Globally Harmonized Specifications: Current State and Future Opportunities
January 10-12, 2023
Basel, Switzerland

Current regulatory guidance includes general principles regarding the product specification but provides limited detail about important aspects of its determination. Regional differences include:

- which attributes are included;
- what test is used to measure an attribute;
- what data to use when determining acceptance criteria, and
- how to control attributes which are not related to safety or efficacy.

In this workshop we will discuss the basis of a biologicals control strategy including patient-centric specifications, importance of CQAs, use of prior knowledge, potential flexibilities created as the world managed Covid-19, and how the control strategy relates to manufacturing consistency and assurance that the product will meet product quality expectations. There will be breakout sessions to maximize participant contributions and an extended panel session with global regulators, compendial officials, and industry representatives to discuss the challenges of regional legal and process differences. To maximize impact, this workshop is scheduled to precede an ICH Q 6AB review and revision evaluation, currently scheduled to occur in late 2023. Participants will gain understanding of the challenges and impediments to harmonization of specifications and help provide feedback and ideas to the global Biologicals community and guidance organizations through the Proceedings publication.

Scientific / Organizing Committee

Shawn **NOVICK**	Co-Chair, IABS
Mats **WELIN**	Co-Chair, Swedish Medical Products Agency
Svein Rune **ANDERSEN**	Norwegian Medicines Agency
Karoline **BECHTHOLD-PETERS**	Novartis
Cristiana **CAMPA**	GSK Vaccines
Andrew **CHANG**	Novo Nordisk
Markus **GOESE**	Roche
Melody **GOSSAGE**	Eli Lilly and Company
Emily **JING**	FDA - CDER
Mourad **MELLAL**	Catalent
Laurent **MALLET**	EDQM
Barbra **RELLAHAN**	Amgen
Tim **SCHOFIELD**	IABS
Karin **SEWERIN**	BioPharmaLinx AB
Dean **SMITH**	Health Canada
Tami **WU**	Seagen

DAY 1 – TUESDAY, JANUARY 10, 2023

8:00 AM	Registration & Welcome Coffee
9:00 AM	Welcome
9:15 AM	Keynote Meeting the Challenge of Patient-Centric Specifications **Philip KRAUSE,** Chair: WHO Covid Vaccines Research Expert Group
10:00 AM	Summary from the 2019 2nd IABS Global Harmonization of Specifications Workshop **Tim SCHOFIELD**, IABS, U.S.A.
10:30	Break

Session 1 – Framework

The opening sessions 1A and 1B of this workshop will set the framework for globally harmonized specification discussions, offering perspectives from both Regulators and Industry. Concrete propositions will be shared to define scientifically sound specifications and promote harmonization over multiple regions. The presentations will include patient- centric approaches, strategies for specifications setting in accelerated scenarios, as well as learnings from the COVID-19 pandemic. In addition, current regulatory context for specification setting will be discussed, including recent proposals to revise ICH Q6, and the EMA Toolbox guidance on scientific elements and regulatory tools to support quality data packages for unmet medical needs. Principles and proposals will be applicable to other modalities however mostly based on experience in biotherapeutics and vaccines.

Chairpersons: Emily JING, FDA – CDER; Andrew CHANG, Novo Nordisk
NOTE: All titles represent the focus of each talk. The final titles have not yet been confirmed.

10:55-11:00	Session 1 intro
11:00 AM	Industry Challenges and Successes in Harmonizing Specifications Over Multiple Regulatory Regions **Carol KRANTZ,** Seagen, U.S.A.
11:30 AM	ICH Quality Discussion Group Vision for ICH Q6 Moderation **Roger NOSAL,** Rapporteur for ICH Quality Discussion Group
12:00 PM	Clinical interface with CMC and Specifications – Patient Centric Specifications **Elena FRAGAPANE; Marianna AGGRAVI**, GSK Vaccines, Italy
12:30 PM	Lunch
1:15 PM	Poster Session

Session 2 – Framework (continued)

Chairpersons: Cristiana CAMPA, GSK Vaccines; Tim Schofield, IABS, U.S.A.

1:50 PM	**Session 2 Introduction**
2:00 PM	What Was Gained / Lost with the Harmonization of Specifications for the Covid 19 Vaccine **Dean SMITH,** Health Canada

2:30 PM	Towards Globally Accepted Specifications of Pharmaceutical Products: A Summary of the Current State **Ximeng DOW,** MSD, U.S.A.
3:00 PM	Specifications - Too Wide or Too Narrow? The Age-old Debate Between Regulators and Industry, and How We Can Move Forward **Sean BARRY,** Health Products Regulatory Authority (HPRA), Ireland
3:30 PM	Break
4:00 PM	Panel Discussion moderated by **Andrew CHANG** and **Cristiana CAMPA**: All Speakers from Sessions 1 and 2
5:15 PM	End Day 1
5:30 PM	Reception : Posters

