

Curriculum Vitae of Christian Mueller

1) Name: First: **Christian** Middle: **Eugen** Last: **Mueller**
Date of Birth: April 24, 1968
Family: Married, two children (15 and 13 years)
Nationality: Swiss + German
Academic Status: Professor, Chefarzt
Position: Director, Cardiovascular Research Institute Basel (CRIB)
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2+3) Education, Training, and Academic Career

1995 MD, Faculty of Medicine, University Munich
1993-1996 Thesis
1995-1999 Herz-Zentrum Bad Krozingen, Germany
1995-1996 Postdoctoral Research Fellowship in Intravascular Ultrasound (Prof. J. McB. Hodgson, Case Western University, Cleveland, USA)
1999 - University Hospital Basel, Department of Internal Medicine / Department of Intensive Care / Department of Anesthesia / Department of Cardiology
2002 Board Certification in **Internal Medicine**, FMH
2003 Board Certification in **Intensive Care Medicine**, FMH
2003 Board Certification in **Cardiology**, FMH
2003 Habilitation and Venia docendi, Faculty of Medicine, University Basel
2004 Professorship Swiss National Science Foundation
2005 Fellow of the European Society of Cardiology
2007 Associate professor, Faculty of Medicine, University Basel
2011 - Full Professor of Cardiology, Faculty of Medicine, University Basel

4) Institutional Tasks

- Training and supervision of graduate and postgraduate students in clinical research, Internal medicine and cardiology,
- Support and supervision of several cardiovascular research groups
- Conduct of high-quality clinical research with immediate impact on patient care
- Obtaining competitive funding for the CRIB and for own research
- Inpatient services cardiology department & treatment standards cardiology
- Leitung Universitäres Herzzentrum & CRIB, Personalkommission Kardiologie
- Participation in different committees of the Medical Faculty

5) Previous support of the Swiss National Science Foundation

2001-03: BASEL study; 2004-10: Integration of B-type natriuretic peptide into clinical practice; 2011-15: APACE; 2012-16: BASEL IX; 2017-19: BASEL-PMI; APACE Validation; 2017-20: BASEL IX Validation; 2018-20: Swiss-PMI.

6) Supervision of junior researchers (since 2001, current titles are listed, names provided for those with at least one first authorship in a peer-reviewed publication)

Prof. Dr. M. Christ, Prof. Dr. D. Staub, Prof. Dr. T. Reichlin, Prof. Dr. T. Breidthardt, Prof. Dr. W. Hochholzer, Prof. Dr. R. Twerenbold, Dr. M. Reiter, Dr. K. Wildi, K. Laule, Dr. C. Zellweger, Dr. N. Schaub, PD Dr. P. Haaf, Dr. J. Meissner, Dr. M. Noveanu, Dr. M. Potocki, Dr. B. Moehring, Dr. A. Irfan, Dr. M. Rubini Gimenez, Dr. R. Hoeller, Dr. M. Müller, Dr. B. Meller, Dr. S. Zürcher, Dr. C. Balmelli, Dr. G. Lee, Dr. S. Mann Sou, Dr. Y. Tanglay, Dr. Z. Moreno Weidmann, Dr. F. Stallone, Dr. P. Hillinger, Dr. J. Boeddinghaus, Dr. T. Nestelberger, Dr. Ch. Puelacher, Dr. P. Badertscher, Dr. D. Flores, Dr. H. Singeisen, Dr. J. du Faye de Lavallaz, U. Honegger, Dr. Z. Sabti, Dr. N. Kozhuharov, Dr. D. Mueller, Dr. L. Sazgary, Dr. P. Lopez Ayala, Dr. D. Wussler, Dr. J. Walter, Dr. L. Koechlin, Dr. T. Zimmermann, Dr. B. Hafner, Dr. A. Prepoudis, Dr. A. Yufera Sanchez, Dr. S. Frey, Dr. H. Schoepfer, Dr. M. Belkin, Dr. T. Coscia, Dr. R. Meister, Dr. M. Liffert, Dr. M. Amrein, Dr. K. Arslani, Dr. R. Giger, Dr. V. Troester, Dr. P. Ratmann, Dr. A. Prepoudis, Dr. V. Widmer, Dr. E. Michou, Dr. J. Gueckel, Dr. P. Muzyk, Dr. T. Resa, Dr. D. Mueller, plus **110** MD doctoral students (with monography dissertation) and **55** master students.

