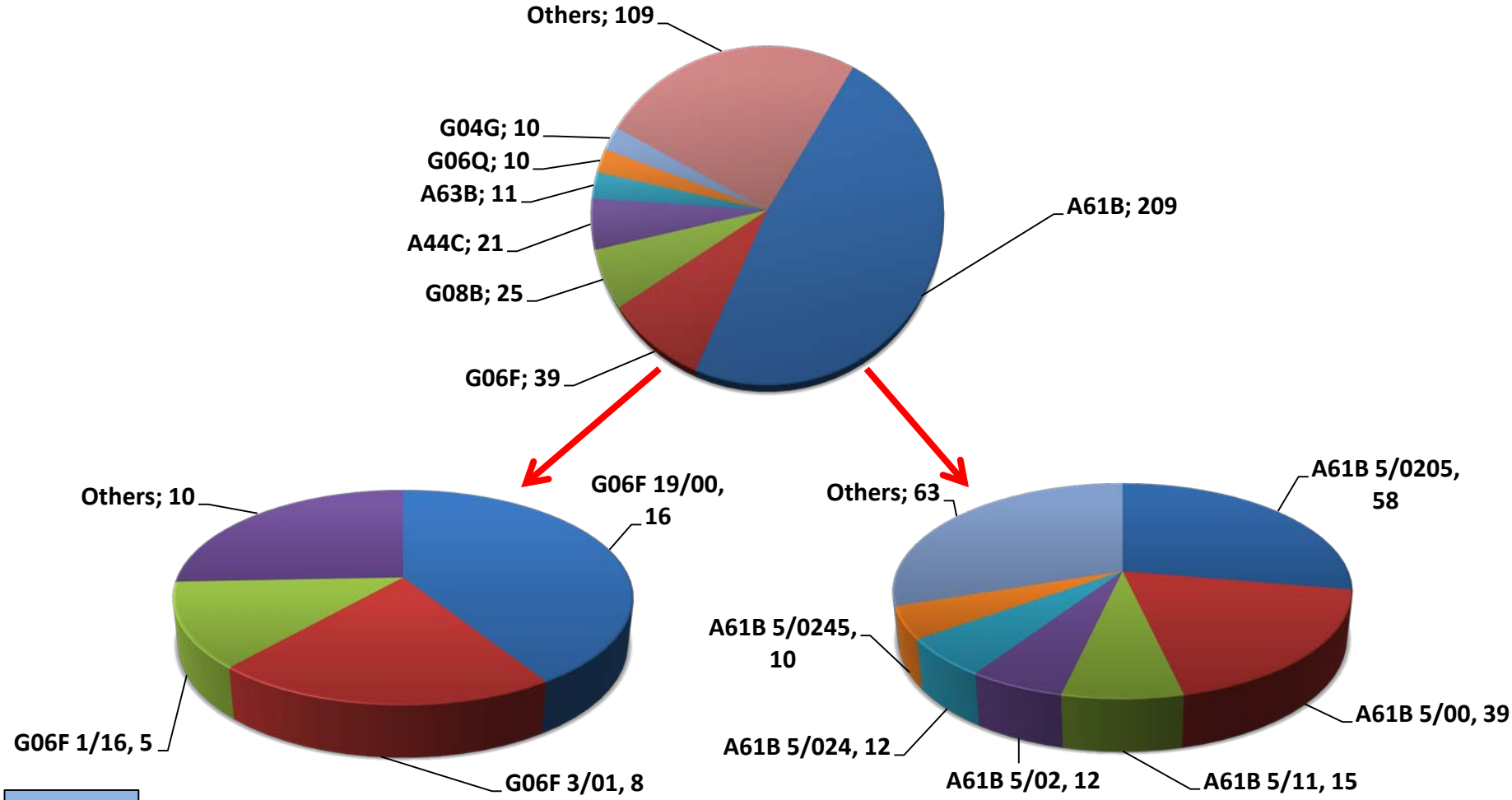
Top Priority Country



Insight

As evident from the data shown above, **majority of the patent applications filed in the domain of wearable health monitoring devices took priority from 'CN' jurisdiction (351),** during 2012-2016.

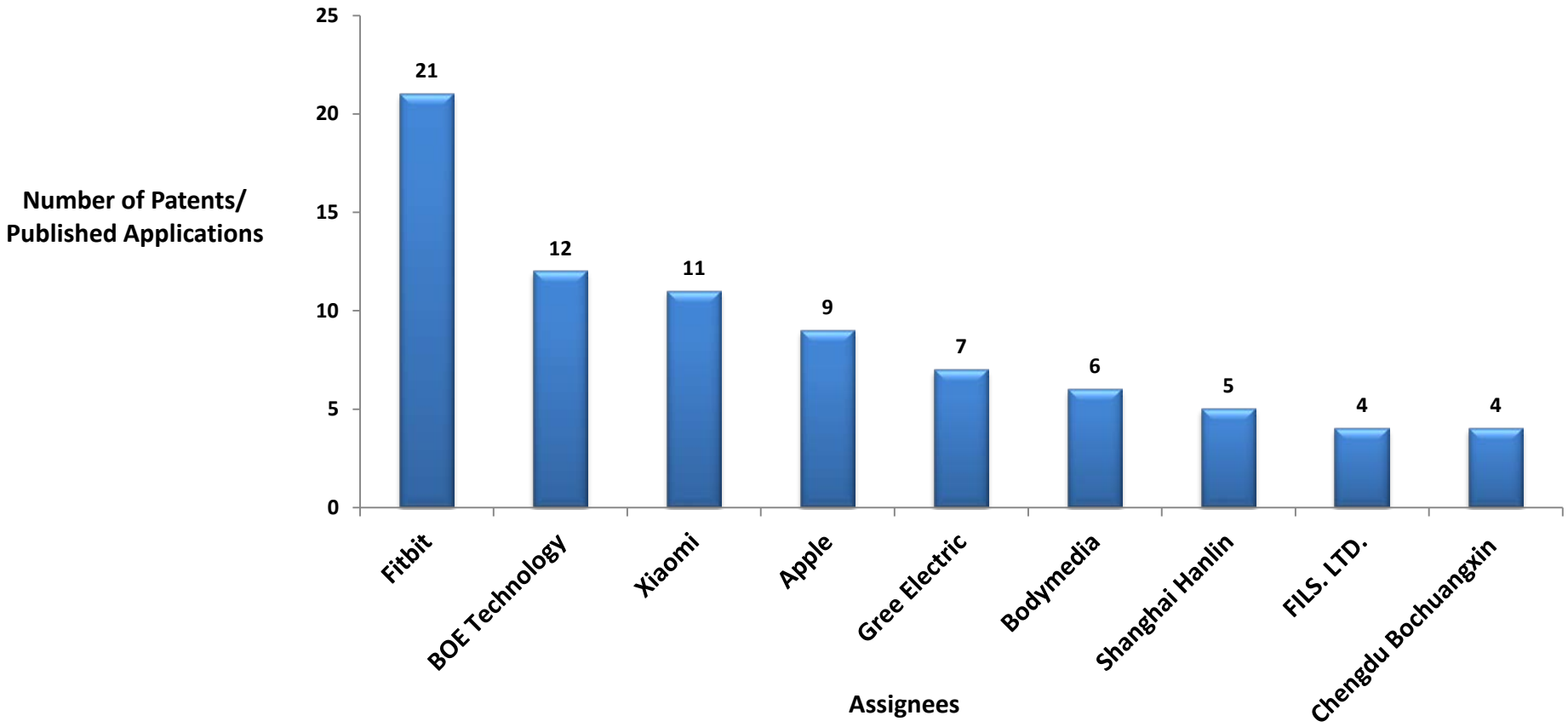
Top IPC Classes



Insight

As evident from the data shown above, **majority of patent applications filed in the domain of wearable health monitoring devices pertains to IPC class "A61B" (209) which stands for "Diagnosis; Surgery; Identification", followed by IPC class "G06F"(39) which stands for "Electric Digital Data Processing",** during 2012-2016.

