

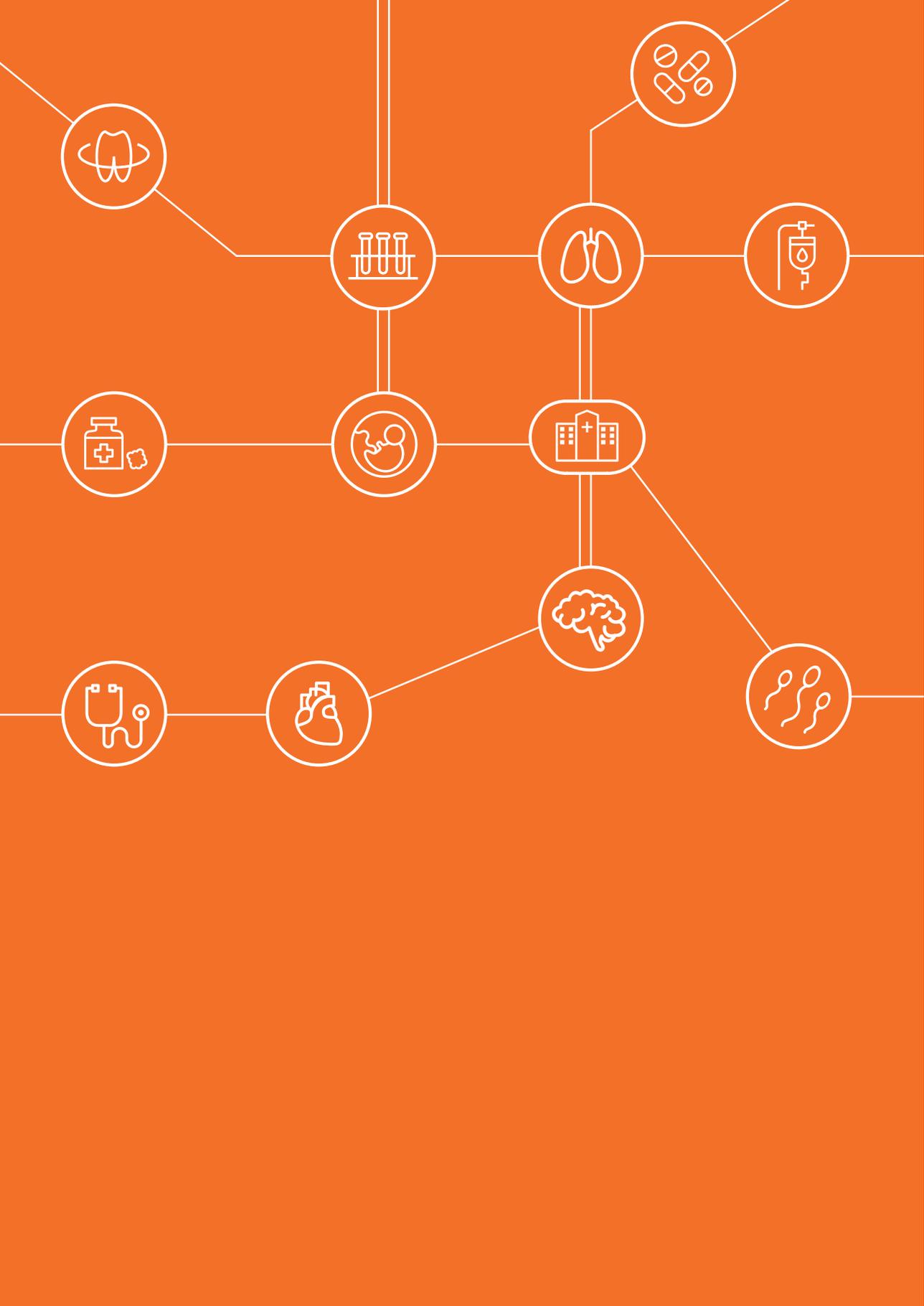


Dana Merchel, Albert Ibragimov, Claudia Krettler, published by Markus Wild

MEDICAL DESIGN TREND UPDATE 2018

A SUMMARY OF THE MOST INFLUENTIAL TRENDS IN MEDICAL DESIGN

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Intro

Medical Design Trend Update 2018



Ask the USER! With this general request for more user participation, we invite you on a tour to understand the current opportunities and challenges for true innovation in medical technology and show you the trends that hold great potential for better medical devices. While most players in the field of medical technology are forced to cope with the rapidly increasing regulatory requirements - such as the new European Medical Device Regulation (MDR) or other current standards, we draw attention to the topic of Medical Design Trends. Two years ago, we published our first Trend Report, which has now undergone a thorough update.

Much has happened in the meantime: energy, mobility or digitization are issues that have now raised public awareness and are stimulate controversial discussions. The right decisions depend on our future, on a personal, national and global level. The frontal political and social attack on the truth, for which the word "post-factual" was created in 2016 and even became the word of the year, creates space for probability and associated possibilities. Instances wobble and authorities erode. Apart from acute care, medicine is increasingly invading private life, with the support of Google and Co., enabling people to monitor their own health and well- being.

For example, while the subjective perception of health in industrialized countries is deteriorating, mortality on a global scale is continuing to decline. Medical and technical advances are objectively on the road to success, but we humans do not feel healthier.

In his latest book, "Homo Deus," Yuval Noah Harari writes, "In the 21st century, people will probably seek immortality. Google Ventures CEO Bill Maris predicted that it would be possible to reach the age of 500 in 2015, and is now investing hundreds of millions of dollars in start-up life science businesses.

In this interesting time with huge innovation opportunities for those who see the opportunities for change and courage, we would like to give some guidance in our discipline of Medical Design with this trend update. The 15 individual trends, which we present here in detail, are current trends that can be observed in modern product developments and must therefore be taken into account. But before we start the practical part to learn how we can incorporate current trends into our development context, let's start with an overview:

We see three major factors influencing our current and future work as product developers in medical technology: **USER**, **DESIGN** and **TECHNOLOGY**

USER

First and foremost, we see the USER, which is now moving more and more into the center of medical product development. Supported by the substantial standards for creating better usability, such as the IEC 62366, the USER has become an element that cannot be ignored. **Usability** becomes the driving force for product innovation, in addition to technological advances. New medical products will have to adapt to completely different contexts in the future, for example to being used in public spaces or in a shopping mall. The **point-of-care** is the trend that brings the advances of modern medical technology to wherever the user needs them. As part of the point-of-care trend, we continue to see **mHealth** gaining ground, meaning greater mobilization of the product right through to permanent body support. The issue of **hygiene** is becoming increasingly important due to the problems with multidrug-resistant germs and the weakening of the concept of antibiotics and has an impact on product design. All in all, the curative treatment should become a more and more positive experience, so that we as patients in the **Positive Clinical Experience** can feel comfortable.

DESIGN

We see a whole series of stylistic drivers penetrating the field of medical technology. With the increasing privatization of medical applications to pure homecare products, **consumer familiarity** is becoming increasingly important. Users and customers are seeking the familiar - especially a smarter touchscreen that they know from your mobile phone. So that it does not overstrain the operation, the product is made as simple as possible. **Minimalism and simplicity** are an expression of this strong design trend. Color also serves as a leitmotif for the trend-oriented development of medical products, be it in the elegant **Black & White Contrast** or in the selective use of strong colors in the **Color Splashes** trend. The transition to technological innovation marks the megatrend of **connectivity**, which also inspires imagination in medical technology. There are still a number of reservations and even more regulatory hurdles in the way of connecting and bundling data streams, but in terms of design, the connection is already shaping the style.

TECHNOLOGY

While the technological progress that has set the pace so far continues to form the basis for new product generations, in the users' consciousness the motto "higher, faster, further" of technical development is becoming increasingly dull. In our opinion, the most important technological influences on product innovation are **automation** and **miniaturization**. Service robots and support systems will change the clinical and nursing landscape. For acceptance by healthcare professionals and patients alike, ways must also be found in the design to give these new beings the right identity. The progressive reduction of technical components pushes the innovation in the direction of barely noticeable technology and interventions. A successful factor in the trend landscape is certainly telemedicine. **eHealth** is not a new concept, but the associated problems are now being solved step by step, so that here as well an influence on medical design can be expected. The progress in the optical visualization of medical events, be it through particularly high resolution or through virtual realities, is captured in the **3D & 4K visualization** trend. Last but not least, the rapid advances in **3D printing** bring us not only effective development tools, but also superior possibilities of serial production in small series.

Compared to our Medical Design Trend Review 2016, the chapter "Asian Influence" is missing in this issue. In fact, Asian influence continues to exist, causing shifts in global markets and restructuring in international development consortia. But it does not affect design as much. On the one hand, its effects are limited to the fact that more and more products are coming under price pressure and therefore need to be developed and produced more cheaply. On the other hand, the difficult Chinese market has become a complicated driver for many global players. However, we can no longer identify any predicted effects on product development in terms of an Asian Health Style.

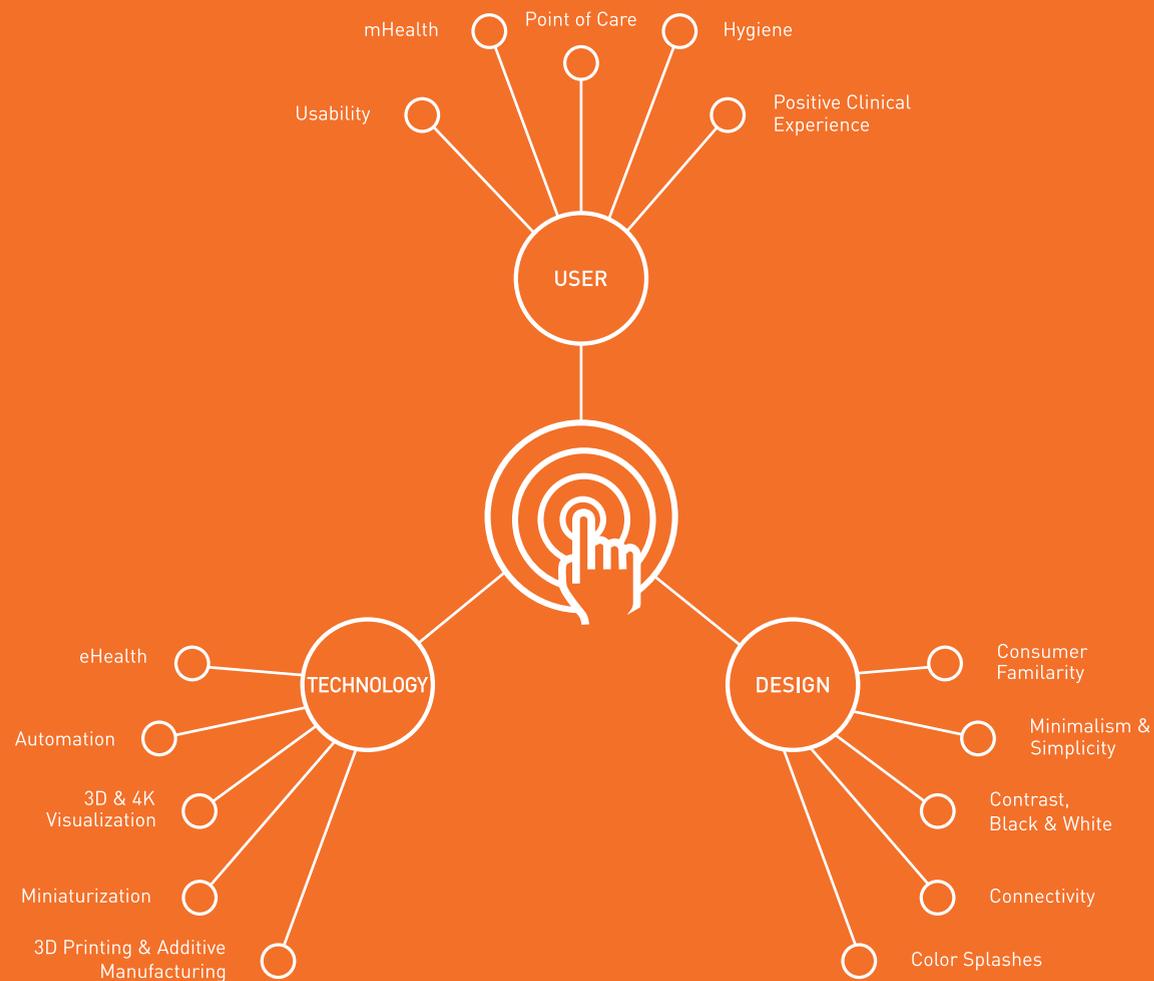
Many thanks to the authors of this issue for their intensive research and pointed presentation of the 15 trends as well as our interview partners from the fields of research, as well as the industry, who objectified our view once again and rounded it off with concrete examples.

We look forward to your questions, feedback and discussion (via e-mail totrendupdate18@wilddesign.de). We will be happy to respond to your messages.

A digital version of the Medical Design Trend Update 2018 is available for download on our blog (<https://wilddesign.de/blog/de/trendupdate18>). Here you will also find the German language version.

Markus Wild

Gelsenkirchen in November 2017



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1 | Point of Care



How much diagnosis does a human need?

„Innovative technologies have created a limitless potential for point-of-care solutions over the past few years. The possibility of near-patient treatment, investigations and diagnostics will mean that medical services will no longer be bundled in the hospital or doctor’s office, but spread much more widely: Diagnostic examinations in the pharmacy or the gym will no longer be a rarity - and maybe even supermarkets will carry them out in the future.“

Markus Wild

Medical technology is constantly moving towards points of care (PoC). In particular, progressive miniaturization and digitization pave the way: components that are ever smaller, lighter, but at the same time more powerful make stationary laboratory and medical technology small and mobile. In some cases, the new devices can be linked with the smartphone or tablet, with which they can control one another and make it easy for us to use them since we are familiar with their use from everyday life. At the same time as technical progress

increases, people’s curiosity about the manifold possibilities of self-tracking is growing. Without sitting in the waiting room or the lab, they want to be able to make a diagnosis about their own well-being: It is not the person who is seeking out the medical device but the medical device comes to him. This is not only limited to the patient’s home – a Point of Care can be located in a retirement home, public building or pharmacy. Wherever a medical intervention is needed a Point of Care can be installed– therefore a lot of providers offer a „point of need“. Older or chronically ill patients - such as diabetics or asthmatics - as well as fitness- and health-oriented people can find out about their well-being by measuring their vital signs.

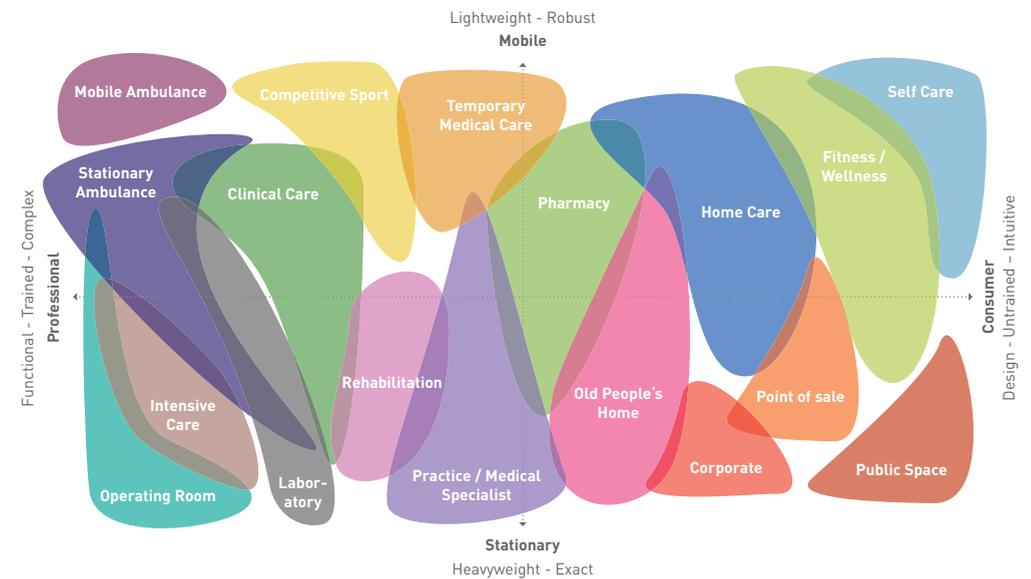
The trend towards self-measurement is therefore not just due to demographic development and the increase of chronic illnesses, but is also associated with a new health awareness. Clinical thermometers or sphygmomanometers, which became pioneers of the point-of-care trend with their entry into private households in the 1990s, have been faced with scepticism from doctors for a long time. Not accurate

enough, lack of precision - argued the medical professionals. Regardless of their bad image, the home-care devices have been able to become increasingly popular over the past few years and paved the way for the point-of-care trend. The basis for this is on the one hand technical advances, for example in biotechnology, data transmission, networking or miniaturization. On the other hand, consumer acceptance of solutions has increased significantly. The use of health and fitness apps has increased by 330 percent since 2014, according to the mobile analytics service Flurry, the confidence in the digitized support seems to be correspondingly high.

Design follows context: complex or intuitive, heavy or light?

The requirements that the design of a PoC solution has to meet are determined, not least, by the location of use. In our design research, we differentiate between 18 different contexts in which PoC devices are used today, from rescue medicine to self-care in one’s own home. In addition to the premises, the typical persons or roles as well as the work processes play an essential role. So if the PoC device is used by an ambulance service, in an operating room or in rehab and thus by trained personnel, the devices are much more complex and function-oriented than those used in the home environment of the patient. Here, the focus is more clearly on a modern, aesthetic and in some cases even personalizable design. Intuitive usability is more important in a private environment than for professional use.

Whether personal or professional, heavy or light, functional or trendy - the thorough analysis of the PoC context is particularly important in answering elementary design questions.



Quick Diagnosis and Self Tracking: Curse or Blessing?