DAY 2 – WEDNESDAY, JANUARY 11, 2023

9:00 AM	Welcome to Day 2

Session 3 – Regulatory Panel Session

The ICH has approved a review and update to ICH Q6 A and B to align this 1999 guideline with concepts introduced in ICH Q8-14, such as risk evaluations, patient centric considerations, and a focus on QTPP and CQAs. Sessions 1 and 2 of this meeting have delved into the current landscape of setting specifications and provided ideas and tools which may be incorporated into a revised ICH Q6. This regulatory panel discussion will provide an opportunity to hear from regulators from different jurisdictions on their perspectives of ICH Q6 revision, how the proposals discussed in sessions 1 and 2 of this workshop can be integrated into their regional approval matrix, and what actions, either within their respective agencies, between agencies, and/or between their agency and dossier sponsors, would facilitate harmonization of a product specification between multiple regions.

9:15 AM	Regulatory Panel Session **Chairperson**: **Marion GRUBER**, IAVI CEMED (**Danay MORA PASCUAL**); China CDE (Invited); FDA-CBER (**Robin LEVIS);** Health Canada (**Jayda SIGGERS**); MHRA (**Leonard BOTH);** PEI (**Isabelle BEKEREDJIAN-DING**); MHLW/PMDA (**Akiko ISHII-WATABE**); TITCK (**F. Handan ÖZTUNCA**)
10:45 AM	Break

Session 4 – Case Studies

While, ideally ICH Q6 would define expectations for development of globally harmonized specifications, the goal of a globally harmonize specification has not been realized for most biotechnology products due to conflicting aspects to be taken into account in establishing acceptance limits. This session provides examples where inconsistency between expectations of major regulatory regions has resulted in regional specification variants, and the impact having regional differences has had, including shorter expiry periods and rejection of batches that met quality expectations in other regions. While still a challenging area, there have been successes in developing a globally harmonized specification and the session will also provide examples of such successes and how they were achieved.

Chairpersons: Laurent MALLET, EDQM**; Tammy WU,** Seagen

11:10	Session 4 Introduction
11:15 AM	A Journey Toward Biologics Product Specification Harmonization: Look Back & Look Ahead **Yingmei YANG** (MSD)

11:45 AM	Switching From In vivo to In vitro Potency: 2 Case Studies for Setting New Potency Acceptance Criteria **Patrice RIOU**, Sanofi
12:15 PM	Patient-Centric Drug Specifications: Monoclonal Antibody Therapeutic Case Studies **Andrew Lennard,** Amgen
12:45 PM	Lunch
2:00 PM	Harmonizing Specifications for Drug-device Combinations / Devices **Manfred MAEDER,** Novartis
2:30 PM	Panel Discussion moderated by **Laurent MALLET** and **Tami WU** Panelists: **Yingmei YANG,** MSD**; Patrice RIOU**, Sanofi; **Andrew LENNARD**, Amgen; **Manfred MAEDER,** Novartis**; Jayda SIGGERS** (Health Canada)
3:15 PM	Break
3:45 PM	**Breakout Sessions for Vaccines and BioTherapeutics:** **Discuss Global and Modality Specific Challenges** **Chairpersons:** **Shawn NOVICK,** IABS **Karoline BECHTHOLD-PETERS,** Novartis **Dean SMITH,** Health Canada **Mourad MELLAL,** Catalent Two breakout sessions to address global harmonization challenges and solutions. Breakout groups to address questions in common with all modalities and modality specific challenges
5:15 PM	**End Day 2**

DAY 3 – THURSDAY, JANUARY 12, 2023

Breakout Session ReCap // Session 5: Industry - Regulatory Extended Panel Discussion

8:30 AM	Welcome
8:45 AM	Breakout Session recap / Panel
9:45 AM	Break
10:15 AM	**Industry / Regulatory Extended Panel Discussion** **Moderator**: **Marion GRUBER,** IAVI **Panelists:** **Koen BRUSSELMANS,** EMA; **Kelley BURRIDGE,** FDA, OBP; **Cristiana CAMPA,** GSK Vaccines; **Andrew CHANG,** Novo Nordisk; **Emmanuelle CHARTON,** EDQM; **Philip KRAUSE**, WHO; **Juliana KRETSINGER,** Lilly; **Dean SMITH,** Health Canada
11:30 AM	Meeting review / summary
12:00 PM	Invitation to next meeting
12:15 PM	End of meeting

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Citations/reading list

Strategies for Setting Patient-Centric Commercial Specifications for Biotherapeutic products," *J. Pharmaceutical Sciences* **110** (2021) 771-784 https://pubmed.ncbi.nlm.nih.gov/33035537

Expectations for Phase-Appropriate Drug Substance and Drug Product Specifications for Early-Stage Protein Therapeutics. Kretsinger J, et al J Pharm Sci. 2019 Apr;108(4):1442-1452. doi: 10.1016/j.xphs.2018.11.042. Epub 2018 Dec 6.PMID: 30528942