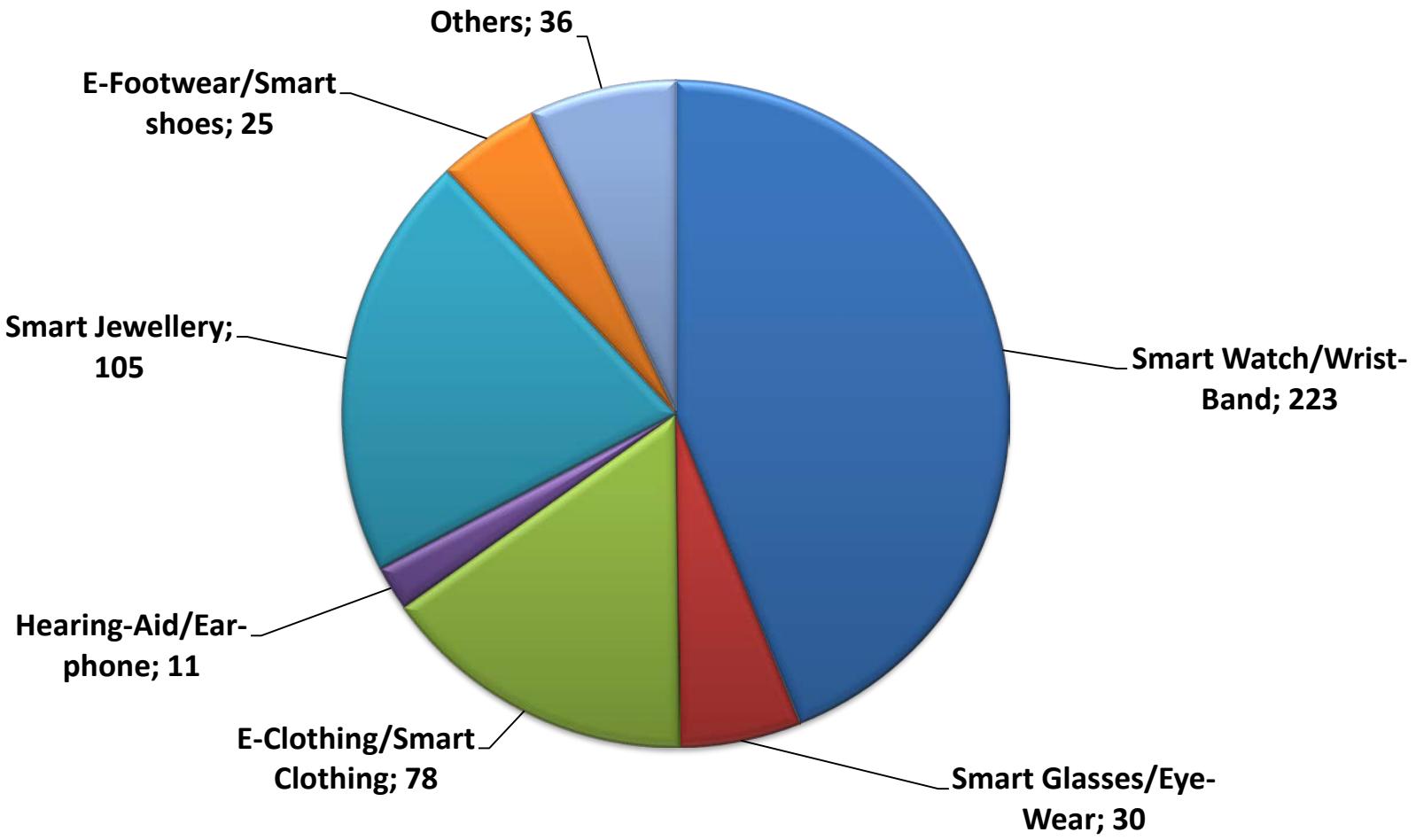
Top Assignees



Insight

As evident from the data shown above, **Fitbit (21), Boe Technology (12) and Xiaomi(11)** were the major assignee/ applicants in wearable health monitoring devices based on their patent filing activity worldwide during 2012-2016.

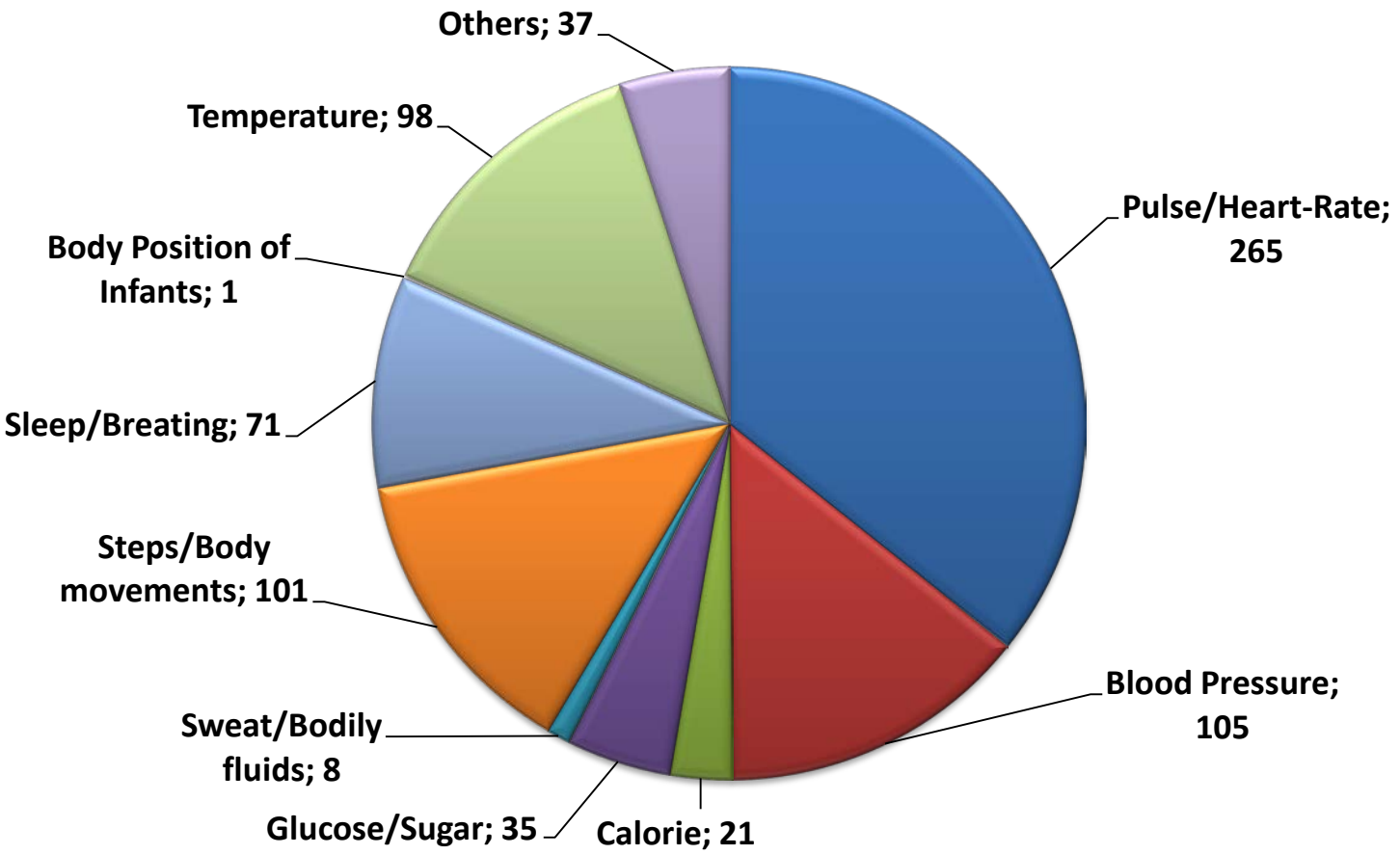
Distribution of Devices According to Body Part



Insight

As evident from the data shown above, majority of the patent applications were filed for **smart watches (223), smart Jewellery (105), and smart garments (78)** during 2012-2016, in the domain of wearable health monitoring devices.

