

Published: January 31, 2023

Citation: Weimann E. and Weimann L. E., 2023. Ways to Mitigate Climate Change by Implementing Zero Emission Hospitals – A Case Report, Medical Research Archives, [online] 11(1).
<https://doi.org/10.18103/mra.v11i1.3464>

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DOI:
<https://doi.org/10.18103/mra.v11i1.3464>

ISSN: 2375-1924

CASE REPORT

Ways to Mitigate Climate Change by Implementing Zero Emission Hospitals – A Case Report

*Edda Weimann^{1,2} and Léa Elisa Weimann³

¹Technical University of Munich, Faculty of Medicine, Children Campus Schwabing, 80804 Munich

²University of Cape Town, School of IT, Cape Town, South Africa

³University of Edinburgh, School of Law, Old College, South Bridge, Edinburgh, UK

*edda.weimann@uct.ac.za

Abstract

If the global healthcare system would be a country, it would be the fifth largest emitter. Hence various health care systems worldwide have committed themselves to become carbon neutral. In Europe, Germany as an economy and the German healthcare system produces by far the most emissions. This has a significant impact on the health of the population in Germany, Europe and worldwide. It leads to Disability Adjusted Life Years (DALYs) as well as premature deaths. To reduce global climate change related damages, disasters and negative health outcomes, Germany has committed itself through various treaties to become carbon neutral and to transform the healthcare system towards net zero until 2030. The article highlights crucial steps for hospitals how this can be achieved. Important management tools are the SWOT analysis, the PDCA cycle, the DHOW model and the sustainable Balanced Score Card. Hospitals should establish Key Performance Indicators for Scope 1, 2, and 3 emissions and monitor them on a monthly basis. Important action areas are energy sources, insulation of buildings, waste, water consumption, nutrition, transportation, chemicals, pharmaceuticals, climate education and leadership. Leadership should be executed as a top-down as well as a bottom-up approach to involve all relevant stakeholders including staff and patients.

Keywords: Healthcare Systems, carbon neutral, transformation, CO₂ Emissions, Health

Background

Reducing emissions from the healthcare sector plays a major role in overcoming the climate crisis, as it accounts for 5.2% of the global ecological footprint¹. That corresponds to the emissions of 619 coal-fired power plants². This results in immense health consequences and damages. As the world's seventh largest global emitter³ and the largest European emitter in the health sector, Germany has a special responsibility to reduce the impact of climate change on populations - nationally and globally. This means reducing climate catastrophes and damages in other countries and the effects on their health systems ("loss and damage"). Through various climate protection agreements, the Paris Agreement and COP26 in Glasgow, Germany has committed itself to measuring and reducing emissions in general as well as in the health care sector⁴. In November 2021, the German Medical Association decided to achieve a climate-neutral healthcare system by 2030⁵.

CO₂ emissions from hospitals

The healthcare sector is globally the fifth largest greenhouse gas (GHG) emitter, with hospitals contributing 13% of GHG emissions⁶. In Europe, the German and Swiss healthcare systems generate the most emissions⁷. The German healthcare system emits 57.5 million tons of CO₂, which accounts for 5.2% of Germany's total emissions. Based on the GHG protocol that was launched in 1998 by the World Resources Institute for carbon accounting, emissions are divided into Scope 1 (direct emissions), Scope 2 (indirect

emissions) and Scope 3 (emissions through the value chain). Of this, 17% accrue to Scope 1, 12% to Scope 2 and 71% to Scope 3 of global healthcare in the healthcare system⁶.

The aim is to reduce emissions from the healthcare sector across the EU and become climate-neutral by 2030^{8,9}. In addition, health systems must be better prepared for the negative health outcomes of climate change through adaptation and resilience^{10,11}. A framework for a climate-neutral healthcare system was published in Germany in 2022^{8,12}. The question remains: How can zero emission hospitals be implemented? In accordance with their role as one of the biggest contributors to the climate crisis, hospitals should define and record key performance indicators (KPIs) of their main areas of action. Based on this, a hospital-specific strategy can be developed with management tools such as the DHOW model, SWOT analysis and the Sustainable Balanced Score Card (BSC). Furthermore, measures must be defined and implemented and re-evaluated through a PDCA cycle (Plan-Do-Change-Act). This needs to be done through a combined top-down and bottom-up leadership approach.