Innovative technology developments are constantly presenting a wide range of potential for PoC solutions, so that even outsiders can see the opportunity to participate new markets. Technical progress allows many opportunities to gain a foothold in it. However, whether the products can compete in the market depends, among other things, on whether they are perceived by the clinical staff to be labor-saving or of the private user as meaningful and to what extent the costs are reimbursed by the health insurance companies. Otherwise, there is a danger that only a small part of society will be able to afford better health, thereby further strengthening the already existing two-class society in this area. The advantages of the new systems close to the patient, on the other hand, are enormous: blood tests

previously had to be done in a laboratory, but can now be performed directly on the patient bed. This saves the patient the waiting time or even the inpatient stay. In addition, especially smaller clinics do not have an in-house laboratory, so sampling and diagnosis can take up to several hours, which can have serious consequences in acute cases. Emergency physicians or sports physicians also offer the ever more precise and innovative PoC solutions the ability to react even more adequately in the event of accidents: for example, they can use a mobile ultrasound to create a reliable diagnosis directly on site and take appropriate measures. In addition, because PoC systems are generally more cost effective than the stationary device, even doctor's offices can equip themselves with examination devices that would otherwise have spared those costs.

Fast and painless: Tests determine blood sugar levels, MRSA germs or antioxidants

The range of PoC solutions is growing continuously. With every technical innovation, the possibilities are widening. The company Biozoom from Kassel, for example, has developed a stand display for pharmacies or other service points, where customers can scan their hand, among other things, such as their antioxidants, which are responsible for combating free radicals in the body.



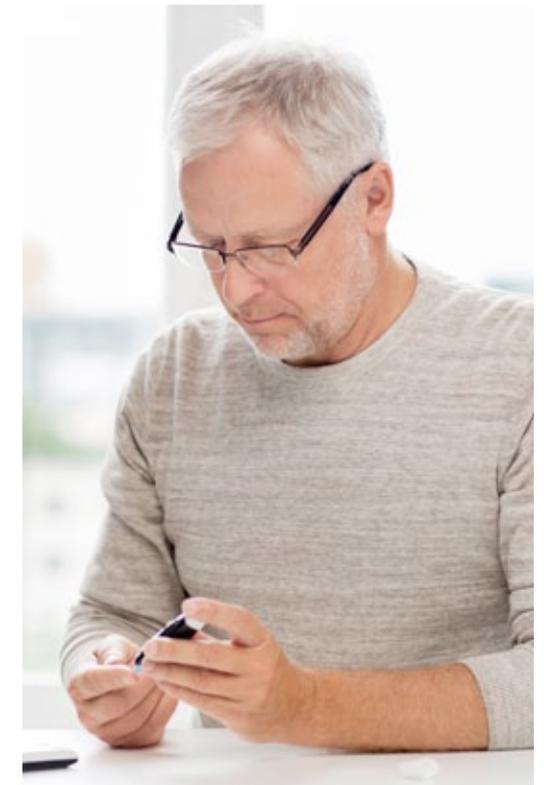
In addition to the precautionary and the need for a healthier lifestyle, however, PoC solutions can also quickly provide certainty about acutely necessary information: For example, a Frankfurt-based startup DiaMonTech developed a non-invasive method for measuring blood glucose. Now that innumerable established companies have tried this and Google has developed a contact lens with a measuring chip, a solution seems to be in sight: By next year, the Glucobox by Laser is supposed to be not only painless, but also available for over 400 million diabetics worldwide delivering more accurate data than current commercial measurement solutions, allowing physicians to better tailor medication to their patients.

Antibiotic-resistant pathogens should also be able to be determined directly at the PoC in the future. The Freiburg-based start-up SpinDiag is developing a screening system identifying risk patients when admitted to a hospital - and that in just 30 minutes instead of the previous two to three days. Affected patients can be isolated directly, reducing the risk of infection for other patients.



Learnings Point of Care

- It is not the person who has to seek out a medical device, the medical devices come to the people.
- As technology advances, people's curiosity for self-tracking increases.
- Near-patient systems reduce waiting times. Partly they may spare the patient the inpatient stay. At the scene of an accident safer diagnoses can be made.
- Often, PoC systems are cheaper than stationary devices, making the purchase affordable for doctors' offices or smaller hospitals.



What impact does the advance of medical products have on previously unknown contexts, such as shopping malls or public spaces? How can we optimize this?

1 | Interview with ...

Hardy Hoheisel, Managing Director of Biozoom Services GmbH



Hardy Hoheisel

With your biozoom scanner, you have developed a diagnostic device that enables customers to determine their vital signs in pharmacies. Seems like a pioneer in the field of points-of-care?

Our approach to device development has been to encourage people to adopt a healthy lifestyle. However, individual recommendations for the patient are only possible on the basis of personal vital signs. After we developed the biozoom, together with health insurance companies and health food companies, we launched a prevention campaign called the Triät: Customers of organic markets were able to measure their vital parameters directly at the point of purchase - at all health food stores in Germany and, among other things, to monitor the extent to which their own health care providers were involved. Diet influences your personal vitamin and antioxidant status. A scientific study has shown that regular measurements with biozoom can sustainably promote self-initiative on preventive behavior and the adoption of a healthy lifestyle. Since antioxidants could previously only be measured using a blood or tissue sample, we are certainly one of the pioneers in health tracking at the point of care.

What is the future of the biozoom? Are you planning to expand or redesign its functions?

We have implemented a broadband spectrometer in the device's sensor technology, which enables us to visually detect a whole range of biomarkers. On the one hand, this has the advantage that we can quickly meet the market requirements for specific measured quantities. On the other hand, our system is medically valid and thus enjoys a unique selling point in the market.

At the moment, our device is used by humans for individual lifestyle improvement. Likewise, it offers, for example, patients with rheumatism or obesity, for whom the subject of nutrition is of vital importance, an overview of the current health status quo. Even cancer patients whose antioxidants after a chemo are non-existent, can query their level and receive recommendations for a faster recovery.

As we still see a lot of potential here, we are constantly researching new fields of application in cooperation with universities and partners, so that the biozoom will develop strategically.

How do you assess the impact of increasing decentralized patient care?

Decentralized patient care offers tremendous potential in my view. Health tracking is on the rise. By 2020 alone, 200 million wearables are to be sold each year according to forecasts by market researchers at Gartner. Today we are already able to equip the patients with small portable devices that transmit their vitality parameters centrally to the doctor or medical supervisor. Rheumatoid and obesity patients are only the beginning. The optoelectronics of the so-called MSRRS sensors make it possible to equip wearables with valid analysis. Likewise, the trend will continue at the point of care as the customer increasingly checks his vital parameters. The customer benefit is obvious: No appointment, no waiting at the doctor, for a few euros, the customer gets a medically valid analysis within a few minutes. Preventive additional benefits are taken over by the health insurance in any case only after indication. In the traditional sense, if you want to know the daily intake of all vital nutrients that a healthy organism needs, you have to go to the doctor, he will do a blood analysis and you will have to bear the costs of 32 euros yourself. Or you go to the point of care of health insurance companies and pharmacies for a two-minute, mostly free of charge measurement, get your results automatically interpreted and of course also receive recommendations for action. Health insurance companies have the enormous development potential to recognize and reward increasingly preventive behavior of customers as part of their bonus programs.

It is usually even financially worthwhile for the insured person if he proves to be preventative. A vitality check is already enough. Even within the framework of occupational health management, these sensors can make an important contribution. More and more companies offer their employees the opportunity to monitor themselves at the workplace with the result that latent overuse syndromes (burn out) are detected, encouraging employees to adopt a healthier lifestyle and reducing absenteeism.

Thank you, Mr. Hoheisel.

The interview was conducted by Claudia Krettler.

2 | Usability



The user - the driving force for product innovation?

“A new technology can be very innovative: Whether it brings an actual added value for the user, is decided by its usability. The technical lead will therefore lose importance; instead, the usability of a product will become a key competitive advantage.”

Markus Wild

The bottom line is the success or failure of a product. In the medical sector, too, this is increasingly coming into focus. It is particularly important here that one can operate technical devices, instruments and aids intuitively and without errors. More and more available information, increasing time pressure, a multinational workforce and inconsistent operating concepts are common sources of error that can lead to serious consequences.

The usability today plays a central role in the medical device development process and, by definition of ISO 9241-11, describes the degree of fulfilment with which users achieve their goals effectively, efficiently and satisfactorily. The goal is to design medical devices in such a way that more efficient work processes, a higher degree of safety for the patients and a lower burden for the users can be achieved. Other important aspects are added by the user experience: It should also be a pleasure to use the product not only in the context of the purpose, but also before and after to experience the process in a positive manner. This increases the acceptance of the user and the product is better integrated into everyday life.

Therefore, in the last few years, the usability engineering process has become one of the most important influencing factors for medical products in addition to risk management. Not only in Germany, this is now prescribed by standards such as DIN EN 62366-1; other countries, such as the US, also provide rules for usability engineering. This is extremely advantageous for designers because product design can and must now be justified in detail in terms of user-centered design.

Design creates usability: functional, intuitive, ergonomic

The approach to the design development process needs to be differentiated in terms of usability, as it needs to be optimized for different purposes. One part concerns, for example, ergonomics. The products are increasingly drawn to the human body, its dimensions, its physical capabilities and the surface topology. For wearables in particular, a precise fit is of great importance, since even the smallest deviations can seriously impair wearing comfort. In the not so rare case, such inconvenience causes the user to wear the wearables only rarely or even not at all. Success and failure are not very far apart.

Another part of usability deals with the optimization of operating procedures, for example on screen surfaces, as well as software development. Through connectivity, the sphere of activity of devices and systems continues to grow and includes more and more hardware and software systems as well as integrations. The operation is potentially more complex, but this should not be perceived by the user. So the goal is to make the operation as easy and intuitive as possible while increasing demands and increasing complexity.

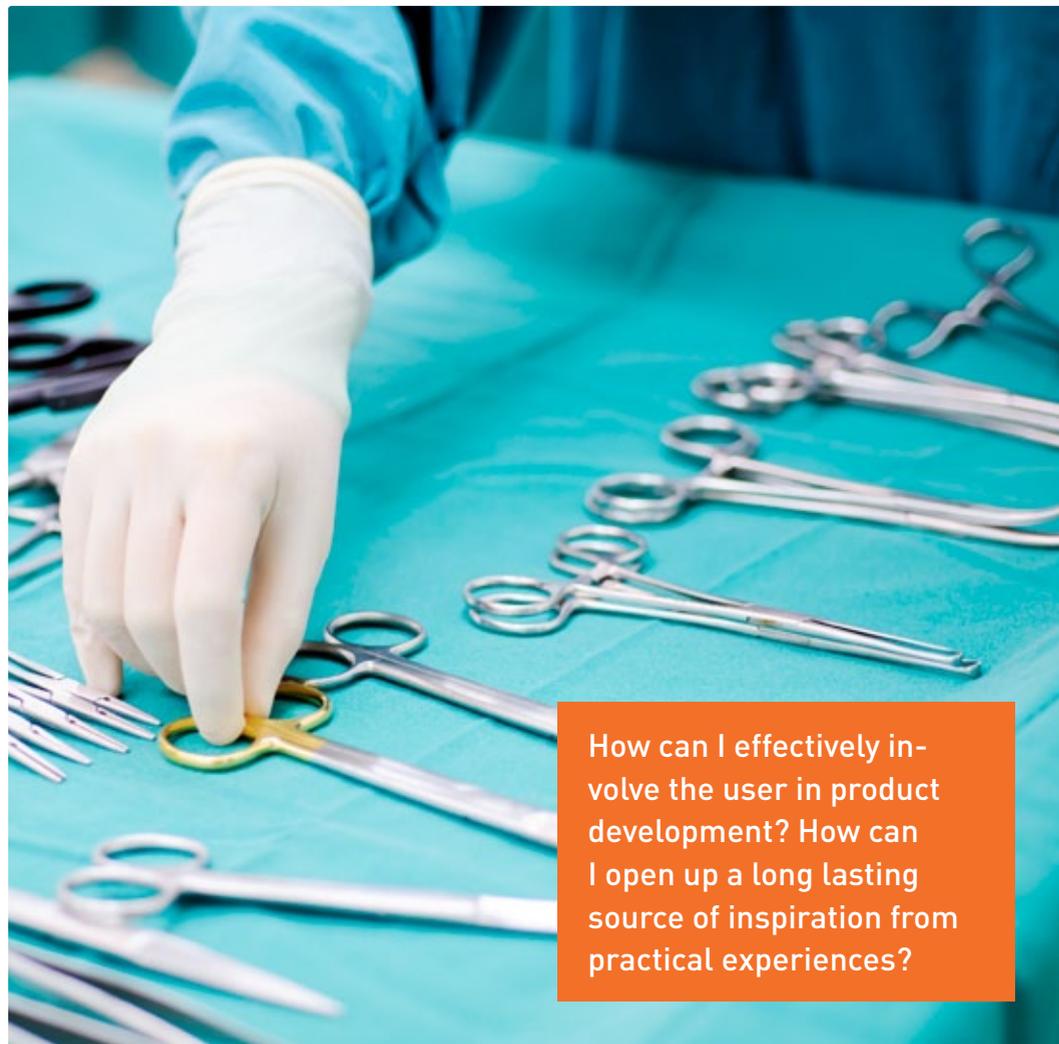


Multiple awards for good design and usability:
the intensive ventilator Elisa 800 VIT from Salvia Medical

The user is king: the usability engineering process

In order to achieve the greatest possible acceptance of a product and thus its success, the requirements of the users must be worked out. For this, a new job profile has been established with the usability engineer. Since the behavioral patterns of the users can be predicted with great reliability, without even having spoken to them or watching them during the execution of the intended operating procedure, a methodical procedure has been developed in the context of the usability engineering process.

The focus is on the analysis of the context: Here, the user shows the usability engineer in a relevant environment and shows how he functions under real conditions. An interview in a meeting room would not reflect the needs and abilities of the user. Problems, such as misplaced operating instructions, would not be taken into account and, if necessary, the actual needs of the users would not be recognized. Only when these findings from the context analysis are available, can usability engineers derive the requirements of the users and formulate the requirements. This results in resilient requirements that have to be implemented during development and design.



How can I effectively involve the user in product development? How can I open up a long lasting source of inspiration from practical experiences?

2 | Interview with ...

Michael Engler, Dipl.-Informat. (FH), Michael Engler IT-Consulting (Essen)

Marc Ruta, Dipl. Industrial Designer, Director Design Development WILDDESIGN



Michael Engler



Marc Ruta

Usability seems to have gained immense importance within a very short time. How do you rate the acceptance of this topic in companies?

Engler: The growing importance has two different origins. On the one hand, rising investments in usability engineering are bringing the topic into focus. On the other hand, the regulatory requirements have risen sharply. Here, the United States lead the field with the Food and Drug Administration (FDA), which regulates the approval of medical devices in the national market. But in Europe, too, usability will continue to gain importance as the requirements of this topic will continue to increase with the introduction of the new Medical Device Regulation (MDR) and the EU Regulation on In Vitro Diagnostics (IVDR).

Ruta: The claim to good usability has always been formulated, directly connected with the designer and evaluated with the satisfaction of the customer. In recent years, however, this has increasingly been strategically and methodically established in projects. As a result, a usability expert sheds light on the topic, the designer has to deal more intensively with the requirements identified, and the subject is discussed more controversially.

To what extent will the Regulation on In Vitro Diagnostics (IVDR) and Medical Device Regulation (MDR) influence Usability Engineering?

Engler: The effects are high, because so far, the manufacturers were often very cautious about the topic. Now this topic is part of the MDR and the IVDR and since all products have to be adapted to the MDR / IVDR, this will certainly require some effort. In addition, the requirements for usability engineering are more clearly formulated for new developments. Further, attention must be paid to addressing usability issues in market observation as well.

How do you make sure that a newly developed product is user-friendly? What exactly is your job as a designer and usability engineer?

Engler: The key to success is to include usability in the development process before the product idea is defined. Only in this way can we optimally work out the potential for innovation and then implement it consistently in the further process steps of product development. The main switches are then the creation of the design input and the requirements. If you work cleanly, develop a prototype in advance and evaluate it by user, nothing can go wrong. Another advantage of this approach is that it speeds up the development significantly, since the requirements have already been clearly defined in advance.

Ruta: The most meaningful approach is testing by users on the basis of prototypes. For example, if you change the display principles or change mechanical actuators to touch modules, no one can predict in advance how the new interface will fare. A lot of experience helps with good preparation. In further tests the assumption must then be confirmed.

What are the particular usability challenges of a medical device product?

Engler: Certainly the handling of the special requirements by standards and regulations. Of course, we also optimize the products for commercial success in medical technology, but at the end of the day we have to make sure that the products are safe for users and patients. We accomplish this by running the usability engineering process, which must demonstrate that there are no unacceptable risks associated with usage errors. However, since we have to work cost-efficiently and at the same time be technically feasible, this is always a tightrope walk.

Ruta: The biggest challenge for us is the acceptance that the user simply does not use the product the way we designed it and thus this will not lead to an approved product. The reports on user errors also impressively prove the role that human behavior plays in the security of the application of products. The iterative determination of solutions requires a lot of perseverance and understanding from those involved. The knowledge of how this work has to be integrated into the overall development process helps in communicating with the customer and in his documentation needs.

What influence do you see in the usability of a product on the purchase decision or in terms of the competition?

Engler: For the manufacturer, it offers a high potential for realizing innovations and thus outperforming competitors by incorporating usability into product development. If you start the usability engineering process even before the product definition, its benefits can be systematically developed, so that the final product is even more pronounced.

Ruta: A good usability proves that the developer has worked intensively with the product and the users. In addition to a safe operation, this leads to greater satisfaction and thus to a higher level of motivation for the user. Training costs can be reduced, device lifecycles become more efficient, and downtime due to repair or "non-use" is reduced. The positive feeling is transferred to the employer and the manufacturer. And last but not least to the patient. In the long run, well-designed systems will prevail, in terms of performance, service and profitability in order to have a good lead over the competition.

How will this topic evolve in medical technology in the future?

Ruta: The confidence in the machines and the tools available will determine the work significantly. Assistive imaging systems that support the user in the actual execution, not just the patient, are used in the imaging support of neurosurgical procedures or robot-assisted surgery. The mastery of these systems will replace the operation of equipment in the long term. Until then, the mechanical relief of the nursing staff and the overall improvement of operating processes and systems have an ever stronger influence in the development process.