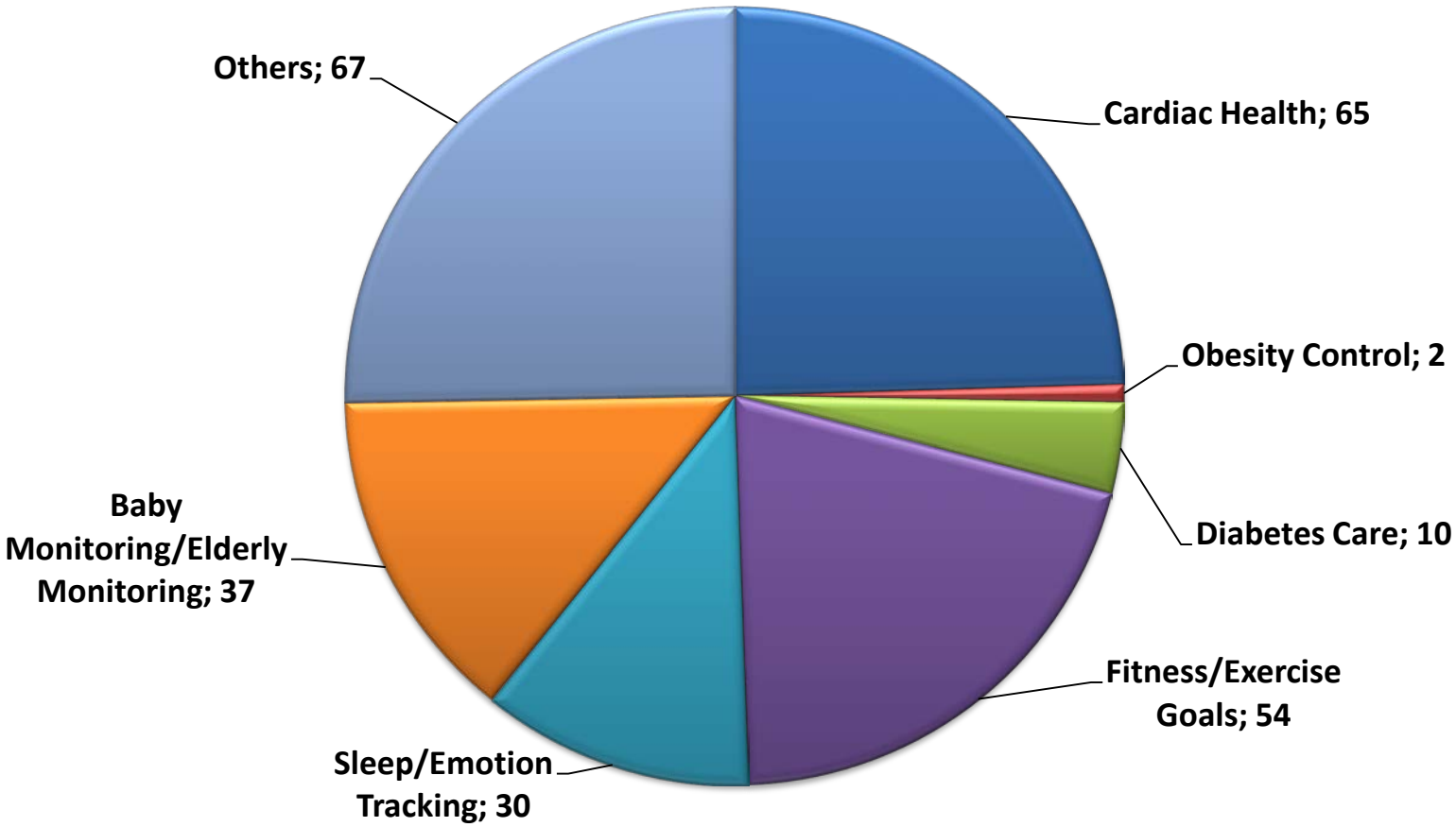
Physiological Monitors - Distribution



Insight

As evident from the data shown above, majority of the patent applications were directed towards tracking/monitoring of **pulse/heart rate (265), blood pressure (105), and steps/body movements (101)** during 2012-2016, in the domain of wearable health monitoring devices.

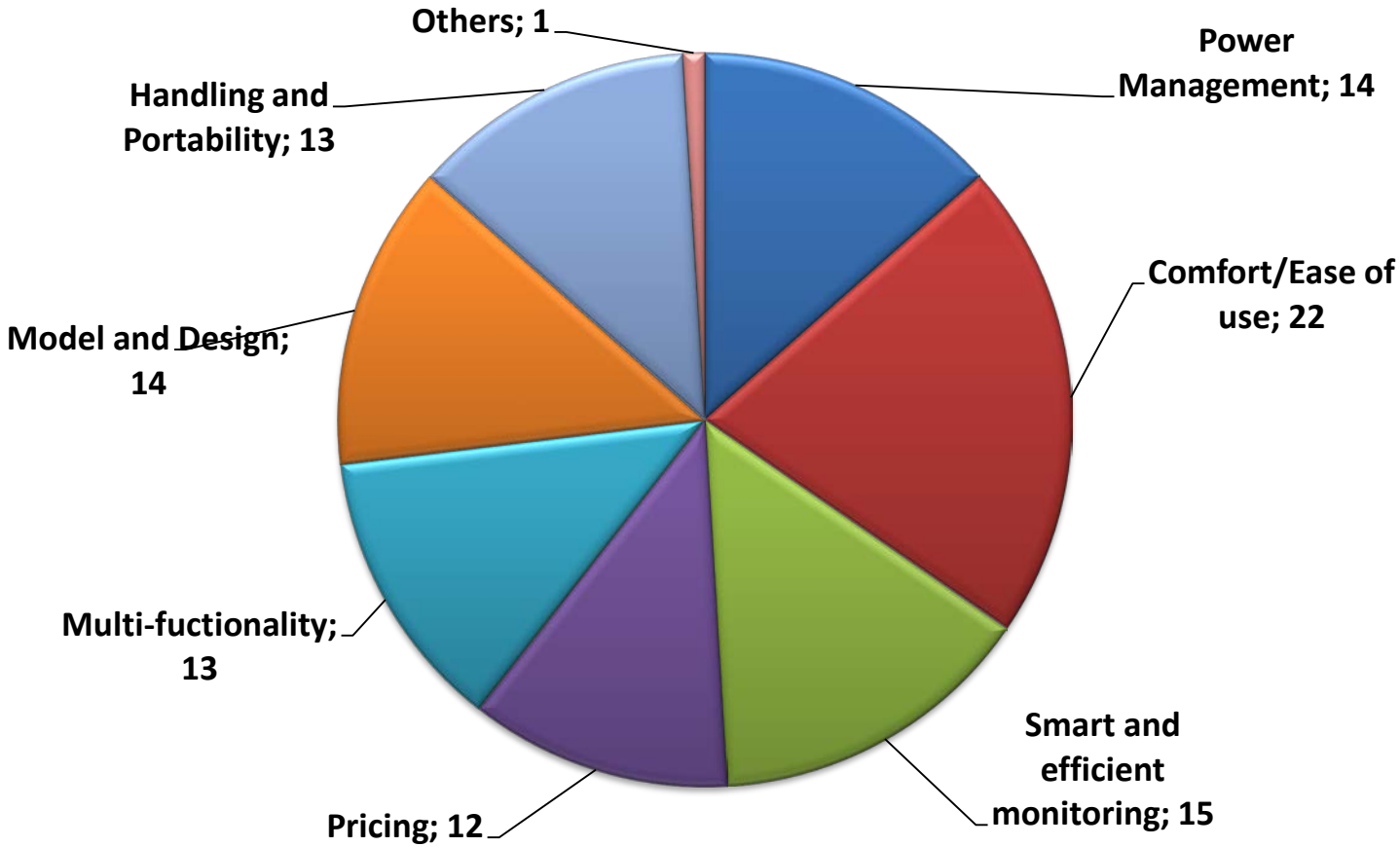
Application - Distribution



Insight

As evident from the data shown above, majority of the patent applications filed during 2012-2016 were directed towards utilization of wearable health monitoring devices in **cardiac monitoring (65), meeting fitness/exercise goals (54), and baby monitoring (37)**.