Methodology:

Based on the results of leading international research groups and the Intergovernmental Panel on Climate Change (IPCC), there is an urgent need for rapid action (Code Red) to achieve climate neutrality in the economy, including the health sector, by 2030¹³.

This article gives an overview about the underlying reasons and need to transform hospitals towards net zero emissions. Through

providing a case report it highlights ways to achieve a net zero hospital in a short time frame. The author has successfully implemented transformative measures towards net zero emissions in two hospitals, in a high-income country (Germany) and a middle-income country (South Africa). The underlying question was how to successfully implement management measures to achieve a reduction of carbon emission and diminish the environmental footprint of hospitals within a short time frame as there is an urgent need for rapid transformation.

One of the first steps is to calculate the total emissions of CO₂ in all emission classes and to jointly develop goals in which steps and by which measures these are to be reduced to zero by 2030. A carbon accounting for Scope 1 and 2 emissions and in a second step for Scope 3 emissions should be performed. Then KPIs should be developed on a yearly and monitored on a monthly basis to reduce Scope 1, 2 and preferably 3, to lessen emissions to net zero until 2030.

Management tools

There are various management tools to firmly anchor sustainability in the hospital. The DHOW model (Figure 1) offers one approach. This model helps to address the above action priorities comprehensively by placing sustainability at the centre of action with the help of the Balanced Score Card (BSC)¹⁴ (Figure 2). A hospital-specific strategy can be developed using a SWOT analysis (Table 1). The SWOT analysis and the Sustainable Balanced Score Card (BSC) are important

management tools to implement sustainable hospital management. The executive management team should develop a sustainability strategy, measure the emissions monthly, present the data on a sustainability dashboard, agree on binding reduction targets and define transformative measures. Based on the current emissions of the various scope classes and the resulting measures, the strategy should be regularly monitored and redefined using the Plan-Do-Change-Act (PDCA cycle). Its implementation can be controlled by applying the Sustainable BSC (Figure 2). It is essential to determine KPIs for the individual action areas. Below are example KPIs for the different fields of action. For a detailed presentation of the various management tools, we refer to the textbook "High performance in hospital management"¹⁵ and article¹⁴.

The **SWOT analysis** determines the current internal strengths (S) and weaknesses (W) regarding the sustainability of a hospital and the opportunities (O) and risks (R) that the hospital is currently facing externally.

Internal perspective	External perspective
Strength	Opportunities
Existing solar panels on roofs	Financial support for e-charging stations
Motivated and skilled zero emission team	Inclusion of local agriculture and food supply
Own kitchen in the hospital	
Weaknesses	Risks (Threats)
No executive buy-in from the hospital board	Neighbouring hospital chain has a sustainability strategy and is already certified.
Competitors have better connection to public transport	Poor understanding of climate facts and no investment commitment from the Ministry of Health