Thank you, Mr. Engler und Mr. Ruta.

The interview was conducted by
Claudia Krettler.



Who wins the competition for the limited body area?

The wearables market is extremely broad. Smartwatches, activity trackers, smart glasses, smart clothes - numerous devices that record vital signs and prepare them for a variety of purposes and analyse them.

In terms of design, the emphasis in the wearables is on ergonomics, usability and hygiene: the product is worn close to the body and must be easy to put on and comfortable to wear. And: It has to be cleaned without problems.

Especially for devices with an exposed user interface, the GUI design must be attractive. The user only likes to wear, in the best case permanently, things that correspond to his lifestyle. The wearable has to be "taken for granted", must not attract attention and certainly not stigmatize. Simplicity is king, less is more.

"Wearables enjoy great approval: within a short time they have become the daily companion for many people. But our body surface is limited. Finding places to fit the device has flared up a competition among the manufacturers, like the right choice of quality materials. Wearables are thus increasingly turning into real pieces of jewellery that underline the personal style as a bracelet, chain or ring."

Markus Wild

Challenges for the future

One of the biggest challenges will be medical approval. Although recording and reproducing data is not critical, medical evaluation and interpretation are. Since wearables usually transfer data to a smartphone or tablet, the correct functioning of the data transfer and processing with the consumer software cannot be guaranteed and secured.

In addition, many users still have concerns about the storage of their personal data (big data). Although data protection is constantly improving, it is difficult for users to know where their data is stored and who has access to it. The energy supply of the wearables technology will also have to improve in the coming years. Modern batteries or regenerative energy sources are still lagging behind the wishes of patients with regard to their running time.



Reliable sensor technology could also make everyday life for countless sick people much easier. For example, many patients forget when to take their medicine. The Ministry of Health is already trying to use an e-health law on the electronic health card to better manage such medication problems, especially in older people.

Market attracts different companies

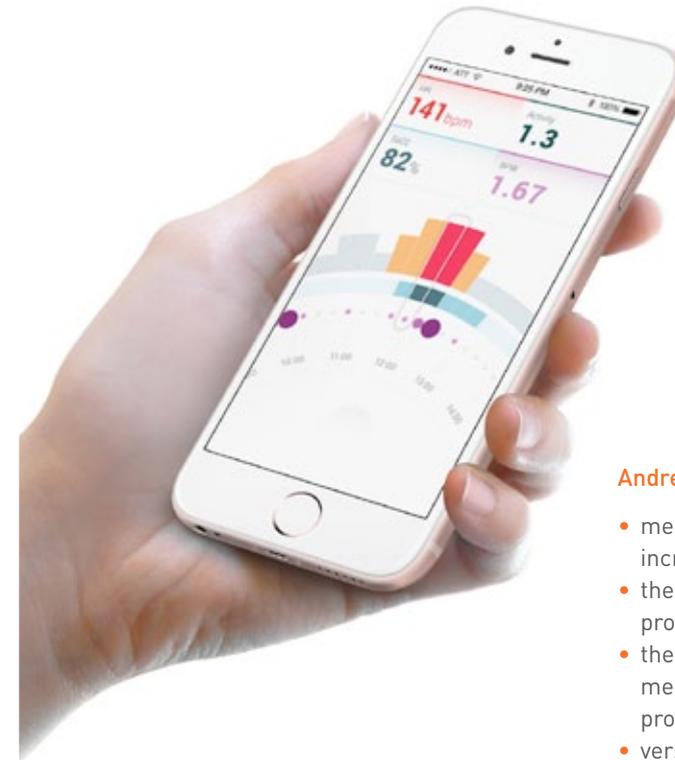
Attracted by the wide range of applications, "outsiders" increasingly want to join the market in their own way. A good example of this is Google with Varily (Life Sciences division). Varily is currently working on a contact lens to measure the glucose level in the tear fluid. This could spare diabetics the annoying sting in the future. With millions of customer data harvested daily, the company can respond directly to user needs and anticipate their demand patterns, so that a search engine can better understand customer needs than decades of medical technology experience.

Another electronics giant has also discovered the growing market: Apple's development approach analyzes the sound of blood flow to predict a heart attack.

Start-ups are discovering the opportunities of mHealth

A successful example of innovative mHealth business models is the young company Biovotion with its wearable, which records the vital parameters - heart rate, blood oxygen content, skin temperature and the number of steps completed during the day. Soon, the functions of measuring blood glucose (glucose), respiratory rate, energy consumption, blood pulse levels, stress and sleep rhythms will be added.

In order to exclude sources of error and to reduce the risk of operating errors, the use of buttons, cables and plugs was consistently avoided. Once the device has been adjusted, no further operation is necessary, because it recognizes when it has been set up correctly and switches itself on automatically - Simplicity at its best!



Andreas Caduff's theses - short & compact

- medical technology is becoming increasingly "consumed"
- the main user is no longer the professional specialist, but the layman
- the need for simplicity - in measurements, data transfers and data processing - is increasing
- versatility - different audiences should be able to benefit from one device
- mHealth is becoming increasingly important as an interface between codification and expertise to address societal issues
- wearables is the wrong word for the product of the future. There must be an integrated landscape that offers solutions
- areas such as security, identification and the ability to act must converge to form a process-optimized solution

How can I make the device so valuable that I want to wear it on my body? How can I improve the wearing comfort at the same time?

3 | Interview with ...

Andreas Caduff, CEO Biovotion



Albert Ibragimov in conversation with Andreas Caduff

We asked Andreas Caduff, Managing Director of Biovotion, about mobile health. Switzerland-based Biovotion AG is one of the world's most innovative eHealth companies and specializes in physiological patient monitoring.

Introductory words from Andreas Caduff in regards to m-Health:

Medical technology is increasingly being “consumed”: The main user of a medical device is no longer a professional specialist like the doctor or the nurse, but the patient himself. For the manufacturer, this means that medical technology must be designed so that even a person without any medical or technical knowledge can safely use these products. The user interfaces are changing drastically and are adjusting to this trend. These technologies can also be applied at home.

This increases the requirements of the products: Measurements, data transfer and data processing should become easier for the customer.

What are the pros and cons in this area?

Let's start with the disadvantages. Which services are used by patients most often? People do not like it when the human-to-human interaction is completely replaced by a machine or software. That will not be accepted. At some point, the successful models will once again include human interaction. Also important is added value for the customer. mHealth is not capable of being integrated into products in all medical fields.

Secondly, a product often has multiple audiences. The problem here is that not every target group benefits equally from m-Health. Each player should benefit in the best case. People are getting older, we have more and more chronic illnesses and fewer people to look after. That's why mHealth is becoming increasingly important as an interface for codifying expert knowledge to address societal issues.

How are wearables developing in the future?

I think the word wearables will increasingly be the wrong word for the emerging product industry. A wearable is a portable device, but what we need to have is an integrated landscape that offers solutions. So we do not only need a wearable, but also a device that guarantees security, identification and the ability to act. These things need to grow together, then the product will no longer just be a wearable, but maybe a medical IoT (Internet of Things), a process-optimized solution.

Is it harder to develop in this area as a start-up?

As a start-up you always have to become aware of the advantage that one has to put in the foreground through innovative, new ideas. The disadvantage that we have little market power and limited resources must not prevail.

Thank you, Mr. Caduff.

The interview was conducted by Albert Ibragimov.

4 | Positive Clinical Experience



Hospital 2020: Well-being oasis versus competence center?

“In the future, two basic needs will be in competition with each other in hospitals and doctors’ offices: How can the patient’s anxiety be reduced by the design of rooms and medical products, yet how can competence be communicated? The patient should feel at ease, but at the same time the environment has to be recognizable, as well as demonstrating the highest level of professionalism.”

Markus Wild

Unpleasant sounds, long waiting times or unpleasant odors: Staying in a clinic or at a doctor generally causes discomfort for the patient. However, as medical treatment has hitherto served only the purpose of helping the patient to recover or alleviate his suffering, little attention has been paid to the aspect of a pleasant ambience.

A change is now emerging in this way of thinking: Manufacturers of medical devices and hospital managers recognize that the environment plays a not insignificant role on the way to recovery. Not only a high-quality technical equipment, but also an atmosphere that makes the patient feel comfortable, contributes to his recovery. Many medical products solve the problems of stress in patients: Narrow rooms



and the unpleasant, loud noise of an MRI device, for example, do not only push claustrophobic people to their limits. For most other people, these or other devices are uncomfortable or even trigger feelings of anxiety.

The design is meant to scare patients away from clinical products and spaces

The new approach is to design clinical products and spaces to make patients reluctant to receive treatment. Medical devices should be optimized and integrated into the environment so that they create a feel-good climate and thus a pleasant user experience. Natural materials – such as wood and textiles – are used in areas where sterility is not required. Discreet music can also be used to create a relaxing atmosphere. Clinical spaces that the patient experiences as such are no longer present in a clean design, but are given a cozy ambience through color accents. In the case of medical products as well, colors are used specifically to minimize the patient’s fear of injections, sphygmomanometers or the clinical thermometer.



Combination of high-tech medicine and a feel-good climate as a success factor

What do you expect from the so-called “Positive Clinical Experience”? On the one hand, it is assumed that the feel-good climate has a major influence on the well-being and, together with professional technical equipment, leads to a faster recovery of the patient. Costs for a hospital stay could be reduced. And since a patient will decide after a pleasant stay to use the health facility in the future, another positive economic effect is demonstrated.

Influence on the atmosphere is also exercised by the indoor climate - ie temperature and ventilation - and the lighting conditions. Not only do they contribute to the patient’s well-being, they also improve the working atmosphere of the staff. Through the use of efficient energy technologies and management systems, savings can also be made in combination with a corresponding service.

Learnings Positive Clinical Experience:

- reduction of disturbing and stressful situations and environments reduces stress and anxiety in the patient
- the more relaxed the patient, the better his chances of recovery
- financial savings are possible
- not only patients and visitors benefit from the atmosphere, but also staff

How to make the devices friendly and the environment free of fear?



4 | Interview mit ...

Marc Raschke, Head of Corporate Communications, Klinikum Dortmund

4



Dana Merchel in conversation with Marc Raschke

How does the interior design of the children's MRI differ from the conventional MRI?

In principle, it is completely different. Less the MRI technique itself, although our device is already much quieter. Normally, an MRI device is very loud because of the circulating magnet and the use usually requires hearing protection for the patient. The biggest difference in the children's MRI is the overall projection, that's usually not considered. Usually MRIs are rather functional. The children's MRT, on the other hand, has an internal screen and all the walls as well as the device itself are illuminated by a projector. The entire room is thus integrated. For the video installation we have support from Adolf Winkelmann (film director, film producer and professor for film design, conception and design in the department of design at the University of Applied Sciences Dortmund). During the collaboration, he created several installation scenarios for our MRI scan.

We are very proud that we were able to work with Mr. Winkelmann on this project. After all, he has already created a video installation at the Dortmunder U building as part of the RUHR.2010 project and has been awarded several prizes (eg Grimme Preis, Deutscher Filmpreis, Bambi, Goldene Kamera, German Television Award).

What were the problems with previous MRI scans?

MRI scans often cause anxiety for children: They're loud, narrow and when an investigation takes longer, children often find it harder to stay calm the whole time. In case of anxiety, they either had to be sedated (adding tranquilizers) or even anesthetized, so that they were able to sleep. This was always a great burden on the child's body - especially when the child was ill.

Is there a special preparation and what does it look like?

Our user experience starts well before the examination in the children's hospital, which incidentally here in Dortmund is not in the same building where the children's MRT is located but across the street. In the children's clinic we created an extra test room, in which a 1:1 simulation of the MRT was built up. This MRI device is not functional. Here the children are prepared by our employees for their upcoming "journey", for example by telling a story and thus linking the experience to an adventure. This way, the little patients can get used to the situation and become familiar with the environment.

How does the device eliminate children's fears and reduce stress before examination?

Children can choose their own scenario. For example, the scenario wildlife. Here flamingos run across the screen and are projected in the entire room.

The complete environment is an active venue. Most children even look forward to the examination after the preparation. They watch the screens and usually are not aware of the actual examination, which can take 20 minutes or even much longer.

Can adults also benefit from this kind of interior design?

Theoretically, this type of interior design can also be interesting for adults, but we only use it for children. The basic idea is distraction. This can certainly be transferred to adults. For example, we have a special recovery room in our hospital with a picture of a cloudy sky on the ceiling. Here the "Gate Control Principle" applies, which means that you can superimpose every stimulus in the human body by another stimulus. This allows a lower analgesic intake, e.g. after surgery in the recovery room.

What are your experiences after the introduction to the market?

The children's MRI has been in operation for about a year now - and in the first six months, the new concept reduced the number of anesthetized children to 150. This is a great success and speaks for itself. Our experiences with the new technique are consistently positive.

Thank you, Mr. Raschke.

The interview was conducted by Dana Merchel.





How long will the antibiotics system still be operational?

“Faulty health care practices and resulting antibiotic resistance will pose significant challenges for us over the coming years. Hygiene requirements will therefore continue to rise. As designers, we are challenged on two levels: First, we must mitigate the severity of the claims in order not to counteract the trend of the Positive Clinical Experience. On the other hand, we can - for example through the use of germ-inhibiting materials or joint-free surfaces - create conditions in our design process that minimize the risk of infection.”

Markus Wild

In health institutions, hygiene is becoming increasingly important. According to recent estimates, according to the Federal Ministry of Health, up to 15,000 people die of hospital infections in Germany alone. Many infections and the transmission of pathogens could be prevented by the correct implementation of the hygiene rules. Another problem: In the treatment of infections more and more resistance to the drugs has been discovered, the doctor's face major challenges. The strategy should therefore be: “stop them in the beginning!” One possibility is offered by the examination of patients for the MRSA virus during admission to the clinic, as they can already carry the virus and therefore infect others.

Medical devices are always used in the vicinity of sick people or persons with a compromised immune system, which are thus particularly susceptible to infections. Not only regular hand washing and disinfecting, but also thorough product cleaning are the nuts and bolts of hygiene. According to §3 Abs.14 of the medical device law products such as syringes, needles, scalpels or scissors need to be low in germ or sterile before being used again. Work steps such as cleaning, disinfection and sterilization as well as a test of the functions must be carried out.

Trend: Design for wipe disinfection

What does design have to do with hygiene? Although a hygienic environment, especially in health care facilities, is an absolute prerequisite, how can it be achieved? An appropriate product design can already prevent the development of contamination: Generous surfaces with smooth transitions without joints and gaps prevent germs from settling there and thus significantly reduce the risk of infection. They are also ideal to be wipe-disinfected and cleaned more effectively. Germ-inhibiting or self-cleaning surfaces with a lotus effect also help to stand the test of life-threatening pathogens.

Also important is the choice of materials: There are particularly easy-to-clean materials such as glass and silicone. By nature, on the other hand, ceramic, chrome or steel are hygienic. For example, ceramic offers a particularly smooth surface, which prevents dirt from penetrating. It is also abrasion resistant and dimensionally stable. Since medical products are very often cleaned and disinfected, the material must withstand these processes. Neither markings or inscriptions nor the material itself may be attacked. Great challenges in the choice of materials and surfaces: Cleaners and disinfectants are not standardized, so that every facility as well as every country or every device manufacturer have their own requirements.

In addition, the designer can make a major contribution to a hygienic product by integrating touchscreens on the surface: Complex technology, which is used to be operated via buttons or switches, now hides under a closed touchscreen interface. Thus, we find hardly any intermediate spaces and the cleaning for the technical components is harmless. Sharp edges are also to be avoided since rounded corners and large-scale partitions are easier to clean.



Starting point: Compliance with hygiene rules

Clinical personnel should also be involved in the fight against germs because despite high standards of hygiene and regulations, there are still cases where diseases are transmitted this way. Effective hand disinfection offers the best protection. Design can also make a contribution here: For the start-up General Sensing, for example, WILDDSIGN developed a hand hygiene system that uses a plastic card in the ID card format that records the disinfection processes of the personnel. It also reminds its wearer of hand disinfection and highlights places where there are opportunities.



Learnings Hygiene:

- infections with hospital germs, especially with resistant pathogens like MRSA, cause serious problems for clinics
- the correct implementation of the hygiene regulations could prevent many infections and the transmission of pathogens.
- touchscreens instead of switches or buttons can be cleaned better.
- contamination can be prevented by a corresponding product design, for example by wide areas without gaps or joints and a corresponding choice of materials.
- during cleaning or disinfection, neither markings nor labels nor the material itself may be attacked.

Product example: hygienic keyboards

Conventional PC keyboards pose a hygiene risk in sensitive areas. Due to the gaps and construction, they can only be disinfected inadequately. Active Key's hygienic keyboards are specifically designed for use in hospitals, medical practices and microbiology laboratories, as well as in industrial and administrative applications.

A gap-free surface by means of a silicone membrane protects the keypad against ingress of dirt and liquids. This makes a thorough wipe disinfection possible. In addition, those keyboards have a "clean function" to turn off the keypad during cleaning.



Methodes to create more hygienic materials

Innovent from Jena pursues a different starting point: The company is currently developing a possibility for coating materials by fluorination. The plastic is characterized by being impermeable to solvents.

For example, there are antimicrobial plastics that can significantly reduce the risk of infection. These thermoplastics can be antimicrobially engineered by the addition of metal salts (e.g., copper or silver salts). Especially light switches, closures, infusion tubes and packaging films are made of it. However, these materials are very sensitive to light and discolour fast. A good alternative here is the addition of zinc oxide.

“How to optimize medical equipment, but also disinfection methods of staff to reduce time and optimize hygiene?”

5 | Interview with ...

Reinhard Fischer, Sales & Marketing Active Key



Albert Ibragimov in conversation with Mr. Fischer

To what extent does the hygiene aspect have an influence on the workplace, for example in hospitals?