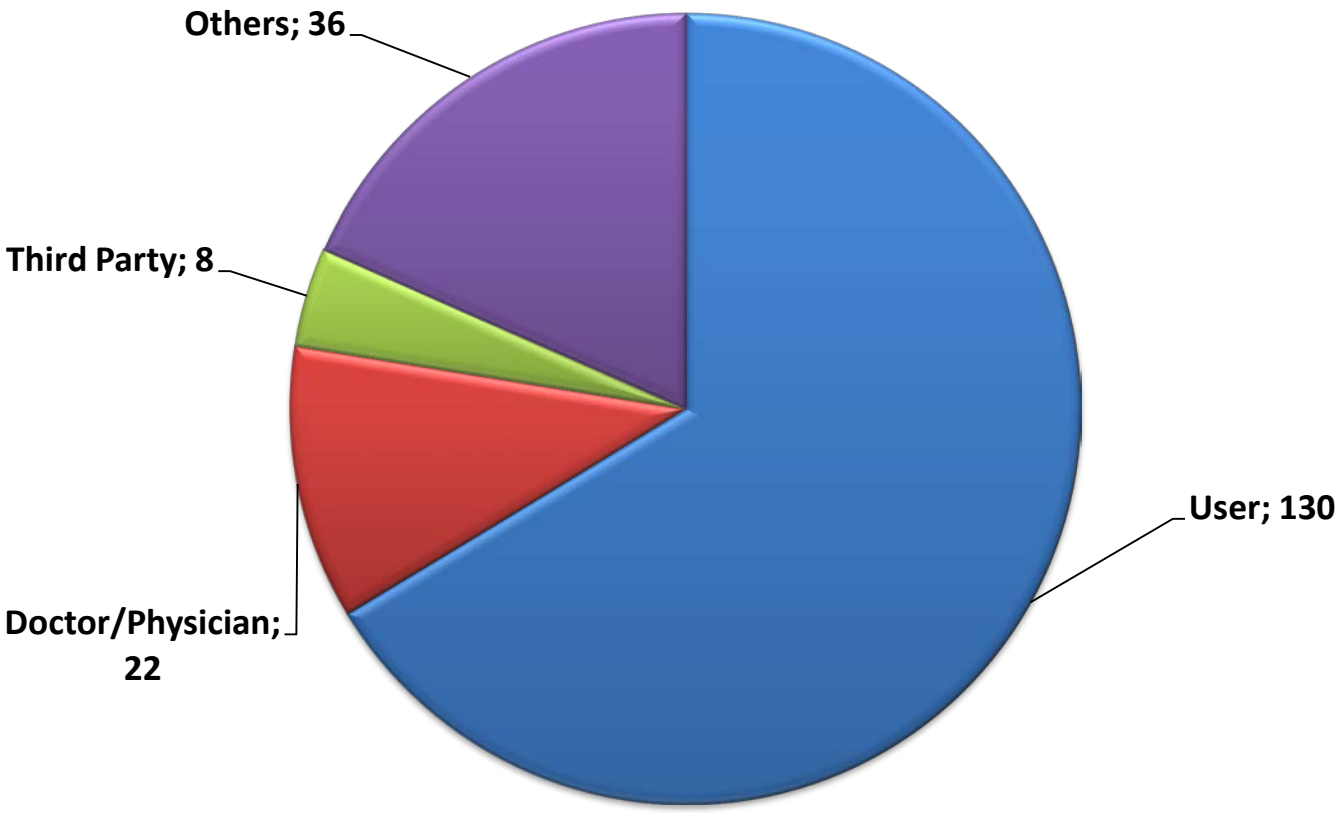
Improvement Areas - Distribution



Insight

As evident from the data shown above, majority of the patent applications filed during 2012-2016 were directed towards improvement in **comfort/ease of use (22), smart and efficient monitoring (15), and model and design (14)** of wearable health monitoring devices.

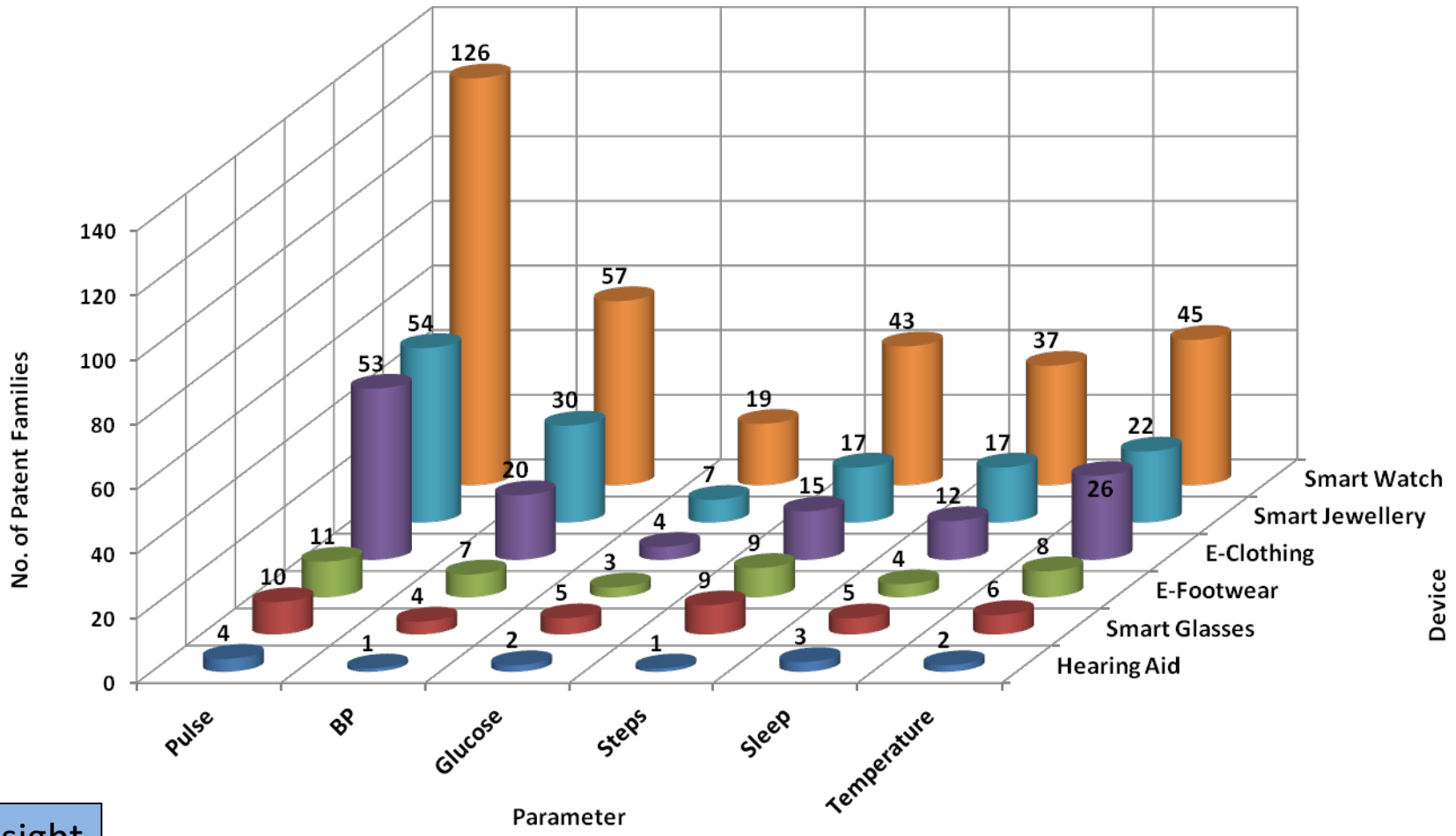
Beneficiary - Distribution



Insight

As evident from the data shown above, majority of the patent applications filed during 2012-2016 were directed towards benefitting **users (130), and doctors/physicians (22**), from the use of wearable health monitoring devices.