Table 1: Example of a sustainable SWOT analysis

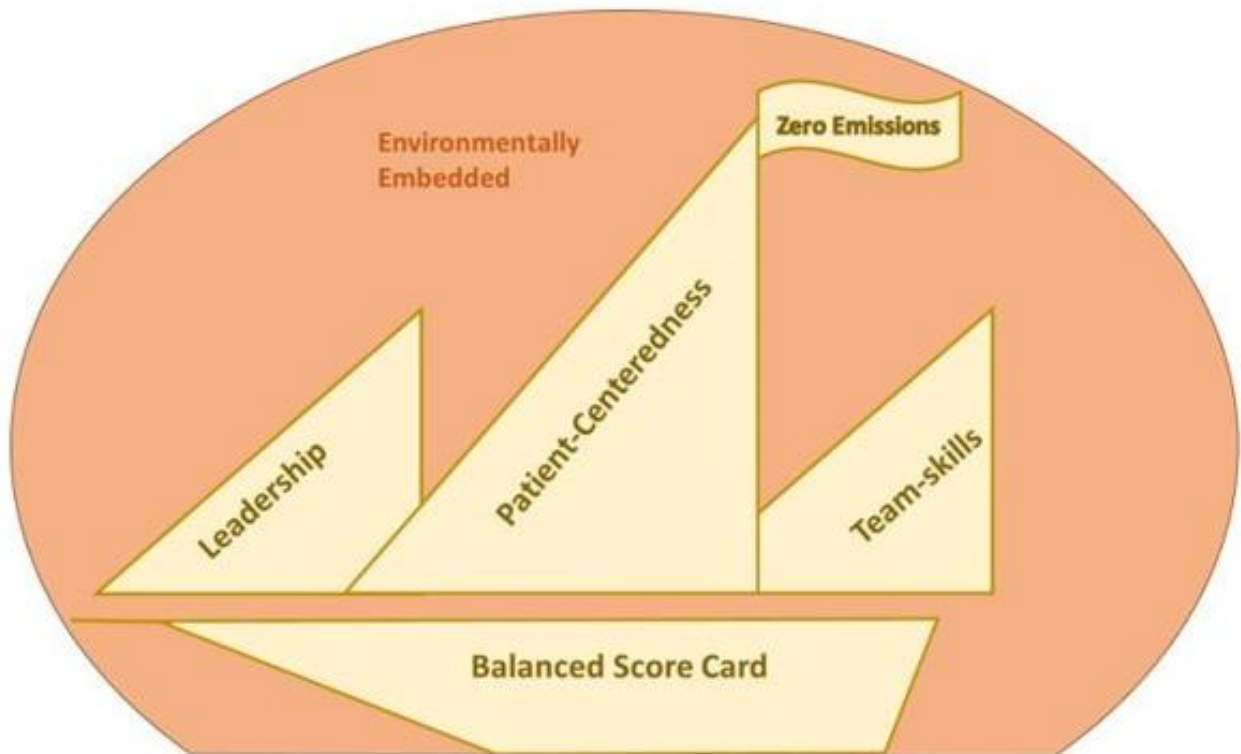


Figure 1: DHOW-Model

As a next step we would like to describe the **DHOW model**¹⁶. DHOWs are sailing boats in the Indian Ocean that transport heavy loads even in stormy seas without fossil fuels and have done so for centuries. Applying the picture of DHOW sailing boats to hospitals - to embark on a successful sustainability zero

emission journey, it is necessary that the staff has the knowledge and skills, the executive management has profound climate leadership skills, the approach is patient focused and all decisions are made using the Sustainable Balanced Score Card to achieve a net zero hospital.