Infections with hospital germs - especially with resistant pathogens such as MRSA - cause serious problems for clinics, as the consequences for weakened people can be particularly serious. That's why one has to prevent it from happening at all. Especially infections, which develop in the hospital or are passed on there by contamination, could possibly have been prevented. Disinfection methods offer one possibility: An attempt is to build up a germ barrier in order to chemically eliminate contamination caused by pathogens. Preferably people should disinfect their hands. There are WHERE and WHO principles that describe how to perform such disinfection. It is just as important to prevent the spread of germs in the environment by disinfecting the objects.

How does your company differ from other manufacturers?

Above all, we focus on usability. Usability is defined in medicine by safety and simplicity in handling processes. Our products are designed for safe and optimized disinfection. In clinics they are usually disinfected with wipes. Our focus was on the design of our product structure and the surface. On the other hand, we strive to improve the usability of our keyboards, e.g. the writing efficiency and also the typing.

Our mouse follows the same principle. The conventional computer mouse has an undercut on the scroll wheel, which cannot be disinfected with wipes and thus all germs, which are located on the surface, are repeatedly transported into the housing.

Our computer mice have no undercuts and have sensor scroll wheels so that the sliding movement can continue. Together with a gap-free, closed silicone membrane, which prevents the ingress of dirt and liquids, our customers receive an ergonomic and precise mouse with well-known movements for hygiene-critical environments.

Are hygiene standards the same in every country?

The Netherlands is certainly one of the countries that is particularly structured and persistent in the topic of infection prevention. However even our neighbors cannot completely solve the problem of increasing antibiotic resistance. Through special management, however, they ensure that their build-up is defused or even prevented: for example, by full-time hospital hygienists or microbiologists. The Scandinavian countries are also very efficient at surface disinfection.

What kind of issues in regards to hygiene will we encounter in the future?

I think we will face a huge problem with resistance in the future, as well as health care facilities trying by all means to restrict infections. In addition to MRSA, which is well known and a controlled problem, we are concerned about Extended Spectrum Beta Lactamases (ESBL) - enzymes that can reduce or even reverse the efficacy of various antibiotics. There are studies that say 10 percent of the patients who come to the hospital carry ESBL. Of course it is important to make sure that these enzymes do not end up in the body. If they do, there is a risk that the effectiveness of antibiotics may be weakened or even abolished. Patients or staff with the worst immune systems in the hospital are usually the victims. Unfortunately, few

new antibiotics work against the resistance, so that the drugs that can be used and that act against these multidrug-resistant pathogens are becoming more and more limited. Hygiene in healthcare facilities will therefore occupy a much more important place in future than previously.

Thank you, Mr. Fischer.

The interview was conducted by Albert Ibragimov.

6 | Minimalism & Simplicity



Less is more - how reduction highlights the essential.

“Not new, but still trendy. Minimalism and simplicity are the designers’ answer to increasing demands and complexity. With each generation of devices, the products are not only faster and more powerful, but also come with new functions and opportunities due to digitization. The more complex the product, the clearer the design should be. Good design is minimal and reduces itself to the essential, so as not to overload the product with the superfluous.”

Markus Wild

Less is more. This “designer wisdom” is applied increasingly. It creates a design with a clear and logical structure. The goal is intuitive usability, so that the product can be used directly and error-free. Only required design elements for the function to be performed are used.

Even non-specialist users should be able to use the device as needed. Especially in the medical field, a product should be designed in such a way that it explains itself and does not confuse the user with unnecessary operating elements or information. An emergency diagnosis device or a defibrillator, for example, should be able to be operated spontaneously and under stress in an emergency. Language barriers or cumbersome commissioning are hindering and dangerous and should be excluded as far as possible.

But the introduction of medical devices into the home area also focuses on intuitive usability. In order to increase the acceptance of the product among its users, the essentials must be clearly recognizable. The cleaner the design of the product, the easier it is to use.

Complex technology in a simple package

Intuitive usability is necessary in order to rule out user errors, which can have fatal consequences, especially in the medical field. Controls and settings should therefore be limited, the focus is on the necessary functions. Spatial structures bring calm to the design and thus facilitate the overview as well as the understanding of the product. The Graphical User Interface (GUI) is a special field of work for minimalism. It should not show anything other than the information needed at a certain moment. Other possibilities are hidden or shifted to other screens, thus preventing the feeling of disorientation and long-lasting searches.

Since minimalism is a basic principle of good design, it is always worthwhile to quote the master in this context. Dieter Rams, the designer behind the BRAUN brand, is regarded as the father of modern industrial design and a vehement supporter of the omission:

Dieter Rams 10 theses for good product design

- Good design is innovative
- Good design makes a product usable
- Good design is aesthetic
- Good design makes a product understandable
- Good design is honest
- Good design is unobtrusive
- Good design is durable
- Good design is consistent down to the last detail
- Good design is environmentally friendly
- Good design is as minimal as possible

What reads so naturally, however, is by no means self-evident in product development.

Reduction as a big challenge

The art of the designer is to find out which features are indispensable and how they can be made user-friendly. A simple look hides meticulous work. It’s about suppressing the impulse to include more possibilities and performance in technical devices. The wish list of marketing and sales in regard to a new product is usually much longer than is actually good for the user. To make matters worse, the exploitation of new technical possibilities is reinforced by engineers. If you follow all of these wishes uncritically, you will most likely receive a product that bypasses the market and the needs of the users.

The designer is constantly stopped here in order to maintain minimalism and simplicity.

Often, the temptation also comes in the form of cost-neutral features to be incorporated, especially on the software side, for example extensive configuration options.

A lot of work and maintenance for the simplification of the design - combined with accompanying test activities, to ensure that the decisions are effective. All this is much more expensive than creating complex devices.



The fact that reduction pays off in this respect is shown by the great success of companies such as BRAUN in the past century and the legitimate successor to this discipline, Apple, who consistently use minimalism as a characteristic design principle. Schematic clarity, which is achieved through renunciation and instead can emphasize the essentials all the more clearly, looks sovereign and is rewarded by the customers with high prices and brand loyalty.

Product example: lifesaver in a pocket format

PocketDefi by Austrian start-up Liiimtec shows the advantages of a minimalist product in an exemplary way. Small and light, it fits in any backpack and can be taken anywhere. With its clear structure, the user retains the required overview and can use the PocketDefi in an intuitive and reliable manner. The device checks itself whether a shock is necessary and can be triggered if necessary by pressing a button. In order to increase the quality of CPR, a voice prompt explains exactly what the rescuer has to do. In this way, even inexperienced people can provide valuable help in case of emergency.



Health care for the unborn baby

Also, the Belly Bean Fetal Doppler concept - a non-invasive diagnostic device designed to record, measure and assess the foetal heart rate shows his strength in his tidy design. There are many possibilities that come with the device. If the unborn baby is fine and healthy it reduces stress and anxiety in the mother.

What once only the doctor could investigate, the patient can now analyse himself. Its discreet design makes the product easy to use and aesthetically pleasing. In addition, the Belly Bean is ergonomic and intuitive. Taking precaution yourself - for more classical instruments of the doctor are overpowered by simplicity.



"Make things as easy as possible –
but not easier."
Albert Einstein

"How to identify expendable
controls and simplify compli-
cated processes?"

6 | Interview with ...

Dennis Kulage, Product Designer WILDDESIGN Group



Dennis Kulage, Product Designer WILDDESIGN Group

While Simplicity makes a product easier to use, minimalism reduces design to a minimum. At the same time, the further development of technology always offers new features. What options do you have to accommodate these conflicting claims?

Technological progress is allowing more and more features, with the result that devices are becoming increasingly complex. As designers, we are required in several ways to reduce this complexity and create added value for the user. Our starting point is to reduce time. In order to achieve this, we pursue different approaches: Among other things, we create space and an overview with a minimalist design. A clear structure of the controls and the GUI make it easier for the user to access the product. If the device can be put into operation without much thought, the fear of contact will be reduced, and the user quickly gains confidence in the modern technology.

On the one hand technologies are becoming more complex, on the other hand, many applications are automatically running in the background. They now carry out processes that the user had to control himself before. In addition, artificial intelligence simplifies processes and reduces the complexity of progressive technologies.

Many devices - even in medical technology - are not used for fear of operating errors. Expensive and useful technology is not used because users do not understand it. How do you manage to design a product so that the user can apply it right away?

Our goal in designing a product is to avoid overstraining the user. The user has to find his way around and use the device at first glance. We only succeed in this if we take away from the users the fear of use and instead arouse curiosity: with a clear structuring of the elements, understandable wireframes and usability tests. The device should be intuitive to use.

As part of our design development, we optimize the processes - from the user interface to the use of the products - until we are convinced that there can be no better solution for human interaction. We do not see design as an end in itself; rather, it should be functional while serving the zeitgeist.

In addition, new technologies bring complicated processes together, are bundling them and simplifying their use. For example, passwords and codes scare off many users because they are afraid to forget them and then stop using the device. Thanks to fingerprint sensors and soon face recognition, we can always unlock the device in the future, even if we do not have the password handy at times. These developments increase the comfort of use enormously and increase the acceptance of the device.

Last but not least, we use the fact that the use of smartphones is becoming more and more familiar and natural for us. By being able to control highly complex medical technology via app and not directly via the device, we build more hurdles, because we know the handling from everyday life.

The trend towards an ever simpler and more minimalistic product also carries risks: How do you ensure that a product is not invalidated by not using features or controls?

When designing a product, we do not indulge in features indiscriminately, but filter out the essence very thoroughly. To do this, we deal intensively with the interaction between user and product. What creates added value for humans? What is useful? And what does he really need? So we discover, layer by layer, what the user really needs from the product so that in the end he holds a harmoniously matched device in his hands. In the in-depth dialogue with the customer - from the engineers to sales and marketing - we work together to find an optimal solution that does not overwhelm the user and offers a well-thought-out value.

Thank you for the interview, Mr. Kulage.

The interview was conducted by
Claudia Krettler.

Learnings Minimalism & Simplicity

- easy commissioning creates confidence in the new device
- intuitive operation makes you want to use technology
- the reduction of features has to happen from the customer's point of view, core functions

7 | Consumer familiarity



Wird das Wohnzimmer zum Ersatz-Krankenhaus?

“More and more medical devices are invading the private living environment. Demographically speaking, society is getting older and older, which means there are many possible applications for home and self-care devices. An interesting area is e.g. the support of taking medication at home. Studies assume that in Germany alone between 25,000 and 58,000 patients each year die due to false drugs. Supportive aids can control the time, the type and quantity, and thus not only avoid confusion, but also support the therapy in the long term. Compliance and adherence are the technical aspects that can be improved with suitable products.”

Markus Wild

To be successful in the home care sector requires more than just a technologically reliable and safe product. In particular, a company can set itself apart from the competition by offering a safe, user-friendly, but also aesthetic product: away from a purely functional design to a trendy lifestyle product that can also be easily integrated into the home environment. This trend is supported by the general trend that humans

increasingly want to control their health and fitness and that they need appropriate medical equipment. But how does a company ensure that its product meets the needs of the user?

An answer can be found through design and usability research. Unlike in known usage contexts such as the hospital or the medical practice, we find it very difficult to normalize the most diverse types of home environment. It does not help, that the developers have to move out of their familiar environment and visit the potential users in their homes. The suitability standard IEC 62366 already explicitly stipulates this, but too little is invested at the beginning of a development by manufacturers in this research. Most of the time you only discover added value for the consumer when you can observe and experience the users in their surroundings.

The success of a medical device depends crucially on the involvement of the user. Of course it must reliably fulfil the medical purpose. The more a company considers the user's expectations when developing a device, the more successful it will be.

The goal of this in-depth user research is to find out what the customer wants and to explore the patterns and trends. It provides companies with the basis on which they can best offer products and services tailored to the needs of consumers.

The success of a medical device therefore depends decisively on the involvement of the user. Of course, it has to work reliably. The more a company considers the user's expectations when developing a device, the more successful this will assert itself.

Requirements for the design: smart, noble and functional



The introduction of medical devices into the home environment places new demands on designers. Not only do you have to be able to visually adapt to the home, but you should also keep it as simple as possible - and even better customizable. Colors and shapes that harmonize with a homely environment are increasingly being implemented. The more the customer can identify with their product, the better it will be accepted. In addition to the aesthetic aspect, the home care product must also be functional and can be used, for example, on a variety of substrates - wood, tiles or carpet.

The coloring of home care products tends to be subtle. The individual design with different color variants is increasingly in demand. High-quality materials should enhance the product and establish it as a lifestyle product. In order to further increase the value, the design is based on consummate material combinations. Surfaces that are reminiscent of wood or stone, in combination with metal or glass, appear noble and rid the product of the sober, sterile medical device image. In addition to the aesthetic aspects, the ease of use and user-friendliness play a crucial role in the design. The user interface should be reduced to the essentials in order to provide the consumer with the most intuitive access to his device. Complicated applications with too many configuration options or unnecessary information will annoy or overwhelm the user. The increasing acceptance of apps makes it possible for designers to do without a device display since the device can then be operated, controlled and managed with a smartphone or tablet. This is demanded by consumers time and again, but is difficult to reproduce from the regulatory side of risk management.

Product example QardioBase: intelligent balance for individual health management

These requirements have been implemented by the QardioBase Scales and Body Analyzer. Not only their elegant design finds the approval of the users, also their ease of use speaks for them: Automatic user recognition and data synchronization with intelligent result tracking promises the consumer an individual and easy to understand device. The QardioBase works without a display; the user can view the data in an app. Additional options further add value to the balance and increase consumer value: For example, pregnancy mode allows you to track weekly development during and after pregnancy.

Another mode uses smileys instead of often disappointing kilogram ads. Because QardioBase measures not only the BMI but also muscle, fat, bone and water content, it delivers smarter results than regular scales. The user will know exactly if he burns fat and builds muscle or if he really loses weight, not just water. Long-term goals can be pursued better and with less frustration and more motivation.



Learnings Consumer Familiarity

- The consumer must have the product, show it and carry it with him. He has to use it and watch it. Only then will he use it permanently.
- The product must be designed to fit in any room - from the bathroom to the kitchen - and the user wants to show it proudly
- The product must work on any surface or in any environment - Multi-functionality is a success factor for use at home

“How do I achieve individual added value for my new product for the customer?”



7 | Interview with ...

Martina Janekova, CAIA VP of Global Outreach, Head of Marketing, Qardio



Dana Merchel in conversation with Martina Janekova

How does QardioBase integrate into everyday life and the environment of users?

For cardio core, we have worked intensively on the design and the user experience, as we do with each of our devices. Because we believe that if our product is not loved, worn, and shown around, it is likely that it will not be used for long.

Before we develop a product, we look closely at the problem we want to solve and, of course, which products already exist in this market. We are developing new ways to improve existing products and create something new. For example, at QardioBase, we knew that people regularly control their weight. In the morning many of us follow the same ritual of waking up, brushing our teeth, taking a shower and stepping on the scales.

We have found two problems: The majority does not like to read the weight in actual numbers. They want to know if it has increased or decreased, but rarely are happy with the actual weight. Another problem with the typical bathroom scale is that it is not aesthetically pleasing. They are usually hidden behind the sink, but we wanted to create something that you

would like to use everywhere in the apartment. We wanted a design product for the bathroom or bedroom, something minimalist elegant, but it should accurately measure and give an extended feedback beyond the weighing.

What was included in the design process to best fit the user's home environment?

We did a case study to see how different people use our product. We found out that in different homes with different habits the scales stood in different places. They were not just used in the bathroom. From this we deduced that our scale should fit in almost every room. And that's why we gave them an unobtrusive, minimalist and friendly design that fits into any environment.

For example, we do not use a normal display like other scales. We chose a display that only becomes visible when the weighing is in operation. In addition, the product should work on a variety of surfaces, on tiles, rug and even on uneven ground, it should measure and work properly. We wanted to achieve this universal functionality.

We also found it important that the scales could be used by the whole family. For this reason, the scales have an automatic detection for up to eight people from a household. Just step on them and the scales will recognize you. They show your name so that no confusion can happen.

What are the benefits of smart feedback?

Those who are certainly most interested in their weight may have just started a diet or fitness program. You want to see results quickly. The problem is, whether with the diet or with the fitness program - it's never just a simple weight loss. If you drink, for example, an extra pint of water after a workout, the scales may show an increase in weight. This is one of the reasons why people give up their diet or fitness program too soon because they are discouraged. We wanted to solve that and so the smartfeedback function was invented. It is driven by our algorithms to capture the entire trend of a person. Not only: Today you weigh 50 kilograms and yesterday it was 48. We wanted to see the overall picture. Whether the two extra kilos are perhaps just water, we can see from the whole-body analysis, which is integrated in our scales. The scales can recognize when fat has turned into muscle cells. So, instead of displaying a number that may seem daunting, we simply show a smiling face as long as the overall picture is good.

How does the transfer of readings to the doctor work?

We've created a Qardio portal, a cloud system that doctors can use to invite their patients to file their data because users do not just work with one doctor but with coaches, health clinics and many more institutions. Doctors can invite patients to share their data with them, and it works very smoothly. All you have to say is: Okay, this one doctor should get access to my data. Each measurement is then automatically transferred to the Qardio portal. Not only does the doctor receive a list of measured values. The system analyzes the values simultaneously and groups the patients based on their requirements. A simple traffic light system with green, yellow and red. So the doctor sees that the "red" patients are doing something wrong. Everything is okay with green. Therefore the doctor can do his job better because he can concentrate on the "red" cases.

What special features and reservations do you have with data storage?

First of all, we have a very secure cloud. We are very careful with this data because it is much more than just fitness data - it is health data from real people. We take that very seriously. We have military-standard end-to-end encryption when the data is transmitted over the network.

Thank you for the interview Mrs. Janekova.

The interview was conducted by Dana Merchel.

8 | Contrast, Black & White

8



Timeless and elegant - or boring and discouraging?

"The combination of black and white remains popular. The Karl Lagerfeld look and, in particular, slight gradations will continue to shape products in medical and laboratory technology beyond the years to come. White will be the dominant color, while black will set targeted accents. Parallel to the reduction in terms of color, materials and surfaces are becoming ever more valuable - with the result that in medical technology we will increasingly encounter purist aesthetics and timeless design."