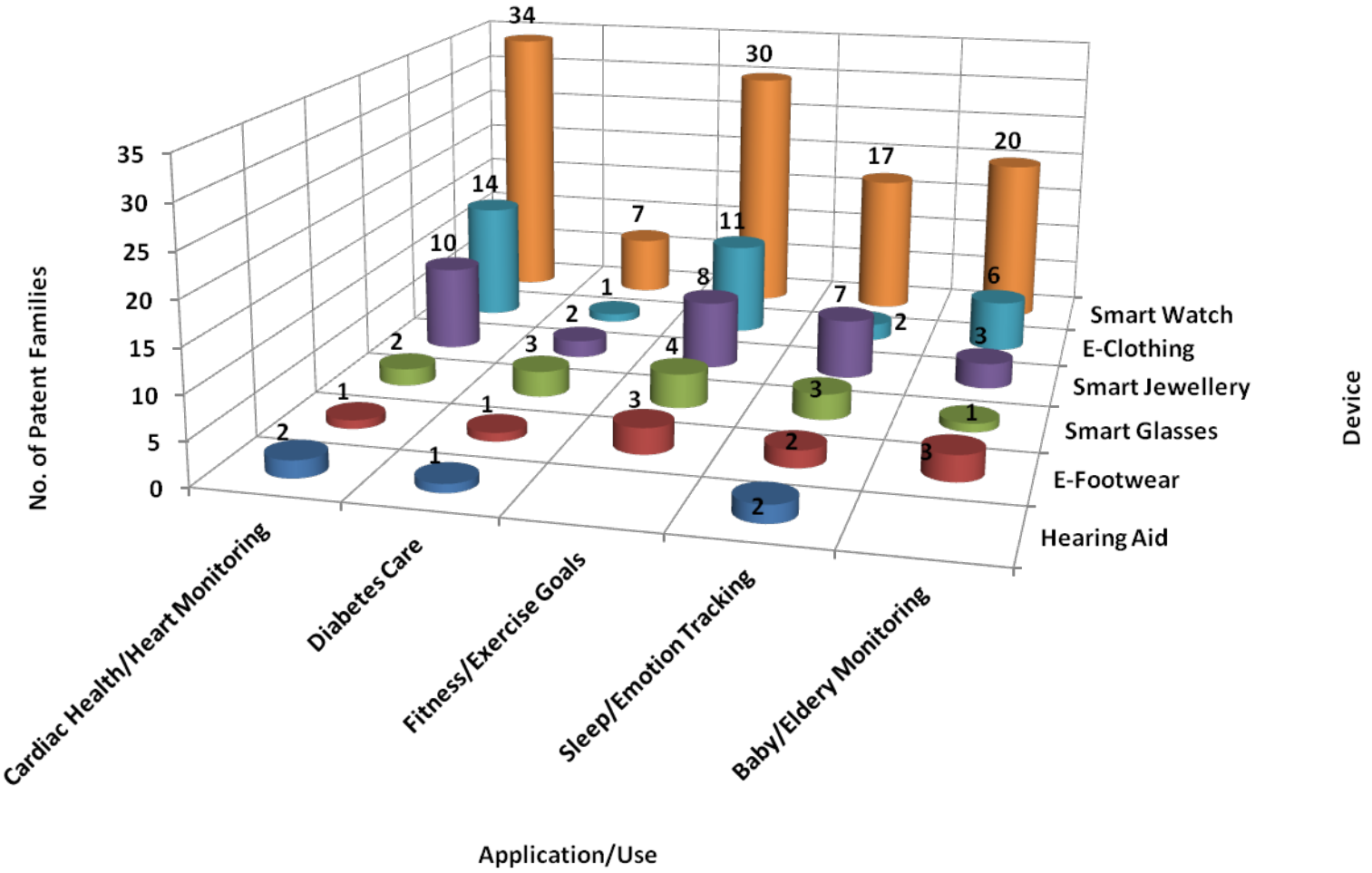
Body Part/Device Vs Physiological Monitors



Insight

Trend analysis depicted above indicates that **smart watches or wrist bands** were mostly utilized for monitoring of pulse/heart rate (126) of users. **Smart jewellery including bracelets and rings** were utilized for monitoring of pulse (54) and BP (30) of users. **Smart garments** were mostly utilized for monitoring of heart rate (53) and temperature (26) of users.

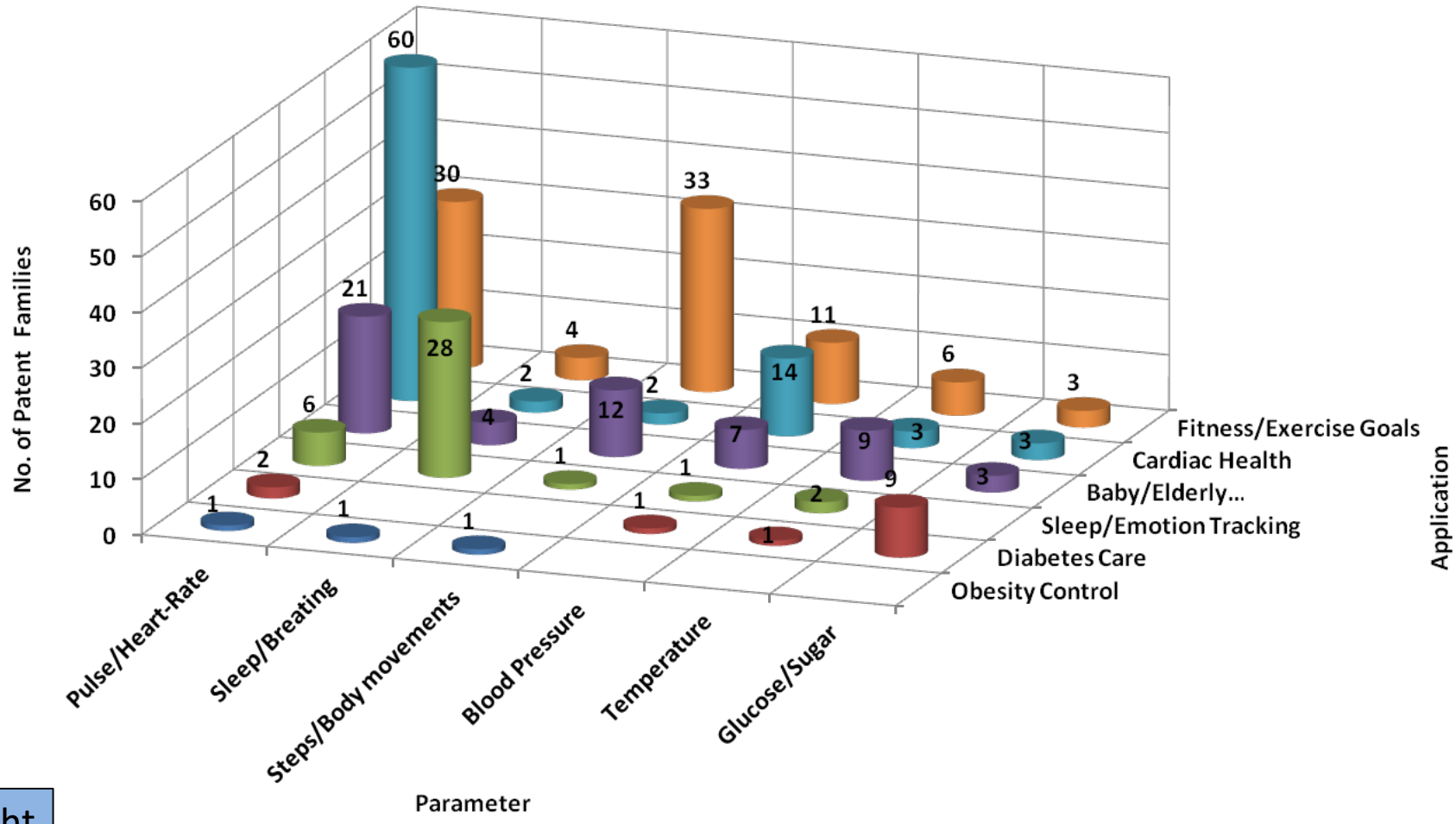
Body Part/Device Vs Application



Insight

Trend analysis depicted above indicates that **smart watches or wrist bands** were mostly utilized for cardiac health monitoring (34) and meeting fitness goals (30) of users. **Smart Jewellery including bracelets and rings** were utilized for sleep/emotion tracking (7) of users. **Smart garments** were mostly utilized for cardiac monitoring (14) and meeting fitness goals (11) of users.

Physiological Monitors Vs Application



Insight

Trend analysis depicted above indicates that **pulse (60) and blood pressure (24)** were monitored for determining cardiac health of users. **Steps and Body movements** were monitored for baby monitoring(12) and tracking fitness (33)of users.