The following Professors have done their **sabbatical** in my research team:

Prof. A. Mebazaa, Prof. C. Meune, Prof. D. Gualandro, Prof. O. Miro

7) Teaching activities

- Research tutorials and direct supervision and training for doctoral students (13 per year) and

- master students (7 per year) + bedside teaching to young physicians
- Courses/lectures in cardiology (about 50 per year)

8) Panels, Boards, expert activities

2004 - Swiss Society of Cardiology (SGK), Intensive Care Medicine, Internal Medicine
2010-2016 European Society of Cardiology (ESC), Acute Cardiovascular Care

Association (ACVC), Board member

2016 - 2020 ESC, Heart Failure Association, Board member

2008 - ESC, Biomarker Study group, member, since 2021 chair

2014 - ESC-ACVC, Acute Heart Failure Study group, founder & chair, now member

2016 - ESC, HFA, Committee for Diagnosis, chair, now member

2014 - 2020 ESC, HFA, Committee for Acute Heart Failure, member

2013 - 2015 ESC, Section Coordinator for 2015 NSTACS-Guideline

2010 - ESC, Reviewer for several Clinical Practice Guidelines

2008 - GREAT-network: Co-founder & current President

2018 - 2020 ESC, Section Coordinator for 2020 NSTACS-Guideline

2018 - 2022 ESC, Clinical Practice Guideline Committee

Associate Editor: European Heart Journal 2016-2020, EHJ -ACVC 2020 - , SMW 2020 -

Editorial Board: Journal of the American College of Cardiology, Heart, LO Innere Medizin

Reviewer for: New England Journal of Medicine, Lancet, Nature, JAMA, Circulation, JACC, EHJ, Nature Reviews Cardiol, Am J RCCM, JAMA Internal Medicine, BMJ,...SNF, DHF, NHF, ... Overall, >150 scientific reviews per year, Advisory boards of several biomedical companies

Organisation of Scientific Meetings

Scientific committee ESC-ACVC 2014 Geneva, plus several other meetings; Chair scientific committee International GREAT Meeting 2010-2021;

Awards: Investigator Award Intensive Care 2001+2003+2005, Swiss Society of Internal Medicine 2004, Viollier 2004, Swiss Heart Foundation 2005, Theodor Naegeli Award 2007, Magda Heras Award of the ESC-ACCA 2014;

Academic Rankings: 2017 Top 3, University of Zürich, Chair of cardiology

Clarivate Web of Science 2019: Among Top 1% most cited researchers in clinical medicine worldwide, among Top 3 in Switzerland

Scientific achievements:

1) Scientific publications: Author and co-author of **>820** written **peer-review publications** including **492 original publications (274** as first or last author)

2) Knowledge transfer, specific contribution: Oral contributions to international conferences:

Regular speaker at international conferences with 15-20 oral presentation per year, last 5 years: Annual meetings of the ESC 2016-2021, Heart Failure Association 2016-2021, ESC ACVC 2016-2021, GREAT 2016-2021, Integrated Management of Cardiovascular Disease 2016-2021

Outreach activities aimed at clinicians and medical personnel

Scientific committee MedArt Basel 2012-2021; chair Cardio Update Basel 2012-2021, webinars of "ESC TV", ESC-ACVC webinars, Co-Founder of ESC ACVC Biomarker Talks, CRIB-Today videos featuring young researchers and their latest publications; Educational and Implementation efforts related to Clinical Practice Guidelines of the ESC, including first authorship and co-authorships of specific educational Q&A documents accompanying the 2015 and 2020 ESC NSTEMI-ACS guidelines, as well as co-author and reviewer activities of several other Clinical Practice Guidelines of the ESC. Leading interdisciplinary educational and implementation efforts of the SGK, the Swiss Society of Laboratory Medicine, and the diagnostic industry in Switzerland related to standardization and harmonization of the reporting of cardiac troponin concentrations to avoid medical harm to patients by erroneous interpretation of results. Editorials in medical newspapers targeting primary care physicians with topics related to major scientific advances and their possible clinical implications. Chair and Member of several study groups within the ESC coordinating and producing outreach activities (educational position papers, webinars, symposia) related to specific cardiac disorders. Faculty Postgraduate Course for Heart Failure (Zürich & London).

Summary: most important research achievements

I would like to divide my research achievements in **three parts**: first **content**, second **training, motivation, and mentoring of physician scientists**, and third **strategy**.

Content: my research aims to contribute to **improving the early diagnosis and management** of cardiovascular disorders, particularly the most common causes of death and disability in Switzerland: **acute myocardial infarction (AMI)** and **acute heart failure (AHF)**. I consider seven novel insights of most importance, as all of them had major impact on clinical practice in Switzerland and worldwide, and four of them already resulted in class I recommendations in current clinical practice guidelines of the European Society of Cardiology and widespread clinical implementation.