Markus Wild

White and Black is back: The classic of color contrasts has been setting standards in the coloration of medical technology and laboratory products for about a decade. While until then a bright grey dominated laboratories, clinics and practices, technical improvements in the production process made white plastic operational for technical products.

With the new technical possibilities, the product designers have rediscovered the color for themselves. White looks open and fresh. It stands for innocence, purity, hygiene and neutrality. As the color is best cleaned, it is not without reason that it is the most frequently encountered color in medical technology. Black, on the other hand, returns as a trend color. Not as a pure black color anymore, but in various anthracite shades and rather dull than shiny, it regains its rank as a fashion color. Black is deliberately used to assign a special meaning to individual elements. Black is combined again with white - and thus forms the most contrasting pair in the color

theory, such as the charging station for the handles of the disposable endoscopes of the company Invendo. The opposing duo is not only considered timeless and elegant, but scores with the advantage of being particularly expressive and able to adapt to any environment.

Colors do not only have a psychological, but also a spatial effect: they can influence shapes and proportions so that they appear larger or narrower, longer or shorter. Colors have also been established for certain functions - such as red as a signal or warning color and green, which suggests that something is ready or in order. The more saturated the colors, the more intense and active they seem, while pastel colors suggest softness. In addition to the emotions, colors and contrasts can enhance a boring product and arouse tension. But different materials are also a suitable means by which designers can add elegance and a tactile feeling to their products.

Contrasts give designers endless variety.

Exciting contrasts can be achieved in addition to the color by different shapes, for example, by adjacent triangles, circles or squares.

Also, the inclusion of different materials can cause a novel, exciting effect. In addition to the optical contrast often also a tactile intensity occurs. Combinations of plastic, metal, wood, rubber, Plexiglas, textile, stone, glass or leather look noble and enhance a product. In addition, material contrasts arise due to different fields of application, for example through gripping surfaces with a rubberised surface.

Other accents can be set in the design by surface contrasts: a brushed in conjunction with a bare aluminum surface or a matte next to a high-gloss structure can contribute to the attractiveness of a product. In medical technology, the white surface is usually shiny, while black is often dull, creating exciting and elegant accents.



Black & White refine medical technology

Attractive design in pure Black & White is shown for example in the P.L.E.A.S.E. Professional by Pantec Biosolutions. With the laser system, the doctor can put micropores in the skin to prepare the skin site for drug administration by plaster. In contrast to the very painful drug injections, e.g. in hormone therapy, the application of the laser system is painless. In addition to the elegant look, the color scheme gives the product a structure and the individual elements a hierarchy. "How can I assign functions or emotions to my product through color design without softening the corporate design of my company?"

Learnings Black & White

- black and white has the advantage of being uniform without being boring
- white places high technical demands on materials and processing
- white is glossy, black rather dull



"How can I assign functions or emotions to my product through color design without softening the corporate design of my company?"

8 | Interview with ... Oliver Koszel, Creative Director, WILDDESIGN Germany

8



The colors black and white have not been popular in the field of medical technology for too long. As in other sectors, such as IT, grey devices dominated. How can the introduction

of black and white devices in hospitals and practices be explained?

The fact that white and black are generally considered for devices in laboratory and medical technology, has its trigger in the technical feasibility: White was previously not UV-stable and yellowed accordingly over time. The products were not only unsightly, but also seemed outdated. Technical improvements have led to the fact that white plastic is now UV-resistant and now allow its use. However, current regulations with regard to environmental protection are currently partially restricting this because plastics with a fire retardant effect cannot produce pure white colors.

Black, on the other hand, had a difficult time due to the associations involved. Many associate with black disease or death, so that the color seemed just unsuitable in the medical field. This seems to have changed fundamentally.

Why just these two colors? Would no other combinations be conceivable?

The combination of black and white has the unique advantage of being uniform. With the use of this duo, the manufacturer eludes the different tastes, as it is accepted by all and offers little attack surface. In addition, the combination adapts to any environment and style. And: It's long-lasting, works for years after production.

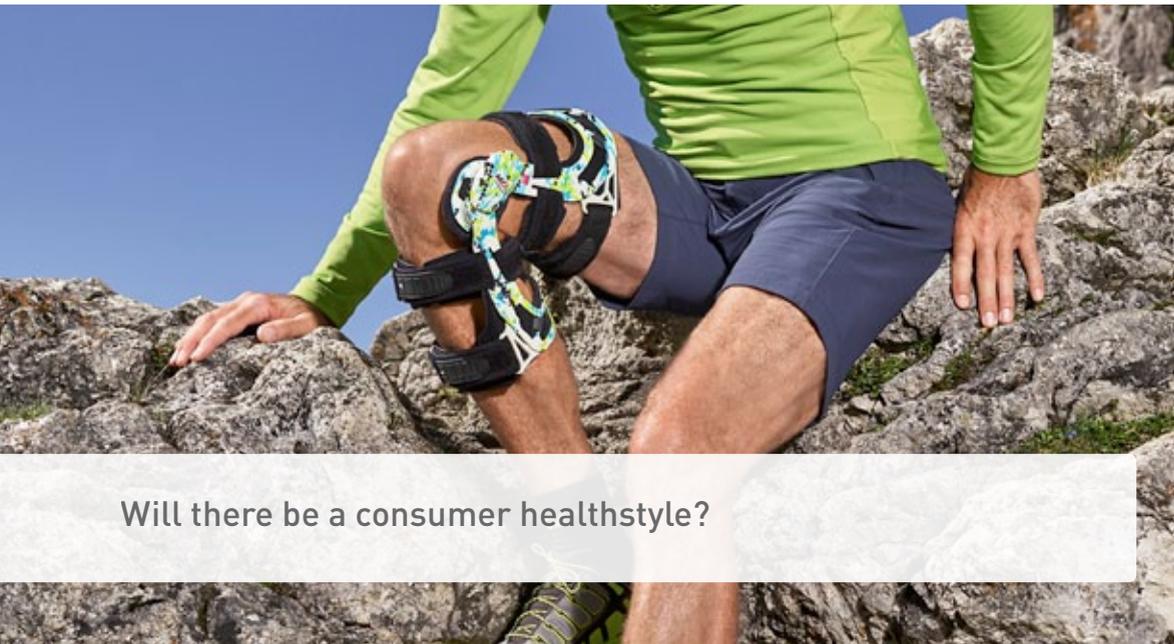
Does this trend also apply to the consumer sector?

The trend comes from the consumer sector and spilled over into medical technology about ten years ago. As in many ways, Apple is style-defining this with their iPhones. Generations of the smartphone got away with those two colors. While in the consumer sector, however, black is often the dominant color, in the medical field it is usually the other way around. The danger of such a hype is that the devices are visually approaching each other.

Do we have a large number of products that hardly differ from each other in the future?

The danger is actually there. An optical approach of the devices is quite noticeable, especially in the consumer segment. The manufacturers shy away from color experiments and rely on the security of these two non-colors. To still ensure that you make your own brand recognizable and distinguish themselves from other companies, manufacturers are increasingly focusing on color splashes: Discreet and restrained colors used for corporate identity - for example, the control switch as a graphic element - can attract attention despite the uniform design of the respective manufacturer. In addition, the trend is breaking, so soon different designs can be expected here.

9 | Color Splashes



Will there be a consumer healthstyle?

Wearables are among the fastest growing segments of medical technology. Whether for diagnostic and therapeutic purposes or as a fitness and lifestyle product: Your triumphal procession is progressing inexorably. The interest in one's own health and well-being into old age also opens the door to the home environment for blood pressure monitors, orthoses & Co. Linked to this, the desire for more style is increasing: away from the sterile, often stigmatizing medical device design to a fashionable accessory that you are happy to show and use to stand out from others. Bright colors are particularly in demand in the sports sector. Users of orthoses, bandages, prostheses or thrombosis stockings want to stand out in bright green or purple and emphasize their own personality (see illustration from Medi). Not sick, but dynamic, sporty and trendy.

“Products for customer's own health and well-being leave their shadowy existence and establish themselves in the private sphere as a stylish attribute. Wearables have long since established themselves as daily supporters. Now, thanks to their modern and colourful, they are also gaining acceptance among the trend-conscious, and they are increasingly becoming a must-have.”

Markus Wild

In addition to the eye-catching colors, more and more lighting racetracks or LED tapes are being used, adding to the attractiveness of the product. With the upgrading the design will increase the manufacturers' acceptance of their products. Users use the product more often and more regularly when they feel it fits their lifestyle.

Will there be a consumer health style?

To make the products suitable for the private sector, they must be able to adapt to the respective environment. The customer should be able to identify with the product. For this purpose, it should be individual and, if possible, personal. The design should be based on the lifestyle or design sector, so that it corresponds to current trends. Eye-catching, sometimes bright colors also show that the user is proud of the product and wants to present his personal healthstyle. Under no circumstances does the consumer want to appear ill or restricted.



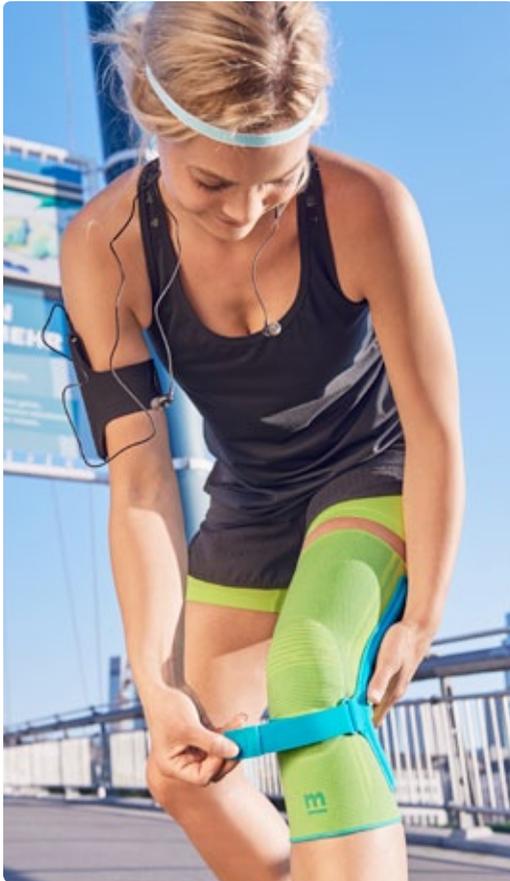
Materials and colors for every taste

With eye-catching colors, companies want to give consumers the opportunity to position themselves in a fashionable way. Often a product is offered in different colors to suit different tastes and lifestyles. Companies like the Beurer GmbH from Ulm usually start with a subtle and common color and use the reactions of the customers for further color variants. In addition to the coloring the choice of material plays a major role in the establishment of a product. To increase the value, you rely on combinations of rather unusual materials like wood or stone with glass or metal. In order to best meet the individual needs of the product, the devices are often operated by means of an app. This allows users to define their required and desired settings and receive the information they need.

Health, self-tracking and wellbeing as a way of lifestyle

The growing demand for more and more products that allow home users to monitor their health, increase their wellbeing, or free an existing illness from its stigma is being adapted by more and more companies. Beurer also attaches great importance to the aesthetic design of its products, so that they are not perceived as disturbing but attractive in the home environment of the consumer. With the use of colors a lot can be achieved in this regard. To comply with the needs of the customers in every respect, Beurer uses customer feedback as the basis for choosing which colors to use.





Color accents in professional medical devices

The use of color accents is also encountered more and more frequently in professional medical devices. With the Salvia intensive care ventilator, e.g. the nozzles for the hose connections are dyed in the corporate color green. This color will stand out significantly from the background, which ultimately has a positive effect on the intuitive handling in stress situations. However, in contexts such as the intensive care unit or the OR, stylistic color accents must always be subordinated to the safety requirements. There are standardized color symbols and signs in the applicable standards. Red is internationally standardized as a warning signal and can therefore not be used for arbitrary color accents.



Learnings Consumer Familiarity

- In the home environment, the product must be particularly aesthetic
- Trend colors enable customization
- Variety of colors in the product range should serve different tastes
- Health, self-tracking and wellbeing are closely linked to lifestyle products
- Color trends will be oriented to the consumer goods sector

“How can a mass-produced product be designed to meet individual requirements?”

9 | Interview with ... Teresa Schellhorn, Marketing BEURER GmbH



Dana Merchel im Gespräch mit Teresa Schellhorn

What advantage do you see from the color conspicuousness of your products?

We offer products for home use. Especially in this area the appearance of the products plays an important role. Therefore, we attach great importance to the quality of our products and develop them in Germany. The consumer wants to have an aesthetic product in his home environment. For example, our blood glucose meters such as the GL50 are available in fresh green, purple etc. In particular, we want to give young diabetics the opportunity to choose trend colors for their products. The individualization of the products by pure coloring is very important.

Was there a customer feedback regarding product color?

Of course there is feedback on which the color design of our products builds. For example, as with our activity sensor, we start with a plain, dark tone like black. Afterwards, the products will be expanded in the area of coloring. Due to the variety we want to meet different tastes.

Why are medical products increasingly geared towards lifestyle?

We do not only have medical products, but also those that help with health and wellbeing, but are not medical devices. Health, self-tracking and wellbeing are closely linked with lifestyle products. Our blood pressure monitors are medical devices that use a Bluetooth feature transferring values to an app. This fits the health lifestyle. You can save the values, compare them and send them to the doctor. In this area you can see the product group of the wearables on the rise. In the Beurer Health-Manager, the values are displayed using a gradient graph. Using a sleep sensor, we have the opportunity to interpret the data using the Beurer SleepExpert app based on heart rate, respiratory rate and motion measurements to record the sleep phases. Here you can also find advices and suggestions for improvement. We try to differentiate ourselves through our quality and the design.

How do you think the color design of medical products will in the change next years?

When it comes to products that are used by the patient himself, the color design will be based on the color trends in the field of consumer goods.

Thank you, Mrs. Schellhorn.

The interview was conducted by Dana Merchel.



Megatrend networking: Does the mass consumer replace the masses of patients?

“Modern communication technologies - especially the internet - are connecting more and more people with each other. The trend to be online continues persistently, despite some counter-movements that demand a more conscious approach to connectivity and fixed off-time. Whether your own home, your watch or your TV - the world is becoming smarter.”

Markus Wild

More and more companies integrate the electronic devices used by people in their products. Networked smart devices learn from people, work self-regulating and thus become increasingly intelligent. Thus, they increase the quality and possibilities of the functions and tasks that they assume and become indispensable for humans. For example, Amazon’s cloud-based voice service Alexa can turn the lights on and off, set the alarm clock, or order a pizza from the delivery service. As Alexa continues to learn, the performance improves with each use. Meanwhile, the voice assistant is not only integrated into smartphones and tablets, but will even be available in the car in the future. It begs the question: will Alexa conquer medical technology?



Self-analysis as a recipe for better health

Connectivity is also acknowledged by the Zukunftsinstitut as an unbridled force. The trends and futurologists see it as the most influential megatrend, which will be relevant to many future issues. In the medical technology industry, networking has a particularly strong impact. Due to increasing life expectancy, people are increasingly placing their health at the forefront of their lives. To improve the health or cure or avoid diseases, people want to be informed about their own health status. Linked to this is the desire to measure oneself as comprehensively as possible. Health apps or wearables that celebrate great success in the areas of health, lifestyle and fitness are the ideal basis for this. The rapidly growing volume and the quality of the available data make it possible to create a more accurate profile of each patient. On this basis, the diagnostics and, consequently, the efficacy and tolerability of therapies can be significantly improved. Personalized medicine will become more and more important and will change the industry sustainably. The motto is no longer a mass but a measured patient.

In order to be able to recognize and filter the relevant data from the huge amount and to be able to draw corresponding conclusions and thereby be able to provide the patient with precisely tailored diagnostics, the Rhön-Klinikum, for example, is developing a cognitive assistance system together with IBM. IBM Watson is able to process thousands of pieces of information in a very short time, helping doctors and specialists diagnose patients. The intelligent system understands the natural language, draws logical conclusions and learns from interaction with its users.

Design requirements

In order to introduce the patients to the new technical possibilities, it is necessary to make the devices user-friendly, smart and stylish. The more intelligent and self-regulating devices act, the more switches, buttons and other controls can be dispensed with. The hygiene factor requires an as seamless as possible design. If the device has a touchscreen, it should only display the information that is needed at that particular moment. In addition, it should be as scratch and shock resistant, powerful, fast and colourful, but at the same time be thin and light. The operation should also work with silicone gloves or other materials, which unfortunately succeeds poorly in the smart capacitive touch displays. The graphical user interface should be intuitive to use.

The apps, on the other hand, should integrate seamlessly into our lives. The user also wants to find familiar processes in it. The human being is in the focus during the conception so that he can operate the device easily and intuitively. The different systems and processes will increasingly converge and thus adapt to the wishes and needs of the users. Apps also eliminate the need for additional hardware. For example, Philips has developed Lumify, the first app-based ultrasound technology. In connection with the app, only the ultrasound head needs to be connected to the tablet or the smartphone and the doctor can already make his diagnoses directly at the scene of the accident or in the ambulance - it is easy to set up and is mobile and handy.

data protection

On the one hand, increasing digitization and networking is one of the key factors for innovation and growth in the healthcare sector, but at the same time places high demands on data protection. According to the eHealth Act 2018, the new EU General Data Protection Regulation (DSGVO) should enter into force to protect personal data. Although the patient benefits from the advantages, such as the avoidance of double examinations or the physician's important overview of previous illnesses and drug intolerances, especially in Germany people's fear of misusing their data remains high. According to a BITKOM study published in March 2017, 60 percent of Germans would use the electronic patient record, but 74 percent would like to be able to decide for themselves which physicians should have access to their file.

Problems with Admitting Medical Devices with Smart Device Control

Health apps track our fitness and remind us to take our medication. With the advancing technological possibilities, the control of medical technology devices increasingly shifted to the smartphone or tablet. But when is an app still a wellness application and when is it already a medical device? A medical app needs to be classified according to the EU Medical Devices Regulation and the German Medical Devices Act. In order to minimize the risks to the patient, the app must meet high regulatory requirements, the security requirements for the software can make the approval of a medical device with smart-device control more difficult. Even the early clarification of the legal framework - from data protection to liability - can avoid problems with the approval.