Assessing Product Quality Attributes Utilizing Appropriateness Criteria and Efficacy and Safety Inputs to Establish Clinically-Relevant Specifications. John Ayres, CASSS CMC Strategy Forum, January 2019

ICH Quality Discussion Group's (QDG's) Proposal for a New Quality Topic on ICH Q6A and Q6B

Toward a Single Global Control Strategy: Industry Study . J. Beierle, N. Cauchon, et al. Pharmaceutical Engineering, January/February 2022

International pharmaceutical federation FIP: Expedited regulatory pathways in LMIC – Webinar: https://www.youtube.com/watch?v=3YEWQQIDdW4

Development of Patient-Focused Commercial Specifications. Mire-Sluis, et al. BioProcess International 18(9) September 2020

Quality Assessment of Products in expedited programs. CDER MAPP 5015.13

EMA/ Industry Specifications workshop 2011

Summary report Report on the expert workshop on setting specifications for biotech products (europa.eu)

Presentations Expert workshop on setting specifications for biotechnological products | European Medicines Agency (europa.eu)

EMA/Industry workshop on use of prior knowledge 2017

Summary report Meeting Report - Workshop on Prior Knowledge - final (europa.eu)

Presentations Joint Biologics Working Party / Quality Working Party workshop with stakeholders in relation to prior knowledge and its use in regulatory applications | European Medicines Agency (europa.eu)

EMA/FDA/Industry Accelerated access (PRIME/ breakthrough therapy) workshop 2018

Summary report report-workshop-stakeholders-support-quality-development-early-access-approaches-ie-prime_en.pdf (europa.eu)

Presentations and video recording Stakeholder workshop on support to quality development in early access approaches, such as PRIME and Breakthrough Therapies | European Medicines Agency (europa.eu)

Schofield, T.L., Robbins, D & Miró-Quesada, G., Chapter on "Critical Quality Attributes, Specifications, and Control Strategy". *Quality by Design for Biopharmaceutical Drug Product Development*, Edited by F. Jameel, S. Hershenson, M.A. Khan, and S. Martin-Moe for Springer, Heidelburg, Germany Published 2015.

Egan, W. & Schofield, T.L., Chapter on "Establishing a Shelf-life and Setting Lot-release Specifications". *Analysis of Vaccines: Principles and Strategies*., Edited by Brian K. Nunnally, Vincent Turela, and Robert Sitrin for Springer, Heidelburg, Germany, Published 2014.

Schofield, T.L. Apostol, I., Koeller, G., Powers, S., Stawicki, M., Wolfe, R., (2008) A Rational Approach for Setting and Maintaining Specifications for Biological and Biotechnology–Derived Products. *BioPharm International*, Parts I-III, June-August 2008.

World Health Organisation Guidelines on Stability Evaluation of Vaccines, October 2006.

World Health Organisation Guidelines on the stability evaluation of vaccines for use in a controlled temperature chain, January 2015.

Schofield, T.L. & Krause, P., Special issue of *Biologicals* on Stability Evaluation of Vaccines, Volume 36(6), November 2009.

John G. Davies1, Di Gao2, Yoen Joo Kim1, Richard Harris2, Patricia W. Cash1, Timothy L. Schofield3, Roujian Zhang2, and Qiang Qin2, ICH Q5C Stability Testing of Biotechnological/Biological Products. *ICH Quality Guidelines: An Implementation Guide, First Edition*. Edited by Andrew Teasdale, David Elder, and Raymond W. Nims. Published 2018 by John Wiley & Sons, Inc.

EBE Concept Paper: Considerations in Setting Specifications, March 28, 2013

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Phil Krause, MD

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Dr. Krause is a physician with board certification in internal medicine and infectious diseases and a researcher with over 100 publications on topics spanning clinical evaluation of vaccines, viral pathogenesis and immunology, and biological product development. He has contributed broadly to public health decision-making both within the US and internationally, including major contributions towards making COVID vaccines available. Dr. Krause has published and lectured extensively on the topic of biological product stability and specifications. As part of a 30-year career during which he gained internationally recognized expertise in all phases of product development, he served as deputy director of FDA's Office of Vaccines Research and Review, where he led assessments of biological products for evaluation and licensure and helped to oversee the development and evaluation of all vaccines authorized and licensed in the US over the past 10 years. He is currently an independent consultant, providing strategic and regulatory advice related to biological product development to non-governmental organizations (NGOs) and to companies that are developing biological products. He graduated from Yale Medical School (MD), Florida State University (MBA) and the University of Illinois (BS and MS in Computer Science)

Meeting the challenge of patient-centric specifications

Phil Krause

Specifications are essential for assuring that marketed products will perform comparably to that which was tested in the clinic. Where information to support a link between specifications and clinical outcomes is sparse, there is a tendency to choose specifications based on product consistency. Thus, the key challenge is to obtain enough data to support this link to clinical outcomes, both for safety and efficacy specifications. Creative use of all sources of information related to CMC, the quality system, along with strategically designed clinical studies and post-licensure studies can facilitate creation and maintenance of this link.