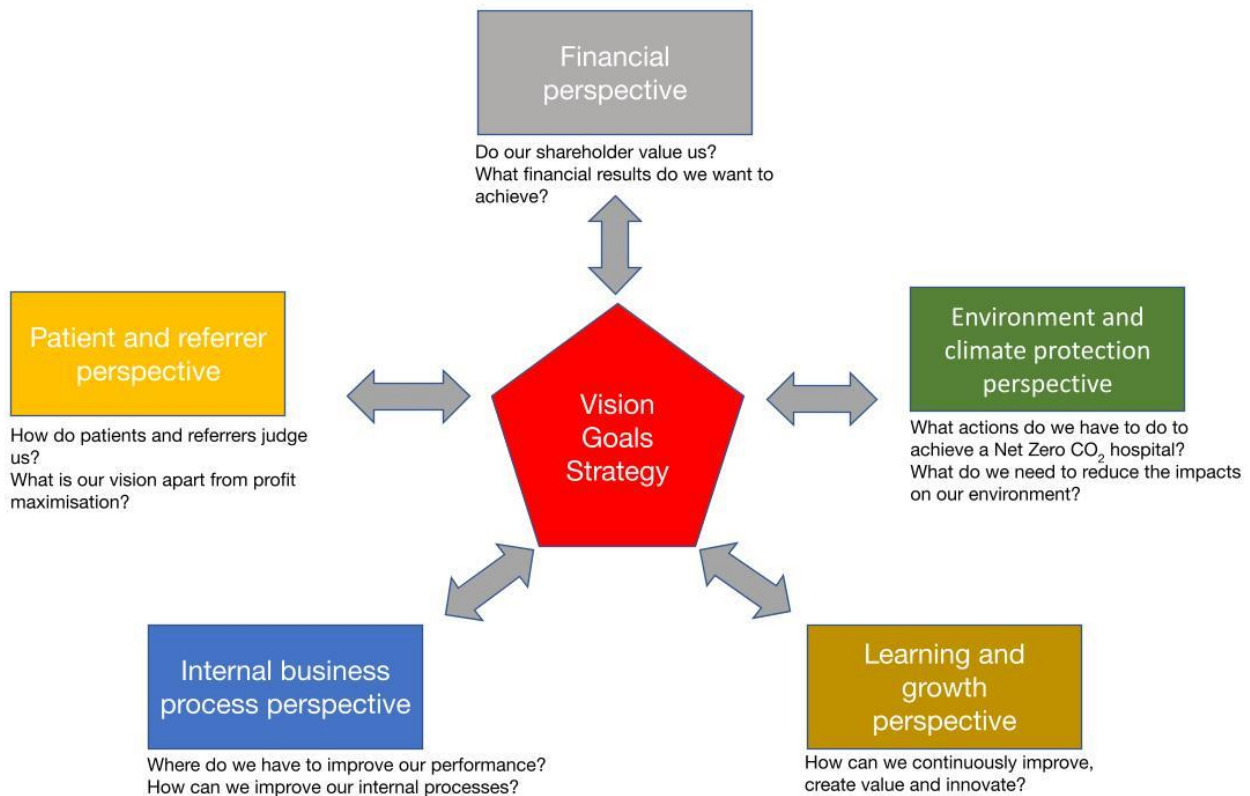


Figure 2: Sustainable Balance Score Card

Action areas

Since the climate crisis is a multifactorial problem and requires multiple solutions,

action areas as well as priorities must be set (Figure 3).



Figure 3. The different action pillars for a sustainable hospital (copyright E. Weimann).

Procurement (Scope 3)

In the hospital sector, procurement has the highest footprint¹⁷. The healthcare sector in the EU is a major buyer of high-carbon products and services. In addition, air, water,

and soil are polluted by exhaust gases, pollutants, and waste produced by the health care sector. Procurement currently only considers the cost factor - the cheapest supplier is contracted - without considering

the secondary effects and the total carbon footprint. Therefore, it becomes necessary to establish a circular approach (i.e., reuse and repair), to give preference to sustainable suppliers and to implement sustainable supply chains through a green procurement policy and practice.

Example KPIs:

- Number of sustainable supply chains
- Number of products that are reused or repaired.

Pharmaceutical and medical protection products (Scope 3)

The pharmaceutical industry is the second largest CO₂ emitter within the healthcare sector⁷. In hospitals themselves, this footprint ranks second, in ambulatory services and private practices it even comes first. In addition to CO₂-intensive activities, there is also water and energy consumption and waste generation in this area. Due to its size, the EU healthcare system could have an impact on the pharmaceutical industry to produce sustainable and regional. There is also a need for improvement in the packaging of medicines and medical protective products for more sustainable and less packaging. Attention must be paid to a necessary medication prescription¹⁸, as well as ordering and storing of pharmaceuticals. There is a huge potential in hospitals to reduce storage of medicines and hence waste in hospitals by centralising it.

Example KPIs:

- Percentage of sustainable pharmaceutical companies used in the orders in relation to the total size

- Percentage reduction of discarded and expired medicines

Energy and buildings (Scope 1 and 2)

Hospitals and medical processes have a high energy consumption. The combustion of petrol, gas, coal, and diesel produces large amounts of CO₂, methane, and nitrogen dioxide. Added to this is the energy loss due to old buildings and inadequate insulation. Due to the long-term investment backlog, the need for renovation and improved insulation as well as sustainable energy sources of German hospitals is considerable. The self-sufficiency of energy resources and generation through photovoltaics and block power plants is becoming increasingly important, also to reduce the dependency on foreign energy sources and fossil fuels. Although coal-fired power plants in Germany and the EU cause around 18,200 premature deaths each year with resulting healthcare costs of €42.8 billion^{19,20}. It is particularly problematic that 7 of the 10 most climate-damaging coal-fired power plants in Europe are operated in Germany, which in turn cause significant illness and premature deaths for the population².

KPIs:

- Percentage of energy purchased from renewable forms of energy
- Percentage reduction in energy consumption

Transportation (Scope 1)

The mostly fossil fuel-powered transport of patients and staff pollutes the environment, which is why a transition to climate-friendly

alternatives is necessary. In the climate balance of a hospital, the transport of patients, staff, emergency vehicles and helicopters accounts for around 10% of the CO₂ balance and must be calculated. The transition to less transport and e-powered vehicles is obligatory. Due to their emissions, diesel vehicles in cities reduce the lifespan of pedestrians by 12 minutes per mile driven¹⁹. Work related transportation as well as training and conferences attendance need to be transformed to climate friendly alternatives.