Connectivity - the highlight of a camera

With the XOTOCAM 1.1, the manufacturer XotonicsMed offers a camera that is optimized for everyday medical use. It can take photographs, films, survey, comment and archive. The highlight besides the simple operation of the complex technology is the coupling to the existing hospital information systems (KIS / PACS) via common interfaces such as HL7 and DICOM. The connection is made via wifi, via RJ45 power plug or via TCP / IP. An encryption of the data is carried out automatically - a basic requirement to meet the data security standards required in Germany. The camera itself can be equipped with a user restriction and various user detection options such as ID, voice or face recognition.

“How can I make my product future-proof with artificial intelligence?”





How deep do we zoom into the patient?

“In visualization we experience an impressive technological progress. The modern imaging techniques make extreme zooming possible and facilitate surgical procedures. Soon, even smarter systems will hit the market, a mix between virtual and real world: Augmented reality is no longer a fiction and will integrate with surgeons’ workflows. Information that the doctor has so far seen on the monitors can also be seen at the touch of a button. What is real and what is virtual will have to be defined by interaction designers in the future.”

Markus Wild

Sharper, faster and more true to life - the visualization technology brings movement into medical environments. New developments are moving into the operating theaters: from analog to digital, then to HD and now to 3D and 4K technology. High-resolution displays, in particular, are a considerable relief for physicians: High-performance imaging is now part of the standard medical equipment, integrating more and more in the workflow and providing the necessary overview in the operating process. In particular, when they can be controlled intuitively and function without the use of hands, they make the surgeon’s work easier, as they allow him to act with full concentration and without changing the image - for example, in minimally invasive and microsurgical interventions in

neurology, ophthalmology or general surgery. They also provide participants in training with pin-sharp, lifelike and meaningful images.

Design requirements

When designing imaging systems with 3D or 4K technology, the needs and location of the application need to be considered. Systems, such as 3D 4K conquer operation and cinematic halls. Spectacles for the operating room are located on the body and therefore have to fulfill ergonomic requirements. The device must be able to be adjusted quickly and be worn comfortably and without damage even during prolonged use, for example during extensive surgery in the operating room. Therefore, it should be made of

lightweight and breathable material. Often, such surgical tools have multiple users, so they need to be easily and effectively cleaned - for example, by providing the 3D surgical goggles with hand-washable facepads.

If the systems are equipped with control elements, these elements must be intuitive and easy to use so that the doctor is not distracted from his work or even interrupted. Designers are called upon to create a meaningful standardization in order to make the operating functions uniform and to simplify the use for the doctor. If the controls are attached directly to the unit, they must be easy to reach and use. Haptic or auditory feedback is particularly helpful because the user can not see the controls.



3D and 4K occupy OR and movie theaters

In the medical field, 3D technology has also proven itself in ultrasound. Full HD 3D monitors and 3D HD video recorders provide real-time 3D ultrasound images for analysis, transfer and archiving to capture and store.

In endoscopic surgery and surgical microscopy, stereoscopic images that give a spatial sense of depth can be made available for training purposes through the use of 3D cameras and Full HD 3D monitors.

Application areas in medicine:

- ultrasound
- endoscopic surgery
- surgical microscopy
- minimally invasive procedures
- microsurgical procedures
- neurology
- ophthalmology
- surgery

Portable 3D display delivers stereoscopic images

Sony's 3D Head Mounted Display System (HMS-3000MT) consists of an image processor and a headset that the doctor wears during an operation. The display shows 3D color video or images taken by 3D imaging systems. By providing the surgeon with images with realistic depth of focus, it guides him through the procedure with particular attention to detail. Also for training it offers the doctor an ideal platform. The ability to connect a second 3D head-mount display in the system allows two physicians to share and view images simultaneously.

In order to ensure that the 3D head-mount display can be worn without any problems, even during long periods of use, the focus was on ergonomics. In addition, the doctor can also overlook the operating table despite the display.

The Benefits of 3D and 4K Technology

The benefits of using the two high-tech imaging options: 4K technology excels in higher resolution and detail, while the high-resolution 4K technology delivers the highest level of detail 3D technology ensures higher contrast and better depth perception.

4K displays can display four different Full HD signals (1,920 x 1,080) as split-screen, with currently available HD monitors only able to reach a quarter of the HD resolution in each quadrant. Thus, different sources can be used simultaneously and the user gets a better overview of the overall situation. These sources can, for example, be an endoscopic camera, a room surveillance system that can be a patient's vital signs or radiographic documents.

In addition, the surgeon's eyes do not tire so quickly because he does not have to constantly switch between display and patient. Another advantage: thanks to the detailed magnification, the doctor gets a much better overview and can navigate effortlessly.

Learning 3D and 4K technology

- Young doctors accept the new technology well
- Splitscreen in four Full HD signals optimize the workflow
- Higher level of detail for viewing the smallest structures
- improved material for training
- better depth perception and thus more realistic shots
- higher contrast leads to:
 - improved navigation
 - time savings
 - eye fatigue is reduced



“How can 4K and 3D be integrated into new products as ergonomically as possible and thus without restriction for the user?”

11 | Interview with ...

Matthias Lubkowitz, Vice President OR Solutions, EIZO GmbH



Matthias Lubkowitz

What trends do you see in the field of 3D and 4K display systems - especially in the medical field?

While the 3D technology in the consumer sector - apart from the cinema - could not prevail and threatens to disappear from the market shortly, it is exactly reversed in the medical field. Young doctors are accepting the new technology very well. Because 3D enables faithful reproduction of stereoscopic images, minimally invasive surgery becomes much easier. The depth perception is particularly important for this, otherwise the doctors' processes will not be optimized. Another huge trend is the 4K technology. We receive now almost exclusively project requests, which require 4K. Even if the budget is not enough, it is assumed that the systems are 4K-ready to ensure that endoscopes or 4K cameras can be easily connected in the future.

In which direction will these systems evolve?

Still relatively new, but extremely promising are video-over-IP solutions for monitors, which can be integrated into the software of the systems, for example. These allow flexible and loss-free data transmission within and even out of the operating room thanks to the existing network technology. We see tremendous potential in this as they make every image available anytime, anywhere. A video source connected to the technology can be displayed via mouse or touch display which is displayed on a desired monitor.

Also interesting are 8K displays or OLED technology. Although 8K is already in the testing phase, there is currently no content available with this release. The data transmission and processing via TV cable or internet is not yet refined. Once the technology is fully developed, it will be interesting to keep track of which applications will suitably match. By contrast, the luminescent and thus particularly economical OLED technology is gradually becoming established in the industry, but we are still observing its durability. Because medical monitors are in use around the clock, it is important that they have OLED displays and can last long-term.

How will the new technical possibilities change the operating room as well as other working environments?

Monitors with 3D and 4K technology bring considerable relief to the clinical staff. Our integrated wall brackets, which are completely sealed and can therefore be easily cleaned and disinfected, can be divided into up to eight segments. Depending on the procedure, these can be adjusted in advance so that the doctor always has all the essential information about the patient in view - without having to leave the operating table. Students can use these large wall brackets to follow the ORs in detail and use them for their training. Due to the technology, young doctors also need significantly less training, as they can orient themselves much better through the faithful images. Since the procedure also runs faster, this is less stressful for the patient. And the clinic also benefits from investments in new technologies, because by saving time it can carry out more operations.

Are there not similar dangers as with self-driving cars? What problems are already apparent today?

One of the dangers of technical equipment in operating rooms is safety. The data of the patient can be retrieved in the OR via the network, the camera is also used to film the operation and partially save it. To ensure that this information does not fall into the wrong hands, provisions must be made here.

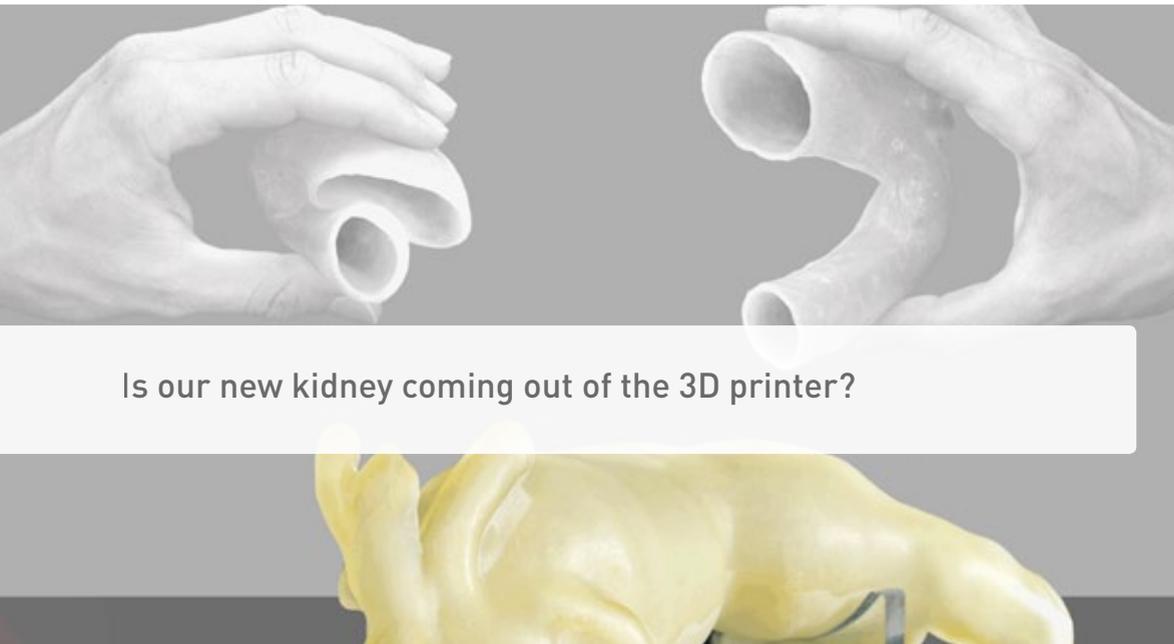
In addition, as the operating theaters become more and more technical, it is important to train the staff comprehensively and in a timely manner. The hospital staff must be able to handle all technical innovations flawlessly - even under tension or stress.

Finally, it is also important to set up a backup for every essential device in the OR: Monitors, PCs or endoscopes need to be replaced quickly if one of the devices fails. A redundant IT in the OR is therefore absolutely necessary for a perfect course of the intervention.

Thank you, Mr. Lubkowitz.

The interview was conducted by Claudia Krettlner

12 | 3D Printing & Additive Manufacturing



Is our new kidney coming out of the 3D printer?

“Additive manufacturing seems to be a field of limitless possibilities: new materials are constantly opening up new application areas and applications. The spread of technology also reduces costs, 3D printing in medical technology will soon be indispensable - so, for example, tailor-made implants from the 3D printer will replace the conventional implants used so far. Until additive manufacturing in medical technology can fully meet the stringent requirements of, for example, biocompatibility, old and new manufacturing processes are being combined so that we are currently in a decade of transition.”

Markus Wild

The pizza printer for astronauts in space or personalized custom-made jewellery to a concrete house shell - 3D printing, also known as additive manufacturing, is revolutionizing the industry. Versatile in use, it has now found its way into many industries such as architecture, the automotive industry, prototype construction and the aerospace industry.

Medical technology is one of the areas that profit in particular from the rapid progress of technology. Individually adapted prostheses, implants, greaves or hearing aids - the possibilities are virtually unlimited. The new hip or knee is already implanted in patients as a 3D print; in addition, physicians can print organs before difficult operations as an anatomically realistic exercise model and thus optimize preoperative planning.

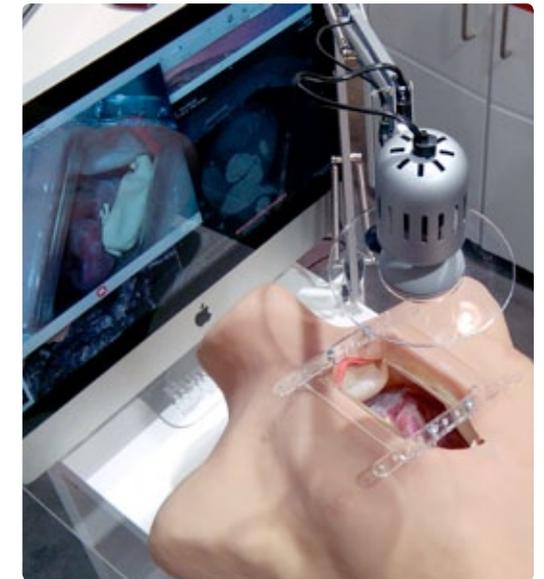
Customized Medical Devices on the rise

With the rapid technological progress, the areas of application of 3D printed products are increasing. Many advantages speak for the additive manufacturing process: They enable the most complex shapes with extremely high accuracy. Precise prostheses, whose design is software-modified to suit the individual's body part, are no longer wishful thinking, but reality. In contrast to conventional implants, a so-called Customized Medical Device is tailor-made for the patient and therefore has a better chance of being accepted by the body. In the field of medical technology, which is strictly regulated and has to overcome major obstacles on the way to approval, these demands will further boost the quality of 3D printing.

Applications

3D printing is used in a variety of ways and has become so established that it has become indispensable. Meanwhile, astronauts aboard the ISS space station can receive personalized medical care during their mission using a 3D printer. Even in developing countries and crisis areas, the 3D printer can provide valuable help to ensure the medical care of the population. Here, access to medicines, medical tools or prostheses or implants is extremely difficult. In the future, even remote and poor areas will be able to print their scalpel or stethoscope cost-effectively with a solar-powered 3D printer, which would considerably improve health care for the population.

At the same time, companies are discovering additive manufacturing as an opportunity to personalize their goods. Sporting Goods Manufacturer Adidas, for example, will be producing a running shoe in part from the 3D printer and offers its customers the option of adjusting the sole of the boot to their own specifications. Some companies also use this manufacturing process to visualize their ideas and progress with so-called “product mock-ups”. This works so well, because the installation of a 3D printer in the office is well possible easily and the device occupies relatively little space. The preparation time is limited to the creation of 3D data sets - ideal for the production of niche products.



Glass, ceramics or human tissue - is everything printable soon?

The materials used in 3D printing continue to evolve. So it is only a matter of time, until any material can be printed. The first bioprinter can already process human or animal tissue. Although this is still a dream of the future, the number of printable materials is already growing, adapting to specific areas of responsibility. For example, the material T-Lyne is particularly flexible, durable and clear. This 3D print filament is based on DuPont Surlyn ionomer resin with polyethylene and co-polymer. Due to its special properties, it is mainly used for the production of prostheses.

In the dental field, however, the first laser-based metals for selective laser melting (SLM) are preferred. These materials, which have been developed by the French company Z3D Lab, are biocompatible and therefore increasingly used as a dental crown or bridge. The selection of materials that can be processed in additive manufacturing will continue to increase in the future. Researchers at the Karlsruhe Institute of Technology (KIT), for example, have developed a process for producing glass products using 3D printing.



3D models and implants enter medical technology

HumanX, a service of the MMM Medical Modeling Manufacture GmbH, has specialized in the development and production of personalized medical models. The company provides solutions for preoperative planning and training as well as training in the form of virtual 3D and real-life patient replica models.



The advantages: Preoperative planning improves the success of the operation and increases patient safety. In addition, the time of the intervention is shortened, the treatment costs are reduced and thus the burden on the patient is reduced.



Absorbable materials reduce the risks

Biovision specializes in the production of bioresorbable implants. New material combinations, which are particularly suitable for 3D printing, should be used in the future and reduce the risk of allergy and infection to a minimum.

Non-body implants, such as bovine bones or corpse bones, can not be excluded, for example, in the treatment of infection with BSE or HIV. The use of foreign bodies, for example by implants made of metal, is not without problems: First, allergic reactions can not be excluded here. Also, usually a second operation is necessary to remove the foreign body from the patient.



Bioresorbable bone substitutes of microporous and macroporous tricalcium phosphate. This fully synthetic material is intended to exclude infections and immunological reactions.

Learnings 3D Printing & Additive Manufacturing

- evaluating complex cases using imagery is difficult. 3D printing allows you to train on a faithful replica and reduce the time needed for surgery.
- replacement technical organs or organs grown from stem cells will be the future of the "donor organs"
- organs grown from stem cells take a lot of time; 3D-printed organs could bridge this time
- patient-specific implants are becoming increasingly cost-effective and are the most promising product area
- resorbable implants can be used to avoid a second removal operation
- the use of synthetic materials reduces the risk of allergy and infection to a minimum
- the development in the area of body-like materials (tissue, bone, skin and tendon) is not yet completed and holds great potential

"How can we include 3D printing in our development to realize individualized medicine?"

12 | Interview mit ...

Dr. Marcel Pfützner, CTO HumanX, about 3D printed organs



Dana Merchel in conversation with Dr. Pfützner

What are the advantages of producing 3D printed organic products?

The development process of these organic substances is relatively simple. If we work with a 3D printer, we need output data. We obtain these from the CT or MRI scan and then work them up. From these 2D images, we generate a three-dimensional image for 3D printing. We use the printed models to plan preoperatively. In the concrete example, this means that the hospital has a complex case in which the radiological data for the doctor are not sufficient. It is difficult to evaluate with the aid of images. On such 3D models, physicians can train the surgical scenes not only virtually but with the instruments they need during surgery. Especially in the field of cardiology or orthopedics, this becomes visible: In a complex fracture, for example, plate systems can be pre-bent and thus the operating time can be reduced. These options give the doctor security during surgery and save him time during the procedure.

Are there other companies that focus on the same area?

Since we have been on the market, two more companies have joined; These try especially to gain a foothold in the field of orthopedics. However, clinics find it difficult to fund preoperative planning. The doctors and the hospital staff appreciate the offer very much, but do not know how they pay off. Return of costs and reimbursement is not given in Germany in 45 percent of all cases. That is our problem with the offer of preoperative planning.

Could the costs and their reimbursement change in the next few years?