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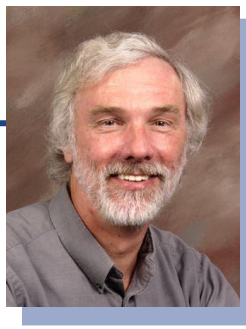

Timothy Schofield (Tim)

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Tim Schofield is the Owner & Consultant at CMC Sciences, LLC. Prior to starting his own consulting business Tim worked at:

- GSK as a Senior Advisor in Global Vaccines Technical R&D, and previously a Director in US Regulatory Affairs,
- MedImmune as a Senior Fellow in Analytical Biotechnology,
- Arlenda as US Managing Director and Head of Nonclinical Statistics, and
- Merck Research Laboratories heading the Nonclinical Statistics department.

Tim received a Bachelor of Science degree in Mathematics from Lafayette College, and a Master of Arts degree in Statistics and Operations Research in 1976 from the Wharton School of the University of Pennsylvania. Tim is a member of the USP Statistics Expert Committee and has participated in industry initiatives related to Quality by Design, analytical method development and validation, stability and specifications. He is the Chairman of the IABS Communications Committee, and on the editorial board and is the business lead for the journal *Biologicals*.

Summary of 1919 IABS Specifications Workshop

The 2nd IABS Workshop on *Setting Specifications for Biological Products: A Pathway to Harmonization* was held December 2-3, 2019, at the USP Headquarters in Rockville, MD. This followed onto a successful 1st workshop which concentrated on specifications for biosimilars. The 2019 workshop brought industry participants and regulators from vaccines, biotherapeutics, and cell & gene therapies together to share and discuss practices and principles related to establishing specifications. This talk will summarize the technical, regulatory, and business considerations that were identified as key to harmonization. This includes an agreed upon basis for acceptance criteria, a regulatory pathway to harmonization, and some technical and business consequences from lack of harmonization. This will provide the audience with a foundation for discussion throughout the 2023 workshop.

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September 14-15, 2022
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Dr. Emily Jing is currently the Associate Director of Scientific Coordination in Office of Biotechnology Products at CDER/FDA. She oversees cross-cutting office activities that include regulatory knowledge management, labeling assessments, and workload management. She joined the FDA in the Office of Vaccine Research and Review (OVRR) at CBER in 2009. She participated in a broad WHO collaboration to select influenza vaccine strains and served as the primary product quality assessor for the first cell-based influenza vaccine Biologics License Application (BLA). Emily joined Office of Biotechnology products at CDER/FDA in 2014 and has overseen the product quality reviews for numerous investigational New Drug Applications (INDs), Biological Product License Applications (BLAs), biosimilars, and deemed biologics. She has participated multiple Pre-licensure Inspections as CMC expert. During the COVID-19 pandemic, Emily led the CMC assessment of IND and EUA submissions for COVID 19, and supported development of other COVID 19 therapeutics as well as potency assay guidance for such products.

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Dr. Andrew Chang is a multifaceted quality and CMC leader with 25 years well-rounded medical product regulatory and industry experiences. He is a member board director for CASSS-Sharing Science Solutions and the chair for PDA Biopharmaceutical Advisory Board (BioAB). At his current capacity as a Vice President, Quality and Regulatory Compliance, Novo Nordisk Quality, Novo Nordisk, Inc. he is responsible for external affairs, providing strategic advice and solutions for quality and regulatory related issues, and expert support to inspections. Since 2013, Andrew has represented Novo Nordisk at several work groups in industry trade organizations, e.g., PhRMA and BIO to advocate patient and industry's interests by developing position papers and participating liaison meetings with the regulatory authorities. He is the co-chair for BIO Cell and Gene Therapy Task Force, a member of PhRMA and BIO's International Regulatory Policy Work Groups and representing PhRMA as an expert and topic leader to ICH Q12 Expert Work Group and implementation work group, respectively for developing and implanting guideline on Pharmaceutical Products Lifecycle Management. Prior to industry, Andrew had served more than 11 years in US FDA most recently as an Associate Director for Policy and Regulation, Acting Deputy Director, Lab Chief and Senior Regulatory Scientist in the Division of Hematology, Center for Biologics Evaluation and Research (CBER). While at FDA, Andrew was known as a leading FDA and CBER spokesperson and has presented the FDA perspective at many national and international meetings. He also served as the FDA deputy topic leader for developing ICH Q5E guideline and the FDA observer for European and US Pharmacopeia's Expert Groups on Blood and Blood Derived Products. During his tenure in the FDA, Andrew received numerus high level FDA awards for his exceptional and outstanding performance on regulatory review and management, GMP inspection, and policy.