Patent Litigation

Patent Number	Patentee	Defendant	Comments
US 8,725,276	Adidas	Under Armour	In February 2014, Adidas filed a lawsuit against Under Armour for alleged patent infringement of its mobile-app technologies that monitor heart rate, calorie burn and other indicators during workouts
US 5,058,427 US 6,289,238 and US 7,215,991)	Avocet Sports Technology, Body Science LLC	Polar Electro	In 2011 and 2012, Avocet Sports Technology (for patent US 5,058,427) and Body Science LLC (for patents US 6,289,238 and US 7,215,991) sued Polar Electro alleging patent infringement
US 7454002	SportBrain	Adidas, Fitbit and Nike	SportBrain sued Adidas and Fitbit in 2012, and Nike in 2013, for infringing several of its fitness-related patents.
US 9,031,812, US 8,909,543 and US 9,042,971	Fitbit	Jawbone	Fitbit filed multiple cases against Jawbone in September 2015, accusing Jawbone of infringing three of its patents on motion and activity sensing

Product to Patent Mapping

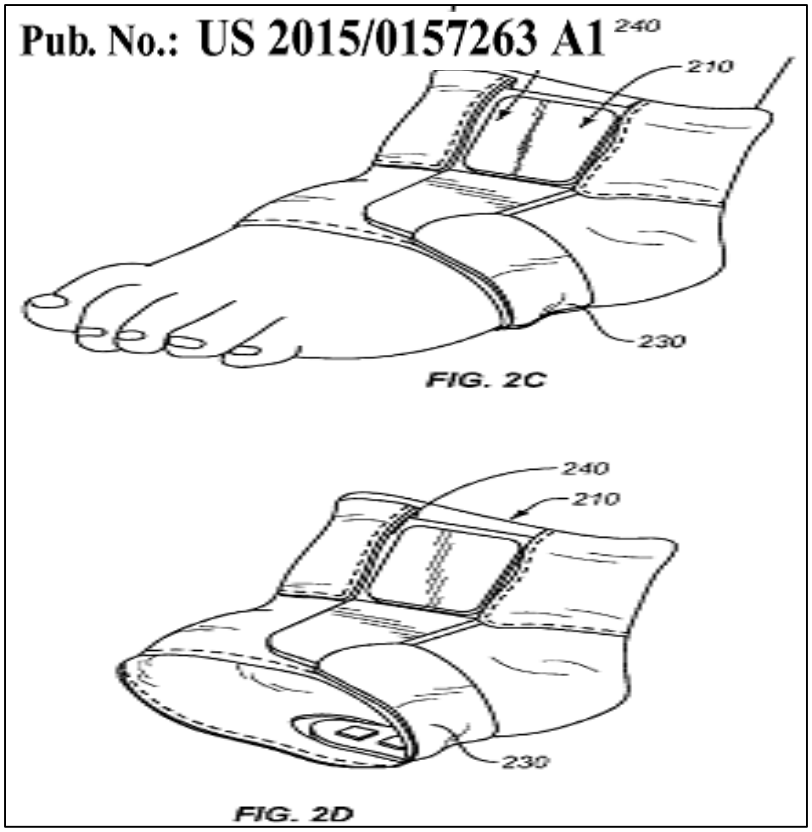
Owlet
Baby Care

SMART SOCK

The Owlet Smart Sock fits safe and secure on your baby's foot and tracks their heart rate and oxygen levels while they sleep.

- Pulse oximetry measures heart rate and oxygen levels
- Sounds notifications if baby's levels are out of range

http://www.owletcare.com/product/



Product to Patent Mapping

US 20150157263

1. A system for wirelessly monitoring the health of an infant, the system comprising:

a sensing module removably disposed within a wearable article, at least a portion of the sensing module in contact with an infant's foot;

the sensing module comprising a processing unit configured to receive and process health readings received by the sensing module;

a wireless transmitter in communication with the processing unit, the wireless transmitter configured to transmit the processed health readings to a receiving station; and

the receiving station comprising a display that is configured to depict the processed health readings.

2. The system as recited in claim 1, wherein the sensing module comprises a pulse oximeter.

5. The system as recited in claim 2, wherein the processing unit is configured to analyze raw pulse oximetry data and compress the data before the data is transmitted to the receiving station.

6. The system as recited in claim 1, wherein the receiving station is configured to indicate an alarm if the processed health readings indicate a health trend that falls outside of a particular threshold.

7. The system as recited in claim 6, wherein when the receiving station indicates an alarm, a notification is sent to a mobile phone.

13. The system as recited in claim 1, wherein the wearable article comprises a sock.

14. The system as recited in claim 13, wherein the sensing module can be removed from a pouch within the wearable article, such that the wearable article can be washed.

PRODUCT

Salt Lake City startup Owlet Baby Care, founded by five Brigham Young University students and recent grads, claims to have created the world's first baby "smart sock." The bootie transmits a child's heart rate, oxygen levels, skin temperature, sleep quality, and sleep position to a parent's smartphone or other Internet-connected device. So far the startup has raised more than $63,000 toward its $100,000 goal and aims to make its baby tracker available this November.

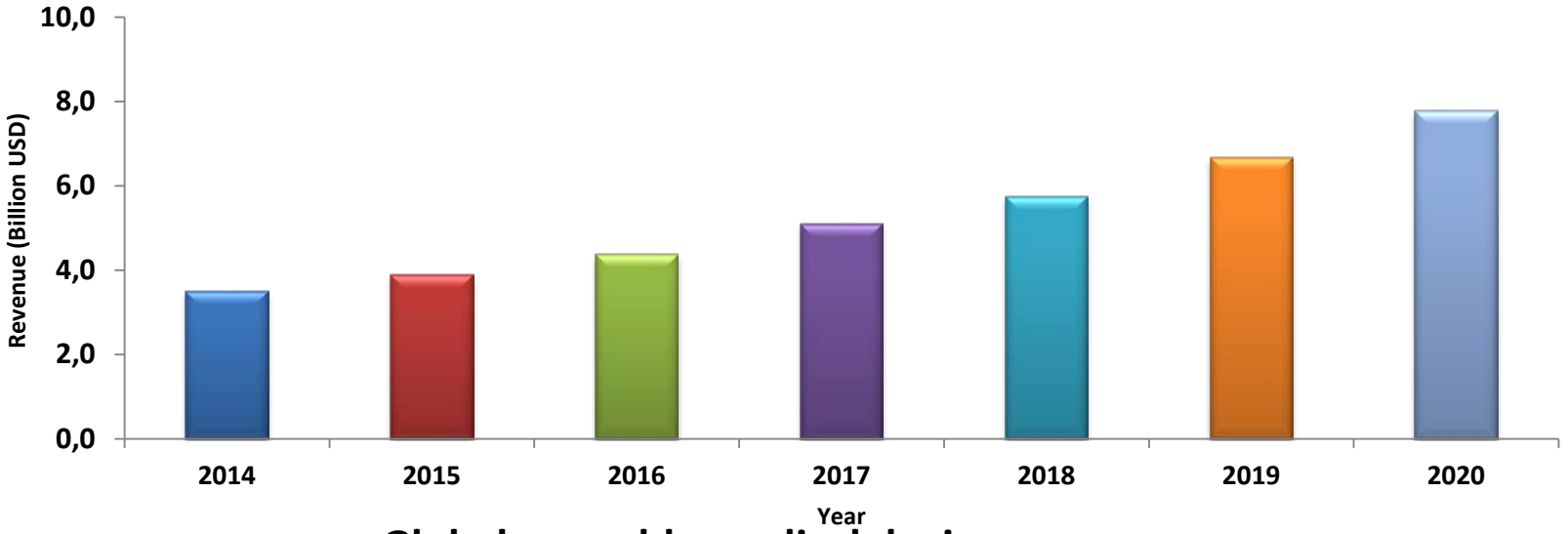
As of yet, Owlet does not include video or sound monitoring options, but it does send alerts if, for example, "the baby rolls onto his/her stomach which is the most unsafe sleeping position," writes co-founder Jordan Monroe in an e-mail. Owlet also alerts parents whenever the device picks up on significant deviations from an infant's baseline statistics—for instance, when the baby is getting 10 percent less oxygen than normal or suffering a 30 percent loss in quality sleep.