KPIs:

- Number of e-vehicles in the hospital fleet
- Number of trips to the hospital avoided through e-consultation

Nutrition (Scope 3)

In Europe agriculture causes 15% of pollutant emissions in the entire chain from cultivation to processing. Food waste is a significant part of this as it wastes all resources from start to finish, i.e., less could be produced if less is wasted. In Europe, 100 million tonnes of food end up in the trash every year²¹. This makes food waste the third largest emitter. Reducing food waste, offering local and seasonal food and reducing meat consumption to a maximum of 300-600 g per week/person²² contributes significantly to climate as well as health protection. Consequently, a new sustainable diet - the Planetary Health Diet was proposed to enable to feed the world's population, reduce emissions drastically and provide a healthier diet for all²³. This lowers the amount of greenhouse gases. In addition, reduced meat consumptions causes less lung

diseases, cardiovascular disease, and cancer²⁴. Reducing the use of antibiotics in hospital food, i.e., meat, fish, poultry, and eggs, reduces antibiotic resistance and leads to fewer deaths²⁵. Hospitals play an important leadership role in the transformational mandate.

KPIs:

- Number of vegan and vegetarian dishes in relation to the total number of hospital meals
- Percentage reduction in food waste per year/kg

Waste (Scope 1 and 3)

The healthcare sector generates multiple wastes such as paper, plastic, metals, electronics, chemicals, and pharmaceuticals. Much of this waste ends up in landfills or is incinerated, which is harmful to the environment and health. Other waste is problematic waste (e.g., laboratory waste) and must be disposed of separately to minimize negative impacts on the environment and people. More efficient waste management through recycling, composting of food waste, reduction of toxic waste and reduced plastic consumption can be controlled by appropriate legislation (e.g., waste cycle). 75-90% of the waste in hospitals and medical practices is comparable to normal household waste and could be avoided. The aim of the "zero waste" approach, supported by Healthcare without Harm (HCWH) is that little or no waste is produced and that objects are reused and repaired. Microplastics (diameter less than 5 mm) can contain particles that act as endocrine disruptors and are increasingly

classified as a health concern²⁶. Microplastics are now found in foods such as sea salt, fish, dust, and our blood^{27,28,29}. HCWH takes a plastic-free healthcare approach. A European project “Towards plastic free health care” is currently under way (www.hcwh.org).

KPIs:

- Number of waste and plastic audits per year
- Percentage reduction in waste per year

Water

The availability of drinking water is being reduced worldwide by increasing periods of drought and heat, as well as by agriculture³⁰. In Germany, the eastern federal states frequently suffer from water shortages and periods of drought with artificial fresh water supply during summer. During the European heat crisis in 2022, the lack of water in Europe became blatantly clear, as well as the implications for health care. In the healthcare sector and in hospitals, a lot of water is used for cleaning, washing, flushing pipes, nutrition and medical therapies such as dialysis. The consistent reduction of water consumption and the regular use of grey water saves energy and counteracts water shortages.

KPIs:

- Percentage reduction in water consumption per year
- Percentage of grey water use

Chemicals (Scope 3)

The reduction and substitution of harmful chemicals is promoted. An example is the international ban on mercury and CFCs. In the

2016 Kigali Agreement, states agreed to reduce HFCs.

In addition, anaesthetic gases such as nitrous oxide, sevoflurane, isoflurane, and desflurane cause extremely high CO₂ emissions. One hour of general anaesthesia with the climate-damaging desflurane corresponds to a travel distance of 375-750 km by a fossil fuelled car³¹. Desflurane is 1600 times more harmful than CO₂³¹. Education, recycling of gases, switching to intravenous anaesthesia are some of the measures that decrease environmental harm. There are now devices that are already in use which inhibit and capture the release of anaesthetic gases into the air and atmosphere. Some clinics are already using them.

4.3% of UK greenhouse gas emissions are caused by asthma inhalers³⁰. For this reason, initiatives are underway in the UK and other countries to switch aerosol therapy from metered dose aerosols to dry inhalants in a climate-friendly manner and to include the CO₂ footprint in the prescription¹⁷. The switch would reduce climate change impacts and ozone depletion from inhalers in the UK by up to 92%³⁰.