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Carol Krantz is Executive Director and Head of Regulatory Affairs, CMC at Seagen Inc. She has been with Seagen since March 2017, and in that time has built a dedicated Regulatory CMC group while supporting global expansion of Seagen and approval of PADCEV, TUKYSA and TIVDAK. Previously, Carol was on the Regulatory CMC leadership team at Amgen, overseeing a portfolio of development and commercial stage products including ENBREL, VECTIBIX and IMLYGIC. Prior to that, Carol was at Immunex in Regulatory, Process Development, Project Management and Supply Chain groups. She also has served as an independent Regulatory CMC consultant for BioNow Consulting and was the Regulatory CMC lead at Sierra Oncology. Carol received a B.A. in Biology from the University of Pennsylvania, her Ph.D. in Immunology/Microbiology from the University of Colorado, Health Sciences Center and did her post-doctoral studies at the Fred Hutchinson Cancer Research Center. She is a member of DIA, RAPS, PDA and an Associate Director for CASSS.

Industry Challenges and Successes in Harmonizing Specifications Over Multiple Regulatory Regions

Carol Krantz, Seagen Inc.

Specifications for biotherapeutic products are a critical component of the product's overall control strategy and a regulatory requirement. The common goal is to ensure consistent product safety and efficacy while also maintaining product supply to patients. Product quality attributes (PQAs), product knowledge and an understanding of attribute criticality captured throughout product development inform specification setting. The International Council of Harmonization (ICH) Quality Guidelines provide a framework for standardization of specification setting by participating member regions. The specifications for some attributes are guided by regional compendia and regulatory guidance. Linking the potential patient impact to PQAs through an assessment of potency, PK, immunogenicity and safety is foundational to identifying the criticality of PQAs. Setting acceptance criteria globally has presented challenges due to differing regional requirements, such as testing performed, datasets, and flexibility for changes. A recognition that some of these differences may delay timely patient access and product lifecycle improvements, while not improving drug safety or performance, has energized industry and regulator collaboration on removing such barriers. This talk explores some of the industry challenges and successes in harmonizing specifications over multiple regions.

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Roger Nosal is currently Principal Consultant with *Roger Nosal PharmaCMC Regulatory Consultants* and serves as Head of Regulatory Strategy for *NGT BioPharma Consultants*. Prior to September 2022 he was Vice President & Head of Global Chemistry, Manufacturing & Controls at Pfizer where he was accountable for development, preparation & prosecution of global regulatory CMC applications for new commercial products & investigational applications (small & large molecules, combination products, vaccines including the COVID-19 mRNA vaccines and gene/cell therapies).

Roger is currently Rapporteur for the ICH QDG and has served as PhRMA representative to several ICH EWG & IWGs. Roger was instrumental in development & implementation of Quality by Design & was awarded the ***Pharmaceutical Discovery, Development and Manufacturing Forum Award*** from **AIChE** for outstanding contributions to advancing QbD in 2013. He has been an invited speaker/expert panelist (>230) on a myriad of CMC development/regulatory topics including technical innovations (continuous manufacturing, PAT & adaptive controls). Roger's 41 years of experience at G. D. Searle, Monsanto, Pharmacia & Pfizer, includes 28 years in regulatory CMC & 13 as a Medicinal & Process Chemist and author of 24 patents.

Regulator Vision for ICH Q6 Review and Revision

Roger Nosal, Rapporteur for ICH Quality Discussion Group

In accordance with its 2019 remit, the ICH Quality Discussion Group developed an effective approach and a list of priorities to modernize ICH Quality guidelines and enable innovation. The ICH Management Committee endorsed recommendations to update and consolidate stability guidelines and modernize guidance for setting specifications for drug products and drug substances in accordance with science and risk-based concepts described in ICH Q8 - Q12.

These topic revisions are intended to clarify regulatory expectations, address contemporary approaches to assess quality risks and introduce criteria to accommodate and enable innovative technology. In particular, revisions of ICH Q6A & 6B are expected to reinforce the holistic and integrated approach for setting specification criteria in accordance with a drug product control strategy, consider clinical relevance, platform experience and prior knowledge and accommodate continuous evolution through the product's lifecycle.

Recent surveys and anecdotal examples suggest that extent of ICH implementation remains a significant challenge. It is imperative that ICH guideline modernization, especially with respect to setting specifications, is accompanied by reliable regulatory application and alignment to ensure consistent global harmonization.

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Elena holds a degree in Medicine and Surgery from the University of Siena and a PhD in Preventive Medicine. She joined pharma industry in 2001 and vaccine industry in 2004.
Throughout her career she has gained extensive experience in clinical research for a variety of viral and bacterial projects and since 2015 in vaccine development where she has been driving the strategy and execution of several Neisseria meningitidis vaccine projects promoting project-related innovation by leading cross functional integrated teams embracing all required components of the business such as Regulatory, Preclinical, Clinical Development, Technical Development, Manufacturing, etc
As vaccine development leader she has played a key role in the development of Menveo Liquid.

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Marianna graduated in Chemistry and holds a PhD in Physical Chemistry from the University of Siena, Italy; she joined Novartis Vaccines in 2010 as a Formulation Scientist in Technical Development taking on roles of increasing responsibility. In March 2015 she joined GSK and since October 2017 she works as Technical Development Leader being accountable for defining, leading and transversally coordinating the technical development from early phase I up to commercial launch of the investigational vaccine products.