First, systemic plasma concentrations of **B-type natriuretic peptide (BNP)** and **NT-proBNP** are quantitative markers of hemodynamic cardiac stress and heart failure and **provide incremental value in the early diagnosis and management of patients with suspected AHF** (e.g. Mueller C, et al. N Engl J Med 2004, Mueller C, et al. EJHF 2020). Second, **high-sensitivity cardiac troponin T and I** concentrations as quantitative markers of cardiomyocyte injury provide substantially higher diagnostic accuracy for the early diagnosis of AMI as compared to conventional cardiac troponin assays, or other markers of cardiomyocyte injury (e.g. Reichlin T, et al. N Engl J Med 2009; Kaier T, et al. Circulation 2019). Third, using **short-term absolute changes in high-sensitivity cardiac troponin T and I** concentrations provides incremental value to their concentrations at presentation to the emergency department and allows an earlier diagnosis of AMI (e.g. Reichlin T, et al. Circulation 2011, Haaf P, et al. Circulation 2012; Neumann J, et al. N Engl J Med 2019). Fourth, **assay-specific early triage algorithms** combining 1h (or 2h) absolute changes in high-sensitivity cardiac troponin T and I concentrations with their concentrations at presentation to the emergency department achieve very high safety and high efficacy both for the early rule-out as well as the early rule-in of AMI. (e.g. Reichlin T, et al. Arch Intern Med 2012, and Boeddinghaus J, et al. Eur Heart J 2018, Boeddinghaus J, et al. Clin Chem 2019, Collet JP, et al. Eur Heart J 2021, Ayala Lopez P, et al. Circulation 2021). Fifth, given the central role that high-sensitivity cardiac troponin T and I concentrations have obtained in the early diagnosis of AMI, **non-cardiac sources for cardiac troponin T and I** are of major concern. Acute injury and systemic release of skeletal muscle proteins as in acute rhabdomyolysis does not seem to be a non-cardiac cause. In contrast, chronic skeletal muscle disorders, particularly non-inflammatory myopathy and myositis seem to be non-cardiac causes of systemic cardiac troponin T concentrations. Sixth, **early intensive and sustained vasodilation** using universally available and inexpensive drugs (e.g. nitrates), is relatively well tolerated, but **does not improve outcomes in patients with AHF** who are stable enough to not require ICU-admission initially (Breidhardt T, et al. JIM 2012, Kozhuharov N, et al. JAMA 2019). Seventh, **perioperative myocardial infarction/ injury (PMI) following non-cardiac surgery is a silent and neglected killer** (Puelacher C, et al. Circulation 2018). Due to intense anaesthesia and analgesia, it is asymptomatic in 85% of patients and therefore missed in the absence of systematic screening. PMI occurs in about 15% of patients at high CV risk and is associated with a very high risk of death within 30-days (about 10%). Strategies for improved phenotyping

and possible therapy are evolving (Puelacher C, et al. JACC 2020; Gualandro DM, et al. Clin Research Cardiol 2021).

Training, motivation, and mentoring of physician scientists: Likely my most important and for sure the most rewarding achievement is that with my training, motivation, and mentoring I have been able to contribute to the academic career of several outstanding physician scientists. More than 60 physician scientists have achieved at least one first authorship on a peer-reviewed publication under my supervision. Many of these physician scientists currently pursue an academic career and continue to combine clinical work with research. Six of them have already been appointed professors themselves.

Strategy: With the help of the Swiss National Science Foundation, I was able to continuously and sustainably follow a specific strategy when increasing the size and the professionalism of my research team. This strategy has over the years found support and recognition by many stake-holders at the University Hospital Basel and the University of Basel. It also has allowed me to co-found and lead the **Cardiovascular Research Institute Basel (CRIB)**. A) **Focus on young physicians and be very inclusive.** Attracting young physicians already shortly after graduation into clinical research is mandatory for the identification, training, motivation, and mentoring of the most talented and most capable physician scientists. This allows safe-guarding the academic leaders of the future to our University, but also builds a positive and appreciating attitude towards research in those physicians, who after their research period with me (e.g. during their medical thesis, n=110) will never again have an active role as researchers. This is of key importance as the update and implementation of research findings by practicing physicians is a prerequisite for all research findings to ultimate benefit patients. B) **Focus on outcome research with immediate impact on patient care.** In order achieve and maintain acceptance and support for clinical research at times of continuously increasing economic pressure in University Hospitals, the immediate benefit of research findings for patient care must be highlighted widely within the hospital, but also to the public. C) Focus on **interdisciplinary diagnostic research** (precision medicine). This area of clinical medicine has major unmet clinical needs, but also provides unique opportunities for academic-lead research. Thanks to intensive and successful networking over decades, I have been able to create, maintain, and expand an international interdisciplinary consortium, which allows me to conduct cutting-edge research protocols such as e.g. Heart & Muscle.