The development has now progressed so far that it is simply factored into the complex cases of private payers and health tourists. The health insurances charge customers more and more money. Customers have to pay for everything themselves. From our point of view, new remuneration systems are urgently needed.

What materials do you use for 3D printing?

Everything that is soft in the body is made soft by us, and what is hard in the body is also made hard. Bones and vessels are made of a hard plastic, hearts are made of soft material. With the 3D printer, you cannot fully replicate what the body can do. There is a requirement for elasticity and durability in the models. For example, a piece of aorta is usually soft; soft material would work much better than hard plastic.

Do you think that in the future 3D printing will make it possible to create extremely similar, almost identical structures?

Making a body-like model is possible. What I can hardly imagine, however, is to produce implantable models, that is, living organs with cells. Although we have a problem with donor organs, we will not solve it with printed organs, as I believe they can never replace a complex, genuine organ. So what will help us in the future? When I talk to experts about it, there are different ways. Either a technical replacement organ replaces the diseased organ and lives as long as the patient. The other variant is that an organ grown from stem cells is used that corresponds 100 percent to the organ of the patient. However, this procedure would take a relatively long time. Until the organ is grown or bred, there would be a large time gap. In the future, this gap could eventually be used to produce a 3D-printed organ. This implantation organ could possibly be created over a period of approximately 50 years.

Are there other product areas that could become interesting for the 3D printing process in the future?

In the field of medicine, I see implants as future prospects of 3D printing. A new hip, knee or shoulder is currently being selected from the catalog of medical professionals. However, these never fit 100 percent. As a rule, something must always be drilled or milled on the patient's bone. So for now we have to destroy the healthy bone in order to use these implants. In complex cases, such as in the field of tumor surgery, the CT data can already be used to create a model on the basis of which patient-specific metal implants can be created. These implants are then supported on the remaining bone remnants. That is and will be a big field for the future. At the moment this is still very expensive, but it will become increasingly cheaper in the future.

I also see a lot of potential in 3D printed exo-prostheses. We are already relatively far in this area. Here you adapt the stem prosthesis to the patient. The prosthesis itself can then also be 3D printed using different high-tech materials.

Thank you, Dr. Pfützner.

The interview was conducted by Dana Merchel.

12 | Interview with ...

Daniel Hug, Manager Biovision about resorbable implants



Dana Merchel in conversation with Daniel Hug

What are the benefits of using resorbable implants?

Implants made of metal must be removed in another operation. With our absorbable products we spare the patient a second operation. Metal removal is therefore an important issue. Of course, metal implants can also remain in the body, but because they represent a source of inflammation you should be able to remove them again. In addition, with our material no side effects and allergies occur. In the case of metal, for example, the nickel allergy is known, and the use of bovine bone or corpse bone carries the risk of BSE or HIV infection. With synthetic materials, these risks can be ruled out.

What material do your implants consist of?

On the one hand we process the Tri-Calcium Phosphate (TCP) - an alpha and beta calcium phosphate. We also use a polymer polylactide PPLAR and a combination of tricalcium phosphate and polylactide, so a composite material.

The manufacturing processes of these materials are different. Calcium phosphate, better known as pure ceramic, is used as a bone substitute material. The polymer products are manufactured by an injection molding process. We are currently trying to develop a method that will enable the future production of these products with a 3D printer. The TCP, however, is more interesting for 3D printing. As Polymer reacts differently to the 3D printing process, we are currently working on new technologies and materials. One conceivable material would be PEEK. This is a plastic that is not absorbed and better suited for 3D printing.

Would changes in production result in other areas of application?

At the end of the production line, an implant is produced after all. Our focus is on trauma surgery and dental surgery, but if there is more demand, we are not limited. The 3D printing technology offers a lot of possibilities.

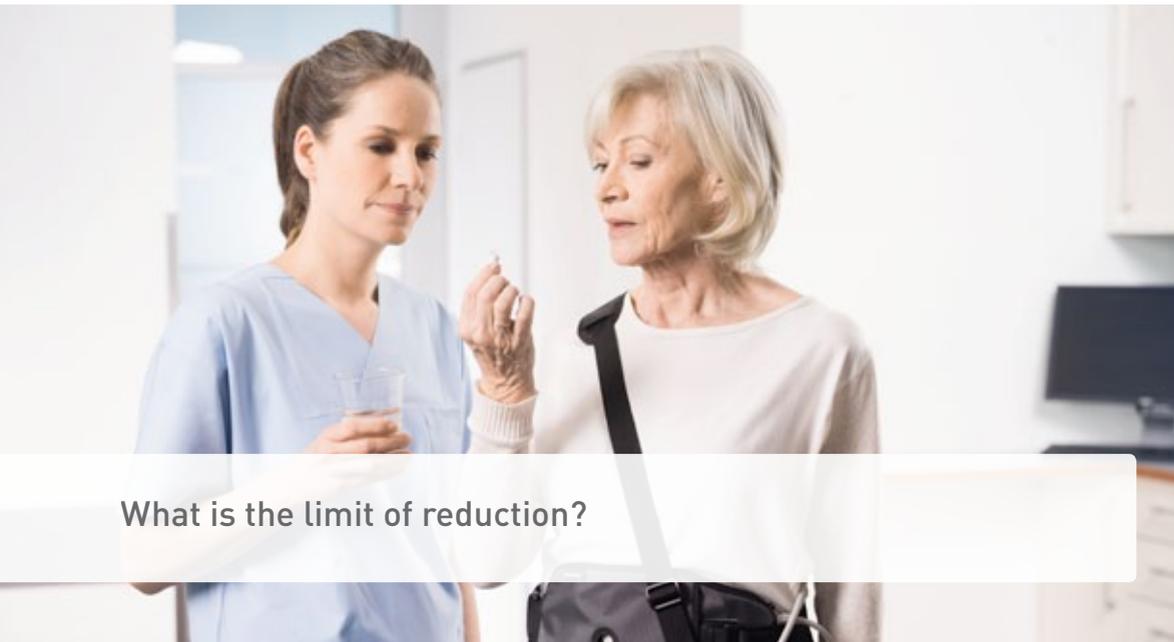
How do you think implants will change in design and material in the future?

From my point of view, there is not much room left for resorbable materials in 3D printing. In this area I feel like we have explored everything. From my point of view there are still design potentials in the development of body-like materials - ie fabrics that are similar to tissue, bone, skin or tendon. For example, there is still no material for the perfect bone replacement on the market.

In contrast, skin replacement has in my opinion already come very far. In addition, we have the advantage that you can transplant skin. Using body-specific material is best for the body anyway. That's why you should use your own substances in the body, which are suitable for it, first of all. For example, some tendons may be used for cruciate ligament surgery. With the technologies used you need to make synthetic material that is similar to the body, the boundaries are completely open.

Thank you, Mr. Hug.

The interview was conducted by Dana Merchel.



What is the limit of reduction?

“Miniaturization continues to be one of the driving forces of innovation in the medical technology industry. In particular, wearables, stents or implants benefit from the development of technology, which allows ever smaller product dimensions. The question is: when is a small device too small? As a designer, we need to create solutions in which neither quality nor functionality nor usability will be affected by miniaturization.”

Markus Wild

Smaller and more compact, with at least the same or, even better, greater functionality: That's what the consumer wants. Following the cross-industry trend of miniaturization, medical technology products are becoming ever smaller. Less use of materials, lower transport costs or new fields of application are among the advantages of miniaturization. As space-saving as possible, but still accessible, the most important functions of a device should be installed. At the same time, new functions must constantly be included. No easy task for the manufacturers, because: The smaller the product, the higher the demands on the components used and their production.

Those who want to remain competitive must satisfy the desire for miniaturized technology despite the challenges. In order to be able to optimally use the limited available space, the size ratios of the electronics will adapt to the device and thus smaller and smaller components and structures will have to be developed.

Miniaturization places the highest demands on the design

Miniaturization is only successful if it takes place in a reasonable way. The operability must not suffer from the small dimensions: keyboards or displays require a corresponding size in order to be used comfortably by the user. Due to the extremely compact design, the control elements and setting options on the device are usually drastically reduced or limited. For some time, the trend has been towards just one control panel on the front of the device. The challenge for the designer is now to accommodate the missing control and functional possibilities elsewhere. One possibility is to allow applications to take over this task, whose interface should be clearly structured and intuitive to use - for example, using a smartphone, tablet or remote control. Also possible is the control of devices by voice commands. To be able to do without a large touch screen as a control panel, devices can also be controlled by means of sensors.

The advantages

Miniaturization brings numerous advantages. First of all, many devices can be made portable by a small size and reduced weight. Especially in the area of the growing market of wearables, the smaller and smarter the product, the more comfortable it is for the user. On the other hand, they minimize traumatic consequences for the patient, because, for instance, shrinking the implant reduces physical impairment.

The endoscopy capsule (ENDOCAPSULE 10) from Olympus, an innovative system for the examination of the small intestine, also shows the advantages of a more compact design: it is small in size and makes treatments easy for the patient without any damage caused, saving him from a hospital stay. The surface of the capsule is extremely smooth and supports oral intake and cleaning. With the size of a gummy bear it is the smallest camera in the world and comprises of six LEDs, a compact battery, a transmitter and a CCD video chip with a diameter of less than a millimeter. “The miniaturization of the device minimizes stress for the patient”, says Daniel Höck, Territory Manager of Olympus Deutschland GmbH.



Energy supply for minimal dimensions

The power supply must be accommodated in the smallest space and places the highest demands on the packaging design. This not only reduces energy storage, but also optimizes its consumption. That is, intelligent software controls power consumption and decides whether to perform an application (e.g., measurement or therapeutic activity) and releases power only given the occasion. This has enormously positive effects on the functionality.

For example, cochlear implants for the hearing impaired and new pacemakers or neurostimulators have been around for 15 years.

With the increased useful life, the quality of life of the patients increases enormously due to the reduction of the components - modern pacemakers are only one third as big as a few years ago - and will be further improved.

What's the future like?

Over the next few years, miniaturization will continue to make progress, especially in the area of active implants. Reduction is particularly desirable because it can reduce patient stress during implantation. In addition, the reduction in size also increases the comfort factor for the patient in the long term. But as the tiny implants of a human can no longer be used safely, efficiently and precisely, the interventions are increasingly automated (see Chapter 14).

Researchers at Harvard University show how fast research on modern implants is progressing: they have developed an implant based on flexible electronics that is so tiny that it can be filled with a syringe whose needle is only 0.1 millimeters in diameter. The implant unfolds after its injection, records the electrical signals of a nerve cell and codes them. Used there it monitors the brain activity of the patient.

The new buzzword: Earable

In the field of wearables, there are many developments in the ear, as this position is particularly suitable for analyzing biometric data. Earables must be easy and stable, so that they are not lost even during light sporting activities. Optimum ergonomic adjustment and the use of soft materials are intended to provide the patient with a high wearing comfort. Also, the product must not stick to a sweater or scarf. It should be used quickly, put into operation quickly and be removed just as effortlessly. Often used as a fitness tracker, earables are intended to appeal to a young and trend-conscious target group with a functional and at the same time aesthetic design. In doing so, the hearing function of the ear must remain as complete as possible.

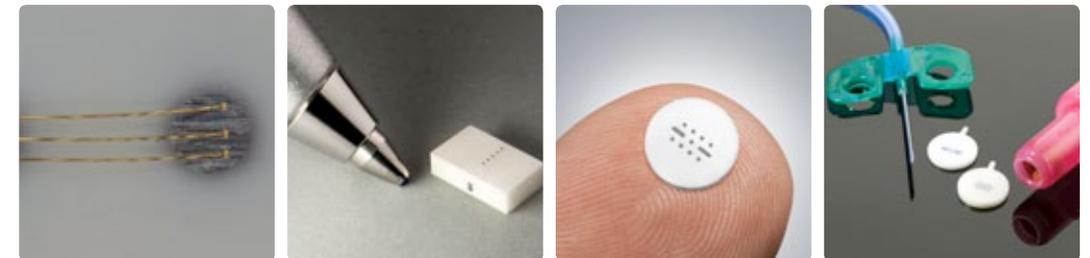


Research project of CiS, Institute of Microsensors, and WILDDDESIGN: functional, aesthetic and discreet design for innovative in-ear wearables

Materialien für die Miniaturisierung

The built-in materials must be of a particularly high quality, since even the smallest unevenness or contamination can have much greater effects than with larger-sized products. The demands on precision in processing and production increase significantly.

Along with the ongoing development of new manufacturing processes or materials, more and more applications are being introduced that would have been unthinkable in the past. For example, the Company Heraeus has developed a technology that could significantly advance miniaturization. With its biocompatible, ceramic and metal material system CerMet, completely new applications in the field of minimally invasive surgery (nerve and brain stimulation) could be made possible because the material can significantly reduce the size of implants for the heart, brain, eye or ear. As a result, implants could be used in the future, for example, in infants. The solid, high-density and extremely robust CerMet material is a combination of tiny platinum and aluminum oxide particles. With the CerMet technology, the electrical interface from the implant into the body can be significantly reduced, while at the same time significantly more channels or interconnects can be integrated.



Learnings Miniaturization

- miniaturization of the device makes the application easier for the patient
- burdens on the patient are minimized
- inpatient stays can be partially avoided by reducing the size
- more and more functions have to be included in ever smaller space
- the demands on precision in processing, on the quality of the material and on the design increase

How can I realise a large number of functions in small spaces without impacting usability?

13 | Interview with ...

Daniel Höck, Territory Manager Olympus Deutschland GmbH



Dana Merchel in conversation with Daniel Höck

For the diagnosis of obscure bleeding in the small intestine and for the identification of small intestinal tumors as well as Crohn's disease we have developed a novel, very small capsule endoscope. Which requirements and applications should be considered because of the size of the new capsule?

The size of our new capsule plays a big role in new applications. By being able to down-size them by 10 percent, the patient can now take the capsule more easily. For many, in the case of minimally invasive capsule endoscopy, the intake represents an immense inhibition threshold, as patients often complained about the difficulty of swallowing the device. With our current model we could minimize the capsule to the size of a gummy bear. Numerous positive feedback confirms that the miniaturization of the capsule has almost eliminated the discomfort.

Are there special advantages of your product compared to other endoscopy capsules?

We offer a special competitive advantage with the Omni Mode. This mode allows you to compare different images and to export redundant images. As a result, the doctor can save more than half of his examination or evaluation time without having to fear a loss of information. This usually takes 30 minutes. Through the omnimode image information and new findings will be filtered out exclusively. But the device does not delete recorded images, so that the doctor also has the opportunity to watch the entire recording. Besides, our capsule has the advantage of having a 3D track function. The doctor can later assess the overall situation by so-called landscapes – certain marks used for processing and analysing. Through these landscapes, the doctor can survey the entire small intestine tract and view it in a 3-dimensional structure in our software. Therefore, it is much easier for him to make a diagnosis: where exactly the bleeding occurs, if it is an anomaly or lesion, he can locate it much better and then decide much faster, which measures are to be drawn from it.

I read that a case evaluation outside the hospital is possible. Can you explain this to me in more detail?

With our new system, the patient can move almost unrestrictedly. He does not have to be hospitalized. After taking the capsule in, the patient receives a waist belt that incorporates a lightweight, slim antenna unit that records the results. The waist belt is positioned at navel level and is easy to use with the connected all-in-one recorder. In addition, no skin contact is necessary. Therefore, the belly strap can also be worn over the clothing, so that the preparation time could be significantly reduced. As the capsule passes through the patient's small intestine, he can perform normal activities. For this reason, the patient is not limited in any way.

Thank you, Mr. Höck.

The interview was conducted by Dana Merchel.



Robots instead of humans: Will the doctor become a phased out model?

“The robot in the operating theater is no longer a dream of the future. Even if he can not replace the doctor, he takes over more and more tasks. It is foreseeable that he will soon be able to carry out minor interventions independently. The robot not only relieves the surgeon, but also supports hospital logistics or nursing. Likewise, artificial intelligence in medicine soon became indispensable: analysis and diagnostics can be computer-aided much faster, more accurate and error-free than humans can.”

Markus Wild

Will we soon be able to schedule an appointment with Dr. Ing. Watson from IBM and no longer with an actual GP? Innovative technologies in the field of medicine will relieve people of heavy physical or monotonous work. Likewise, they can support and secure the physician in finding the diagnosis: Exploding data volumes complicate matters for the doctor as well as rapid developments in research or lack of time for a comprehensive diagnosis. The doctor cannot keep up with IBM’s Watson super-computer: while a person can work through 24 patient files a day, Watson only needs 15 seconds to analyze 40 million documents.

Smart technology cannot replace the doctor, but is indispensable in hospitals. The patient also benefits from the new possibilities. For example, analyses can now be performed during surgery: The MasSpec Pen can distinguish tumors from healthy tissue within seconds. As a result, time-consuming laboratory examinations are eliminated, the physician can better localize the affected tissue and the patient receives less anesthetics.

Further advantages of automation: Due to the technical relief, doctors and nursing staff gain time, which in turn can benefit the individual care of patients. Human errors are kept to a minimum due to the high accuracy and reliability of the equipment, diseases are detected earlier and workflows are made extremely efficient. All in all, this optimization in different areas ultimately leads to a reduction in costs.

Areas of application of automation products in the medical sector:

- patient diagnostics
- minimally invasive surgical procedures
- radiology / imaging systems
- radiotherapy
- rehabilitation
- laser osteotomy
- research
- patient positioning
- tool placement
- support in data analysis
- distribution of medicines
- support in warehouse management
- patient care (for example Alzheimer’s or general care)

Robots in the OR: new challenges for usability

With the advent of robots and artificial intelligence in hospitals and medical practices, the question arises, how designers can support the technical possibilities and generate further added value from them. For example, how can work environments in the OR or in practices be designed in the future so that the new technology is accepted by the user? How can the robot be controlled or interact in the environment of augmented or virtual reality?



In order to be able to operate the robotics for longer periods of time and without fatigue symptoms during several hours of surgery, the demands on ergonomics are high. Virtually controlling forceps, endoscopes or needles require a workstation that reduces the surgeon’s high physical strain during the interaction. Control by gesture or body movement also makes handling the new technology easier.