Clinical interface with CMC and specifications – Patient Centric Specifications

Elena Fragapane, GSK Vaccines

INTRODUCTION—Specification setting for biologicals is often based on manufacturing experience and does not necessarily reflect the true safety and efficacy expectations for the product. This presentation will show some perspectives on how to address this issue.

CHALLENGES—Early Clinical Quality Attribute (CQA) identification and acceptance criteria are key, but are challenged by limited platform/prior knowledge and reliance on nonclinical models is not always obvious for vaccines. If an attribute is expected to show varying values due to instability or challenges to control (manufacturing/ testing), clinical justification should be considered.

APPROACH BEING TAKEN—Patient centric specifications approach is a multidisciplinary effort. Key drivers are Quality by Design approach (observation of CQAs changing over time, analytical procedure selection and development to monitor CQAs in stability, acceptance criteria clinically justified) and prior product knowledge (formulation, analytical testing, manufacturing process, toxicology profile, clinical design). Continuous interactions between CMC and Clinical function is key to the design and trial execution in order to support justification of specifications. Early engagement with Health Authorities on CMC and Clinical approach is critical. An illustrative example will be provided to show how all these elements have been implemented for a vaccine (Menveo liquid).

CONCLUSIONS—Acceptance criteria for product related critical quality attributes based on patient centric approach ensure: strong specifications; delivery to the patient of future commercial lots equally potent as those tested in clinical trial at the desired shelf life; robust rationale for product comparability; higher flexibility in commercial supply by assuring a reduced lot rejection rate.

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Cristiana Campa, PhD, is currently a Technical R&D Advisor and Fellow at GSK Vaccines, with more than 20 years' experience in Chemistry, Manufacturing and Control (CMC). In her current role, she is very active in CMC advocacy, with contributions to cross- company discussion on innovative technologies and development strategies, fostering dialogue with Regulatory Agencies. In this context, she is involved in trade association working groups, mostly related to CMC acceleration and ICH topics.

After her PhD and Post-Doc, she worked at Bracco Imaging SpA (2002-2006), first as a senior researcher and then as head of Trieste research laboratory. She joined Novartis Vaccines in 2006, first as analytical senior manager and then as Head of Analytical Development, Italy. Since 2012, Cristiana has worked on QbD principles cross-site implementation. After acquisition of Novartis Vaccines by GSK in 2015, she has been the Head of QbD Integration and, until June 2018, the Head of Science and Development Practices in Global Technical R&D, covering QbD, Knowledge Management and Development roadmaps.

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Immunologist and A/Manager of a Vaccine Quality Division and Advisor in the Center for Vaccines, Clinical Trials and Biostatistics at Health Canada. Dr. Smith has over 20-years of experience in regulatory science in support of innovation in vaccine development, manufacturing and quality control. He has a wide range of biologics-based scientific and regulatory experience from his Senior Scientific Evaluator and management roles in Centre Divisions including Viral and Bacterial Vaccines, as well Hemostatic Agents and Blood Substitutes.

Representing Health Canada, Dr. Smith contributes to WHO's vaccine and vaccine stability guidance development initiatives and supports WHO's recent efforts with COVID-19 and Monkeypox vaccine responses. He is Health Canada's representative to the European Directorate of Quality of Medicines (EDQM), Group 15 (Vaccines and Sera) in support of the European Pharmacopeia, the Regulatory Advisory Committee to the WHO/Collation for Emergency Preparedness and Innovation (CEPI) and served on the Science and Ethics Advisory Committee for VAC2VAC under the European Vaccines Initiative.

Dr. Smith's Ph.D. in Immunology is from the University of Alberta, Canada, where his research dealt with vaccine antigen discovery, autoimmunity and viral vector-based gene therapy. He was a Research Associate at the National Research Council's Institute of Biological Science, Vaccine Design Group in Ottawa prior to joining Health Canada.

Globally Harmonized Specifications: Current State and Future Opportunities
January 10 – 11 – 12, 2023
Kunstmuseum, Basel, Switzerland

Title: What Was Gained / Lost with the Harmonization of Specifications with COVID-19 Vaccines

Presenter: Dean Smith (Ph.D.), Health Canada

Abstract

Introduction: The presentation will focus on the benefits of patient-centric specifications and industry driven multi-agency interactions to enhance global harmonization.

Challenges: Historic challenges to harmonization of specifications are discussed, where many (but not all) received a push in a useful direction during the pandemic, and more is required.

Approaches Taken / Being Taken: Early phase 1/2 dose ranging studies with well-characterized immunogenicity (e.g., binding/neutralizing antibody, cell-mediated immunity, Th_1 versus Th_2 immune-profiling etc.) are underutilized by the vaccine industry to support robust, defendable patient-centric harmonized specifications. The advantages of this approach are highlighted with an example of phase 2 dose ranging studies conducted by GSK for their shingles vaccine Shingrix, which was subsequently authorized by FDA, EMA and Heath Canada. Such patient-centric specifications "should be" less prone to tightening under regulatory pressure, since they are clinically justified and not based on process capability.