By closely monitoring infant oxygen levels and rollover rates, the tracker, Owlet's founders say, could help eliminate Sudden Infant Death Syndrome (SIDS), which mysteriously kills roughly 2,000 young children in the U.S. each year. Eventually the company hopes to use the big data it collects to help researchers discover causes and predictive models for other infant ailments. "Every parent knows what it's like to [lie] in bed and stress about whether your child is breathing," says Jacob Colvin, Owlet's founder and a father of two, in the press

MARKET SHARE AND TRENDS

Market Overview

- Globally, medical wearable devices market was worth more than USD 3.5 billion in revenue in 2014 and is expected to cross USD 7.8 billion in 2020, growing at a healthy CAGR of over 15%. >>

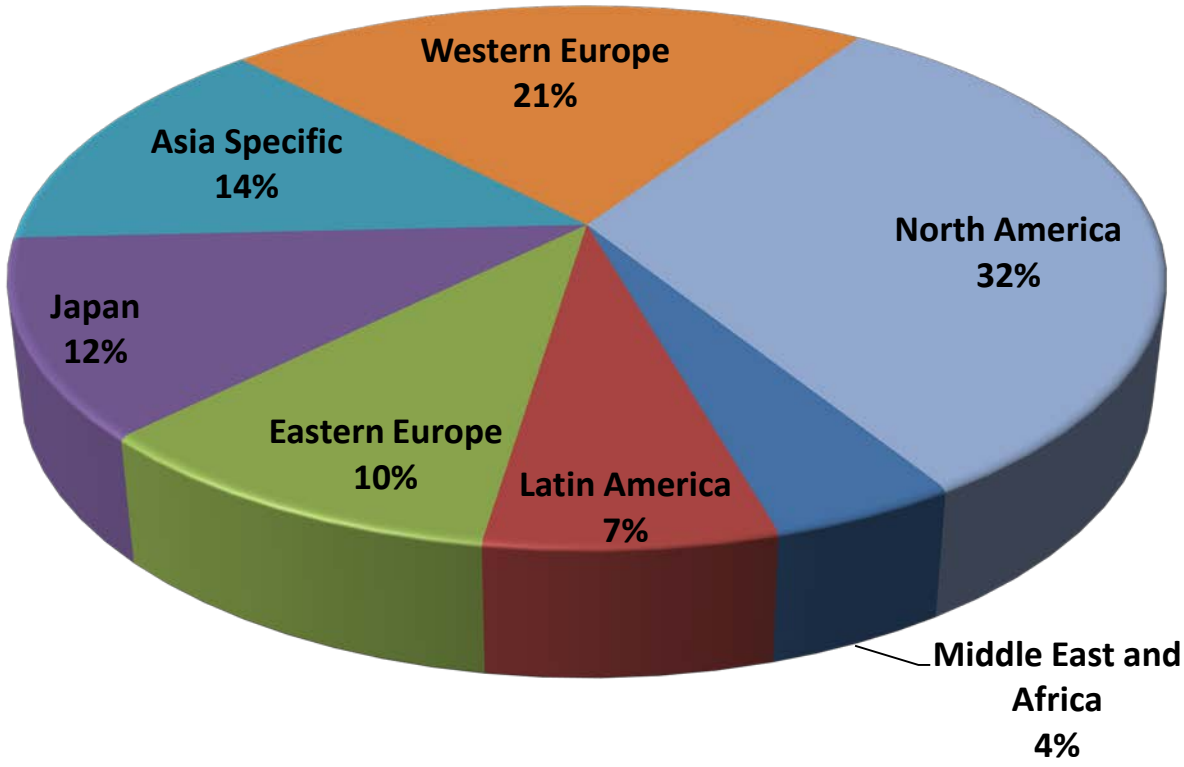


Global wearable medical devices revenue

- This growth of the wearable technology market is expected to be driven by consumer preference for sophisticated gadgets, increasing growth prospects of next-generation displays in wearable devices, and growing popularity of Internet of Things (IoT) and connected devices.

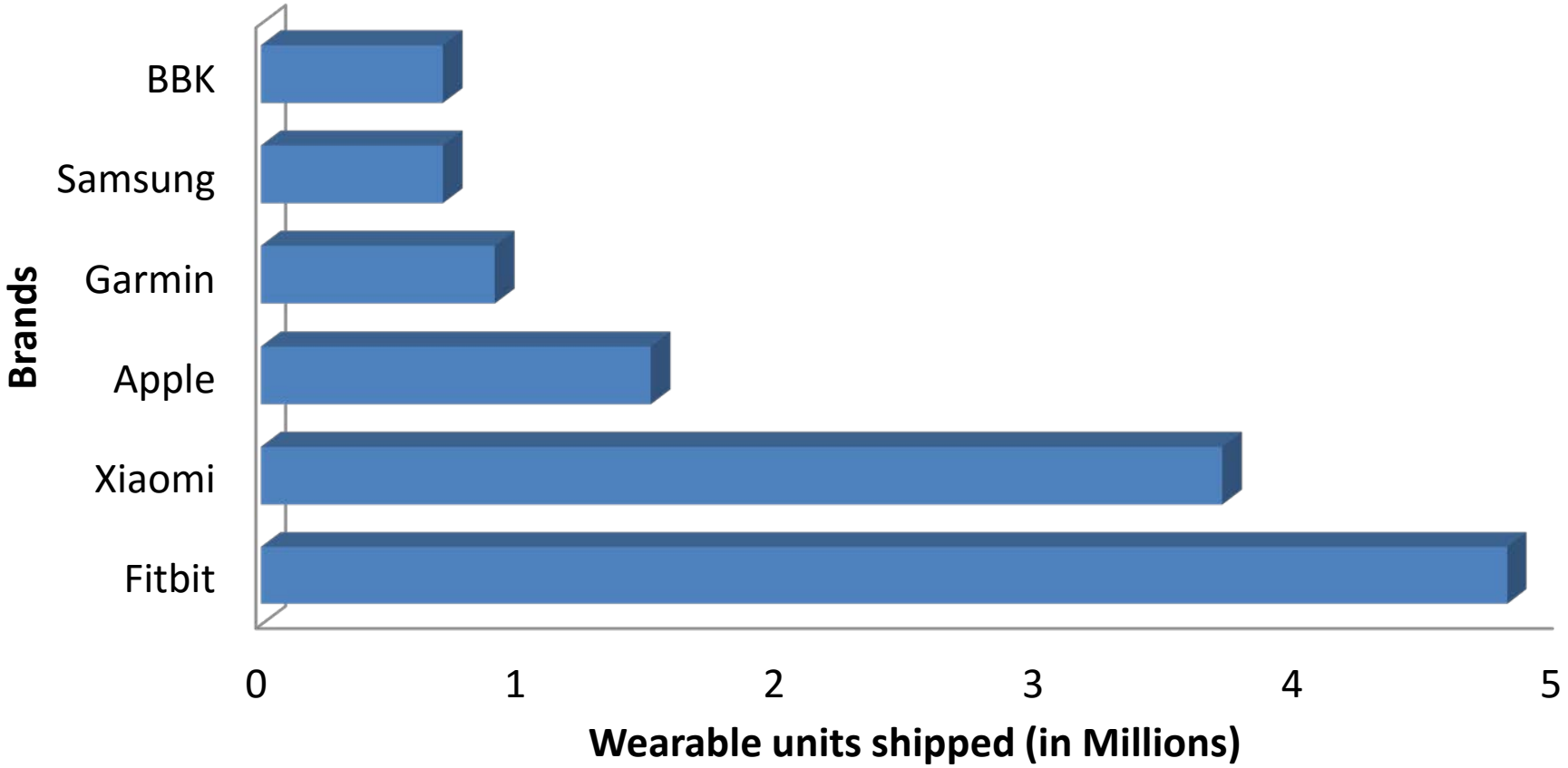
Regional Market Overview

- In 2016, North America dominated the Wearable medical devices market with share of 32% followed by Europe and Asia-Pacific.
- Increasing health awareness among end-users in emerging economies such as India and China is also fuelling the growth of wearable medical devices in the Asia Pacific market. >>