Robotic systems in medicine must also be particularly hygienic, which is why they are usually covered with special films during operations. If these factors are already taken into consideration during the design of the device, it also helps prevent infections. Even with a modular design, problems can be avoided later: It supports the cleaning of the device as well as maintenance and repair work and helps ensure that the device is immediately ready for use again. In addition, simple and rapid interventions are particularly desirable in these usually highly complex systems. Commissioning should already be extremely easy and should not require much preparation to start with as few instructions as possible.

Design as a success factor: user-oriented and with a human “touch”

There are other challenges in nursing. The concerns about machines in this area are still high, but it is only a matter of time before robots will be so cheap that they can be used in the home environment. The corresponding design will then depend heavily on the area of responsibility. For example, if used for the care of a patient with dementia, a robot should communicate warmth and care. Since these robots can also respond to people and talk to them, they make it easier for older people to be alone. The robot Pepper is programmed to analyze people according to their facial expressions and gestures and react accordingly to these emotional states.



The new exoskeletons represent another design challenge. The robotic walker must be able to be individually tailored to the patient's body. A software examines which configuration closely resembles the patient's natural movement sequences and adapts them accordingly. Depending on the application and environment of the automation solution, different design requirements apply.

Research cooperations want to optimize cooperation between humans and robots

The German company KUKA is a specialist in automation technology and one of the leading manufacturers in the field of medical robotics. The goal of the Augsburg based company is not the replacement of humans, but to optimize skills to complement and facilitate cooperation between humans and robots. Especially in the healthcare sector, KUKA is constantly researching new automation solutions for better process efficiency. They also work together with renowned research institutions.

One of the cooperations is the lead project M²INT. In addition to KUKA, the Fraunhofer Project Group for Automation in Medicine and Biotechnology PAMB, the research campus M²OLIE, Siemens Healthcare, Zeiss medica GmbH and Maquet are influential players. Together they form a research group for a semi-automated intervention system for the efficient implementation of minimally invasive and individualized radiotherapy.



Learnings Automation

- Classical automation moves towards the robot. This will not be the goal in medicine. The doctor or nurse must maintain control.
- We must use what man is good at and take away from him what he is not good at
- The decisions based on knowledge are left to the doctor, placement of devices or holding functions can be taken over the robots
- The goal is the creation of a defined intervention space and the acceleration of processes with high security
- In order to make the robots work optimally together, the components must be networked together
- Information has to be found in the right place at the right time

“How can an automation product or robot be designed so that it does not hinder the processes in an intervention room? How can optimal intuitive usability be achieved?”

14 | Interview with ... Andreas Rothfuss, Project Manager for Information Systems for Medicine and Biosciences, Fraunhofer IPA



Dana Merchel in conversation with Andreas Rothfuss

How will Trend Automation develop over the next few years?

In medicine and medical technology, in my opinion, classical automation must be considered particularly intensively and used prudently. Classical automation moves in the direction of the robot. I think this should not be our goal in medicine. Rather, in my opinion, medical technology will be more about using what human beings are good at and taking away what they are not good at. The doctor, for example, is able to recognize tumors on an image and has an extensive knowledge of anatomy. Therefore, it makes sense to let the doctor make the essential decisions: If, for example, in tumor diagnostics using a biopsy needle, tissue must be removed, the doctor determines at which point the needle is inserted. The placement is taken over by the computer - with one hundred percent precision. Also, the holding of surgical instruments can be taken over by robots. The control remains in the hands of the doctor.

What are the work and research priorities of M²INT?

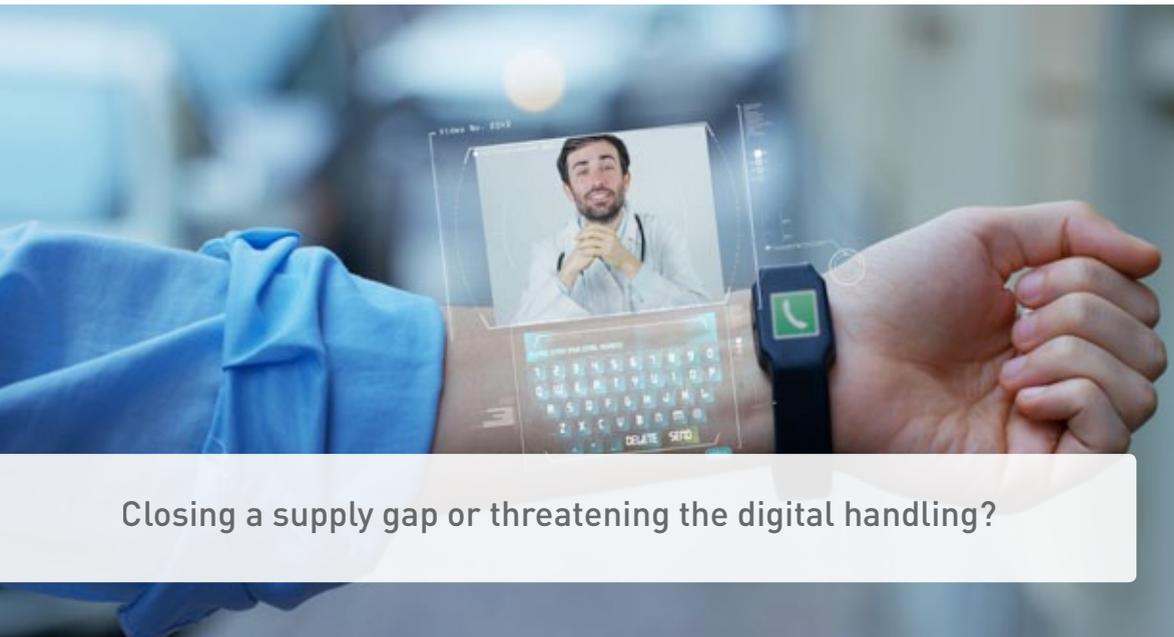
With the intervention assistant, we have developed a possibility for rapid and precise diagnostic and therapeutic measures in the field of tumor diagnostics. In order to further expand the system, our work and research focus lies in the field of system networking: robotic assistance and a multitude of so-called enabling technologies. This is what we call technologies that, by themselves or in combination with other technologies, produce significant leaps in user performance and capabilities. For these enabling technologies, we again need new technology systems - for example navigation systems or, more precisely, tracking systems that know exactly which surgical instrument is present at which location and where it is to be used. They also need to know exactly when and where to stop a particular operation to avoid a mistake or dangerous situation. These systems are intended to track an entire room, and not just a small portion of it, at different update rates and accuracies - from the negligible corner of a room to the important operating room environment.

What is the aim of the project M²INT?

The aim of this subproject of the research campus M²OLIE is to create the intervention space of the future. For that we want to create a more intuitive way of imaging. How does the doctor get more confident working with the imaging procedures without slowing down the process and how can these be sped up? For example, the process of imaging takes over an hour because you first need to position the patient correctly. The preparation and tasks during interventions need to be smoother. Take the needle placement example again. Today, a doctor needs half an hour to three quarters of an hour to place a biopsy needle deep in the tissue. With the help of our developed robotics system, this placement takes only five minutes. One problem is that there are already many devices in the intervention room. Such a special robot would add another. That's why you have to be able to network the robots with each other and thus ensure that on the one hand no one is injured and on the other hand no objects in the room are damaged. How do you achieve that the various data sources produce precise systems with maximum security? And how can we store the information that is needed at the right time in the right place? For that we have to solve the networking problem. Achieving this is one of our project goals.

Thank you, Mr. Rothfuss.

The interview was conducted by Dana Merchel.



Closing a supply gap or threatening the digital handling?

Telemedicine enables diagnosis, therapy, rehabilitation or further education with the help of modern means of communication over a distance. It describes the communication between doctor and patient or between two doctors (Doc2Doc). The confidentiality and the duty to inform remain.

“Telemedicine was hyped as a trend more than 15 years ago. Since then, not much has happened in Germany. Reasons for this are mainly the uncertain legal situation and the financing by the health insurance companies. The now popular fitness tracker and self-optimization apps are bringing telemedicine back to public awareness as an option in healthcare. All the way to tele-consultations, services are created that challenge interaction designers with new tasks: How to design a website for tele-consultations that you trust? How to remotely position medical expertise without challenging the doctor’s position in healthcare?”

Markus Wild

Although telemedicine cannot replace a medical examination, it provides optimal additional support and closes a major gap in disease surveillance and treatment, for example, by collecting expert opinions. Telemedicine can also contribute to improving the quality of life of the chronically ill or elderly: long distances to the doctor or hospital are spared, and the use of monitoring devices avoids emergencies. In order for telemedical products to be able to establish themselves among the users in the future, they must be set up particularly simply and be unmistakable in the operation. Simplicity and intuitive use are a must.

Design focus: reduction and easy data transfer

Quick and easy commissioning is extremely important for telemedicine products. As far as possible, no unnecessary accessories, connections and cables should be dispensed with, and a Quick Start Guide should comprehensively explain the operation. The GUI (Graphical User Interface) must be self-explanatory. In order to prevent incorrect operation, functions and displays should be reduced to the minimum necessary for the application. The evaluating medical staff must be able to rely on the correct use of the products and there can be no source of error. In addition, the user must be confident that the data transmission was successful and protected against unauthorized access. This can be done, for example, by status messages and feedback from the GUI.

Subtle home design

In addition to safe and easy commissioning, the product should be able to fit into the user’s home environment. During the design process, the application and storage location is too note: home-care devices are usually much less technically designed than comparable professional devices for clinical practice. They should create trust through seriousness and simplicity. Color accents are mostly used for support: To facilitate the operation, interaction surfaces are often highlighted in color.

The design should convey reliability, but also take away the fear of contact. In order to increase the identification, the device exterior can be adapted to the individual preferences of the user. In the case of children, for example, these could be color adjustments and stickers. The goal is to animate and motivate the user. The use of the device should become a familiar routine, which requires little work and in the long term is perceived as meaningful.



Promotion & eHealth Law

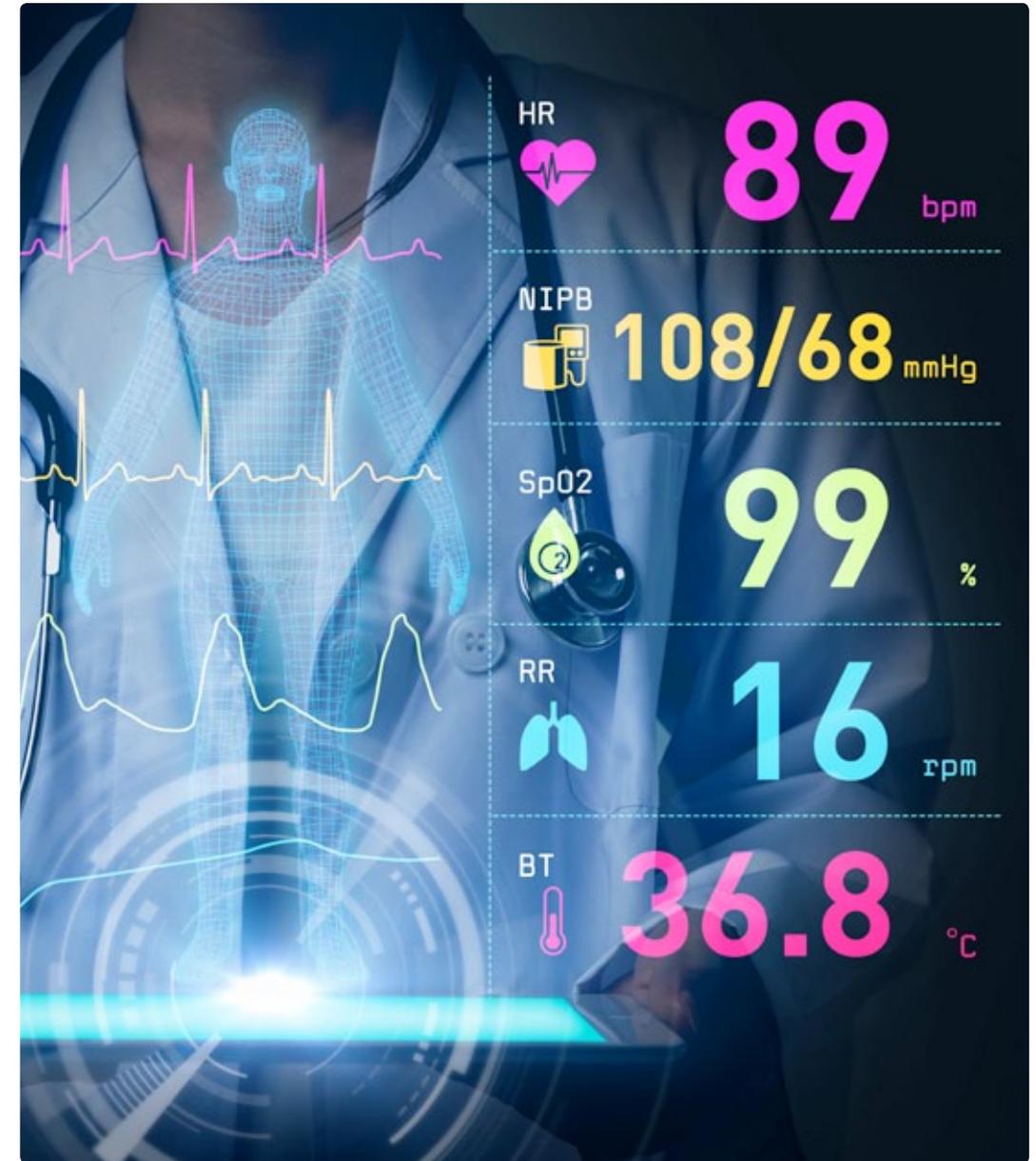
With the adoption of the eHealth law at the beginning of 2017, telemedicine has gained momentum in Germany. The Ministry of Health has also been trying for quite some time to get the electronic health card up and running. This could especially solve medication problems in older people better.

Versatile products

The field of application for telemedicine is wide. For example, the AOK supports its members with chronic heart failure with the telemedicine health program HerzAS. Equipped with a Telewaage and a health monitor, cardiac patients use the program, in which important health-related parameters are transmitted to the Society for Patients in Munich where they will be evaluated. In the case of abnormalities, they will contact the patient and coordinate necessary measures.

In addition to telesales or health monitors, telemedicine also offers space for products that are classified as pure medical and consumer products. The certified stimulation current device by Bluetens, for example, is suitable for electrotherapy, relaxation massages and muscle building. 150 programs in the categories of therapy, relaxation and strength are available – from the reduction of pain perception through massages to sports supplementation or regeneration.

The design of the device is extremely minimal and clean for the application at home: It comes with only one wheel and an integrated button. All other illustrations, such as instructions for the correct placement of the electrodes, are displayed via the smartphone app. Here the user also gets the required feedback.



Learnings Telemedicine

- the more data, the greater the impact and treatment options
- regulatory problems hinder the development of telemedicine
- design to improve the usability of products for the elderly
- the biggest challenge is raising awareness among users

“What design aspects does a product have to meet to eliminate the fear of telemedicine in elderly patients?”

15 | Interview with ...

Bernd Altpeter, Managing Director of DITG GmbH

How advanced is telemedicine in Germany?

Telemedicine is still in its infancy in Germany. Not for technological reasons, but because of regulations. We face some challenges in this area, including compensation. The German remuneration system does not reflect the innovations that currently exist on the market. The health insurance companies do not agree on how they want to settle this benefit. And although Germany has one of the toughest privacy laws worldwide, there are great concerns about the potential hazards involved. These fears hinder many innovative advances.

What significance does the topic of design have for telemedicine?

The really sick people are mostly older people. The use of telemedicine is not as trivial for this target group, so we still have many challenges to tackle in this area. Here I see a necessity to improve the interface and the design. The entire market is very much based on the youth, on the technology hype. In the areas where telemedicine is really needed, we lag behind. We would need to focus much more on design to make telemedicine useable for old and sick people.

Are there differences to other countries?

In Latin America, telemedicine is widely used. This is particularly due to the local conditions, because here the people in more rural areas have to compensate for supply bottlenecks and the shortage of doctors. As a result of this pressure to act, the market must be more ingenious and innovative in order to be able to handle the supply.

Telemedicine is also a way for China to ensure medical care. As it is difficult to build infrastructure for such a huge nation, China is investing in this technology to use it for faster medical care.

What are the advantages and disadvantages of telemedicine?

Older people cannot travel large distances to see their specialists, but the specialists need the data to treat the patient. Overcoming spatial distance is one of the key benefits of telemedicine. On the other hand, telemedicine provides an uncomplicated and quick way to receive expert opinions. We see a big challenge in diagnostics. With the increasing number of chronic diseases, which are now also treated by the GP the safety during treatment must be assured. Getting a second opinion from another doctor and sharing it can be very helpful. Furthermore, telemedicine offers faster therapy adjustments and also a degree of customization. In addition, patients are given more ownership by being able to use more medical devices. With their help, they can determine their own health at home. Sensitization takes place especially in prevention, because the unhealthy development due to poor nutrition and lack of exercise can be prevented by this technology.

How can safe patient use of the product be guaranteed?

There are many challenges that we have to face. For one, the user's understanding of technology poses several entry barriers. Most people do not even know how to use their devices. Therefore, appropriate training for the use of the device must be guaranteed. In addition, patients need to learn to understand what the data does in terms of their health. The values must contribute to the individual benefit for the user. Especially with pure digital solutions, the problem is that the attractiveness of the gadget fades quickly, and the user is often bored with only one app. Humans as an intervention parameter cannot be substituted. People and technology have to go hand in hand.

What are the measures regarding data security?

From the data security point of view, we face no serious challenges. The prerequisite is that we can guarantee security for data transfer and management. Here we often fail because of the lack of cooperation between the individual market participants. We observe that there is no interest in data security, for example in regards to the growing number of wearables. Eighty percent of these wearables do not meet the standards that exist. The biggest challenge is to make users aware of data security and show them how to use it sensibly.

Thank you, Mr. Altpeter.

The interview was conducted by
Albert Ibragimov.

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