Additional examples of this approach include the COVID-19 mRNA vaccines from Pfizer-BioNTech and Moderna. While the stability indicating vaccine critical quality attributes (CQAs) involved are fundamentally different, the principles involved are the same, as are many of clinical assays and requirements for a well-characterized product immunogenicity profile. While GSK had years to plan and optimized their commercial scale up, during the pandemic this was not an option for any manufacturer. Yet the strategy was implemented by some manufacturers and benefited both scale up and authorizations, but was not ideally communicated or understood by agencies given the pressures of the pandemic.

Conclusion: The use of early Phase 1 / 2 dose ranging immunogenicity clinical studies, when combined with phase 3 efficacy data, and industry driven multi-agency collaborative regulatory engagement, provides a path forward for global harmonized patient-centric specifications that better serve both patients' needs / access to products and innovation.

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Ximeng received her bachelor's degree in chemistry from Wuhan University in China in 2012 and obtained her PhD in Analytical Chemistry from Purdue University in 2016. She joined MSD Animal Health at Rahway shortly after graduation and worked as analytical project lead for highly complex, small molecule programs. In Jan 2022, Ximeng transferred to Biologics AR&D and started her journey in the world of large molecules. During her time at Biologics AR&D, Ximeng has supported analytical development activities for multiple highly complex monoclonal antibody and fusion protein programs. She is also currently serving as the specification development facilitator focusing on the template and workflow strategy for biologics specifications.

Towards Globally Accepted Specifications of Pharmaceutical Products: A Summary of the Current State

Ximeng Dow, Vanessa Auquier, Dilbir Bindra, Kaitie Grinias, Alex Fialho, Peter Tattersall, Julie Cheng, Barbara Rellahan, Brian Regler, Julie Adamson, Paul Walsh

Background

Product specifications are critical components of the overall product quality control strategy for any new biotherapeutic during clinical development and commercial licensure. Setting the appropriate specifications that are harmonized for the global market can be challenging even with the current active effort to align global quality guidelines. To further understand the current state, a survey was performed through the Global Specification Harmonization Working Group within IQ (International Consortium for Innovation and Quality in Pharmaceutical Development).

Methods

A survey was performed among 11 biopharmaceutical companies ranging from small biotech to large pharma. In the survey, general product information was first collected and subsequent questions were tailored based on previous response. The survey was designed to collect market specific health authority feedback and allowing participants to further dive into the rationale, outcome, and impact of each specification question.

Results

The survey received responses for 43 unique molecules (15 biologics). Overall, Purity-Charge Variant, Purity-Size Variant, Potency, Glycans, and Bacterial Endotoxin are among the attributes that received most regulatory questions. Most questions originated from difference of opinions on whether a test is required (29%) or from agencies' request to tighten the acceptance criteria based on batch history, stability data, and clinical exposure (40%). In most cases (except for Glycan related questions), tighter acceptance criteria were implemented globally or for specific markets as the outcome. In addition, BET, as a compendial test, also received a high amount of questions, reflecting inconsistency between ICH and local agency expectation.

Conclusions

The results indicate that the acceptance of same product specification has been inconsistent across different markets, even for tests with compendial chapters. Based on shared experience across multiple companies, this inconsistency often led to significant impact on supply chain management and product availability to patient.

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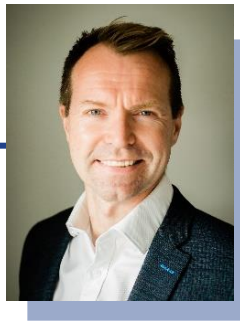

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Seán Barry is a senior pharmaceutical assessor at HPRA, the Irish national agency, where he is head of the biological products assessment team. Seán has extensive experience in the assessment of clinical trials, new product applications, and lifecycle management of biological products, including monoclonal antibodies, recombinant proteins, vaccines, and ATMPs. Seán is the current vice-chair of the EMA Biologics Working Party (BWP), a member of the EMA Biosimilars Working Party, and a member of the Heads of Medicines Agency Biosimilars Working Group. Seán has contributed to the development of several EMA guidelines and is a member of the ICMRA working group developing international collaborative assessment pilots for CMC post-approval changes.

Specifications - too wide or too narrow? The age-old debate between regulators and industry, and how we can move forward.

Sean Barry, Health Products Regulatory Authority, Ireland

For products in early access programmes, accelerated approval pathways, or for orphan products used to treat rare diseases, there are often a limited number of batches available at the time of licencing. This creates a challenge for both industry and regulators in defining appropriate specification acceptance criteria. In such scenarios, establishing acceptance criteria based on manufacturing capability or clinical qualification would likely result in limits which are too narrow and lead to unnecessary batch rejection during the lifecycle of the product. In contrast, acceptance criteria derived solely from statistical analysis of a limited number of batches could result in specification limits which are too broad and cannot be justified clinically. Therefore new approaches are needed to define the most appropriate specifications. For example, justifications could be based on additional sources of information such as in vitro data, or prior knowledge either specific to a development platform or from related development programs. Ultimately it must be justified that the final registered limits will result in a safe and efficacious product. However there is no single agreed approach on how such justifications should be presented in regulatory filings, and a global approach is needed to harmonise regulatory expectations.