Wearable Health Monitoring Devices Brands

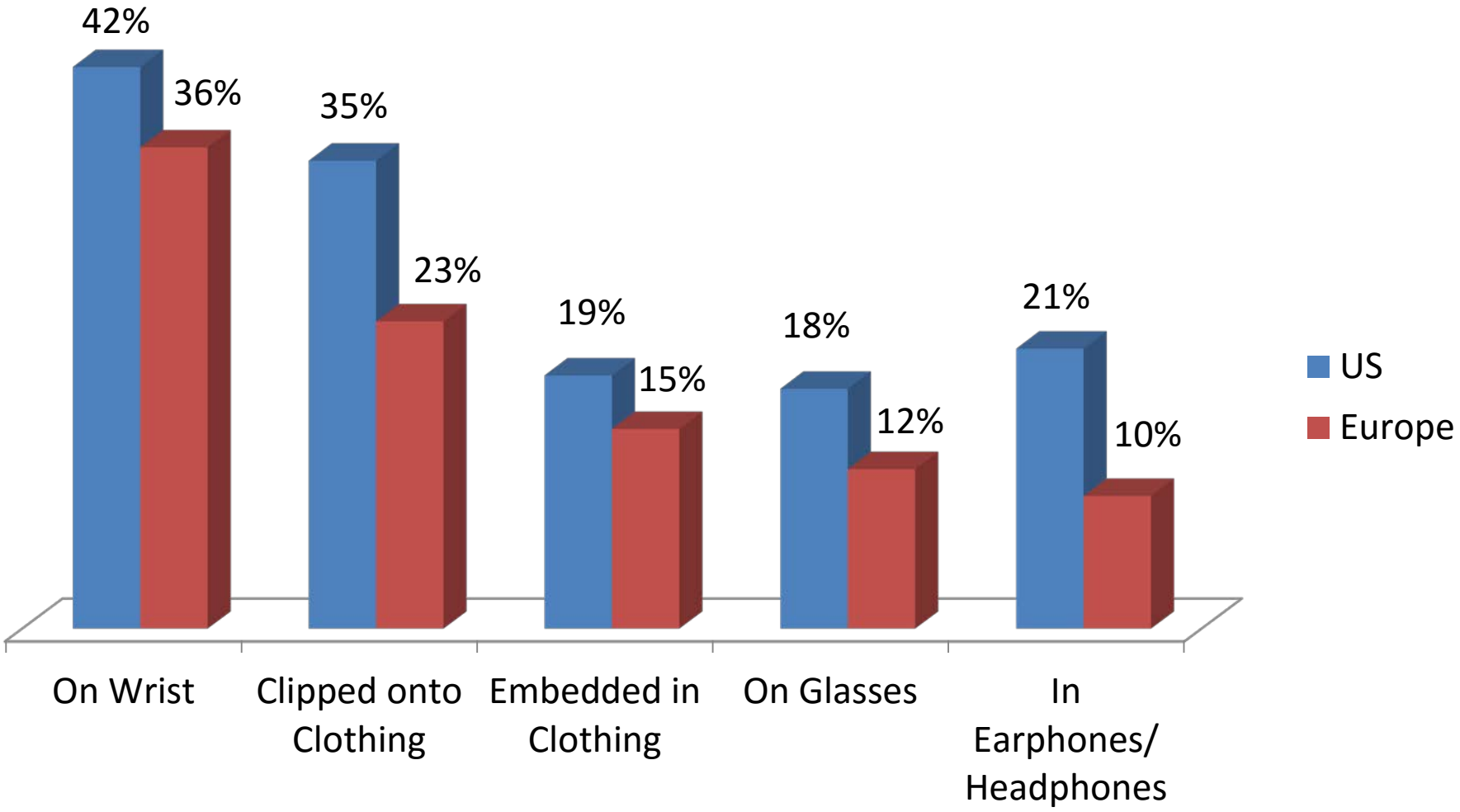
- Top wearable brands according to market-measurement firm IDC, in the first quarter of 2016 >>



Key Players in Wearable Health Monitoring Devices Market

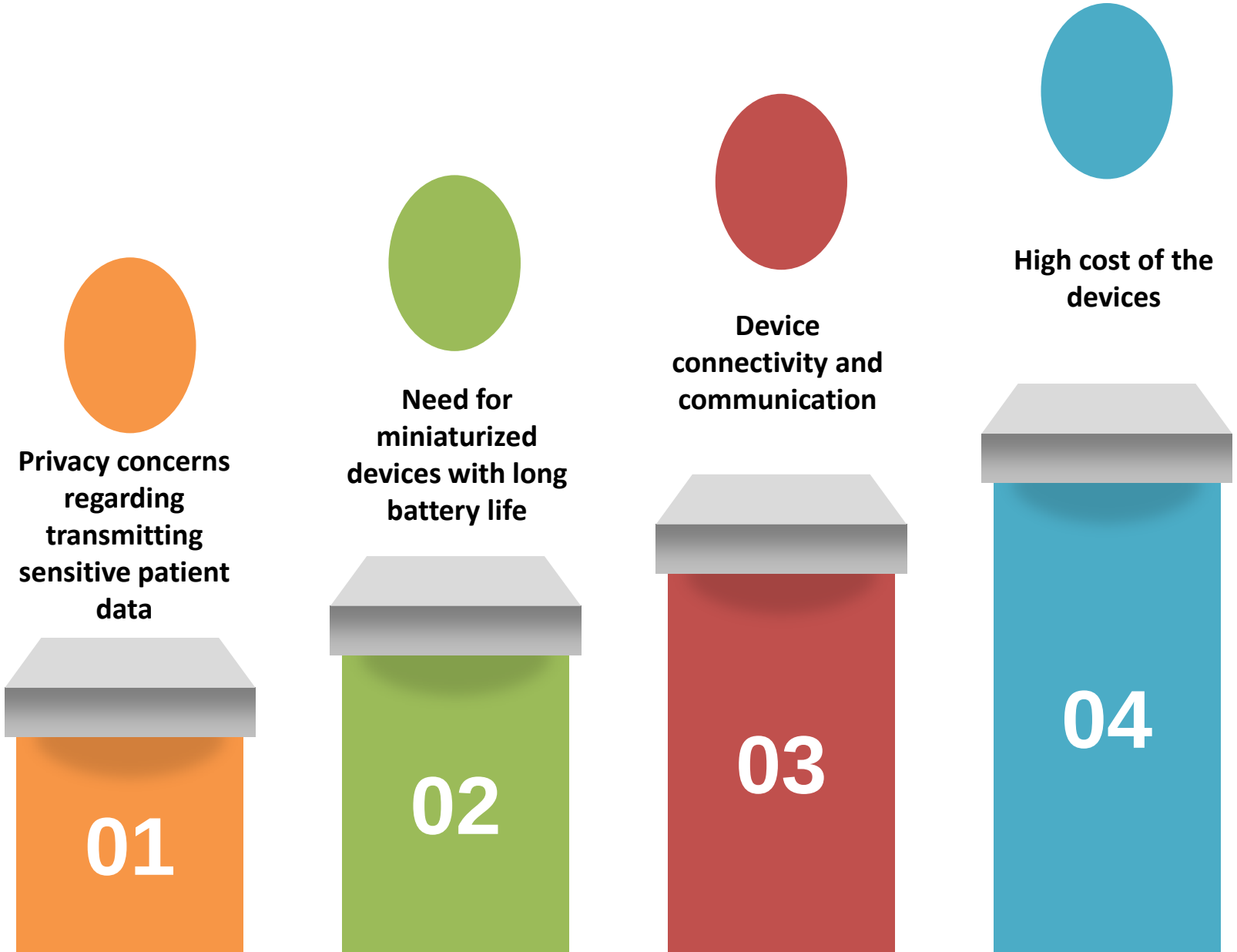
Wearable Preferences

US and European Consumers interested in wearing/using a Sensor Device (2014) >>



Major factors driving growth of wearable health monitoring devices market

Challenges in wearable health monitoring device market



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Mergers and Acquisitions

Acquirer	Acquiree	Highlights	Year	Source
Polar Electro	Health First Corporation	Polar Electro acquired HealthFirst Corporation, a developer of software and web-based products used for health and fitness assessment, and other education and nutrition programming	2010	Source
Jawbone	Massive Health Body Media	In February, Jawbone acquired Massive Health – a developer of apps and big data to foster healthy living. In April, it acquired Bodymedia for over $100 million and earned around 80 patents of Bodymedia that are primarily related to wireless sensors and wearable monitors	2013	Source
Intel	Basis Science	Intel completed the acquisition of heath-tracking wearable device maker Basis Science	2014	Source
Covidien	Zephyr Technologies	Covidien acquired sports and medical wearable company Zephyr Technology.	2014	Source
Medtronic	Covieden	In January 2015, Covidien was acquired by market leader, Medtronic	2015	Source

Recent advancement in Wearable Health Monitoring Products

- Google Fit Preview SDK arrives to help Android developers build smarter health and fitness apps>>
- Apple HealthKit announced: a hub for all your iOS fitness tracking needs>>
- Apple releases ResearchKit open source development kit to medical researchers>>
- Apple Advances Health Apps with CareKit- New Software Framework Helps Developers Empower People to Take a More Active Role in their Health>>
- Under Armour and HTC make a bold move into fitness tech with Health Box >>

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