KPIs:

- Percentage switch from inhalation anaesthesia to intravenous anaesthesia
- Percentage conversion of dosing aerosols to dry inhalers

Sustainable buildings and biodiverse gardens

The negative eco-balance of building materials such as cement-concrete and the

high CO₂ footprint of the construction industry is increasingly coming into focus. Hence, hospital renovations and new constructions must reduce their impact on the environment as well as on the climate. There are certified sustainable architectural offices (e.g., DGNB) that take these aspects into account when building or converting. Existing building structures should be re-used, plastic and concrete should be avoided as far as possible and renewable raw materials should be preferred and prioritised. The fossil fuels used by construction vehicles and tools urgently needs to be converted and reduced, as does the increased energy demand caused by construction. Fossil fuels and wood (wood chips, pellets) should be avoided as energy sources in hospitals due to the small particle pollution (PM 2,5) they cause. Hospital gardens should also be laid out in a way to enhance biodiversity and greenery in order to increase biodiversity, mental health for patients and staff by creating green areas as well as shade in summer¹¹.

KPIs

- Percentage of renovations instead of new construction
- Percentage of renewable building materials instead of concrete
- Percentage increase in trees and biodiversity in hospital gardens

Climate education and curricula

Even basic facts about climate change are not known to large parts of the population - up to the upper management levels. Likewise, the connection between climate and health has so far not been fully conveyed to health care

professions and is still missing in most training and university curricula. It is therefore necessary to communicate these facts in courses such as lectures and educational program to achieve a broad understanding of climate-conscious measures among colleagues and non-medical staff to upskill people. Other interest groups include patients, parents and relatives, e.g., in climate consultation and on ward rounds, where climate consultations can be performed in relation to illness and wellbeing. Climate education should be an important building block in a sustainable hospital concept¹⁶.

KPIs:

- Number of training courses on sustainability and climate change offered to staff per year
- Number of climate training courses for management per year

Climate leadership

The healthcare sector should take a leadership role in becoming sustainable and carbon neutral¹⁷. Besides, governance approaches are equally important. A research paper compares the differences between the UK and Germany and makes recommendations accordingly³².

In addition, universities, organisations, pension funds and insurance companies in the healthcare sector should no longer invest in fossil fuels ("divestment"). Pharmaceutical companies should switch to renewable energies. The use of planes and fossil fuelled cars should only be used in exceptional cases¹⁷. In Europe we are dealing with a clear oversupply in medical diagnostics and

treatment procedures that do not contribute to the well-being and health of the population. Each of these procedures carries a cost, energy, waste and CO₂ burden that often causes further procedures. A lean management approach could be carried out to reduce costs and CO₂ emissions^{14,33}.

KPIs:

- Number of national and international sustainability certificates
- Percentage of achieved sustainability goals based on the dashboard per year

Summary and outlook:

The latest report from the Intergovernmental Panel on Climate Change (IPCC), released on February 28, 2022, issued CODE RED for our planetary survival as humanity¹³. In the related press conference, UN Secretary-General Antonio Guterres said: "This report of the Intergovernmental Panel on Climate Change is a litany of broken climate promises. It is a file of shame, cataloguing the empty pledges that put us firmly on track towards an

unliveable world. We are on a fast track to climate disaster. Major cities under water. Unprecedented heatwaves. Terrifying storms. Widespread water shortages. The extinction of a million species of plants and animals. This is not fiction or exaggeration. It is what science tells us will result from our current energy policies. Today's IPCC report is an atlas of human suffering and a damning indictment of failed climate policy as well as political leadership."

As also highlighted in COP27 (Conference of the Parties of the UN) in Sharm el-Sheik we cannot wait for our governments to adopt climate policies that are commensurate with the impacts. We as health professionals, scientist and citizens must act from the bottom up¹⁸. We have the tools and opportunities to do this and achieve societal change that is urgently needed. It is in our hands to pass over a habitable planet to the next generation. This time frame and window of opportunity backed up by the Lancet Report 2022 is short and rapidly closing¹.

Corresponding author:

Prof Edda Weimann, MD, MPH
Technical University of Munich
Faculty of Medicine, Children Campus
Schwabing, 80804 Munich

University of Cape Town, School of IT,
Cape Town, South Africa

Email: edda.weimann@uct.ac.za

Website: www.eddaweimann.com

Funding

None

Disclosure Statement

None

Conflict of Interest

None

Author Contributions

None

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