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Marion Gruber is the Vice President for Public Health and Regulatory Science at the International AIDS Vaccine Initiative (IAVI). In this role she is leading the development and execution of IAVI's public health and regulatory science efforts to advance IAVI's product development programs in order to facilitate global access to preventive and therapeutic products critical for global public health. Prior to joining IAVI, from 1992 to 2021, she served as public health official at the US FDA where she held various research, regulatory and policy positions most recently serving as the Director, Office of Vaccines Research and Review (OVRR) (2011 to 2021). In that role she was responsible for the review, planning, development and administration of OVRR's national and international programs directing a multi-disciplinary team engaged in vaccine and related biological product development, regulation and licensure. Other key responsibilities included collaboration with top level agency officials, industry representatives, foreign government representatives, other national regulatory authorities as well as global organizations such as WHO and CEPI to advice on regulatory policy, programs and licensure strategies for preventive vaccines to facilitate access of these products critical to global public health.

Marion Gruber received her PhD degree in Microbiology from the Christian Albrecht University, Kiel, Germany and a MS in Biology from the University of Ulm, Germany .

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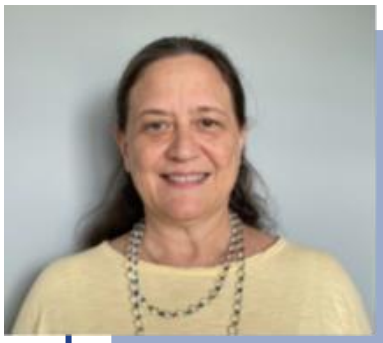

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Dr. Robin Levis has worked at the US Food and Drug Administration since 1995. She is currently the Deputy Director of the Division of Viral Products in the Office of Vaccines Research and Review at CBER/FDA; a position she has held since 2006. Prior to this position, she served as the Regulatory Coordinator for the Division of Viral Products (2002-2006) and served as a Senior Staff Fellow in the Laboratory of Vector Borne Viral Diseases (1995-2002). Her initial research work at the FDA related to flavivirus replication and the role of the NS1 protein. She then transitioned to be the lead CMC reviewer for licensed rabies virus vaccine products and rabies vaccine and related products under development. Her work with rabies virus vaccines was related to the development of an alternative, in vitro potency assay as an alternative to the currently licensed NIH potency test.

In addition to her work in the Office of Vaccines at CBER, she serves as the CBER representative to ICCVAM, as an observer to EDQM Group 15 for vaccines, and serves on several vaccine working groups for the Coalition for Pandemic Preparedness Innovations. Her role on these International working groups is to provide regulatory support to CMC development and product quality.

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Jayda Siggers is a Senior Scientific Evaluator in the Biotherapeutics Quality Divisions (BQD) of the Centre for Blood, Blood Products and Biotherapeutics (CBBB), at the Biologics and Radiopharmaceutical Drugs Directorate (BRDD) of Health Canada. Jayda leads the quality review of pre and post market drug submissions for biologic therapies. She earned a Master of Science in toxicology from the University of Saskatchewan (Canada), a PhD in immunology from the University of Copenhagen (Denmark) and completed a post-doctoral fellowship in the department of Biochemistry, Microbiology, and Immunology at the University of Ottawa (Canada). Jayda recently represented Health Canada on the WHO drafting group for WHO *Guidelines for the production and quality control of monoclonal antibodies and related products intended for medicinal use*. She is currently Co-Chair of a draft Parenteral Drug Association (PDA) standard titled *Analytical Method Qualification / Validation for Biologics* and leads an internal working group for ICH Q2 / Q14. In her spare time, you will find Jayda chasing her family down mountains and up hills on one of her bikes.

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Dr Leonard Both is Team Leader in the Biologicals & Biotechnology Unit of the UK's national medicines authority, the MHRA. He is coordinating a team of experienced MHRA assessors. He is also the MHRA's Licensing lead for the ACCESS Consortium which comprises five international medicines regulators.

Leonard has assessed MAAs as an MHRA Senior Quality Assessor and provided regulatory advice on many aspects of biological products including vaccines and monoclonal antibodies.

During the pandemic, Leonard has worked in the MHRA's Covid-19 'Vaccine Acceleration and Licensing' workstream and is the lead for several Covid-19 vaccines and therapeutics.

Leonard is a board member of the Control Programme Board (CPB) at the National Institute of Biological Standards and Controls (NIBSC). During this tenure at MHRA he has served on WHO, EDQM, and EMA expert groups.

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Isabelle Bekeredjian-Ding is Head of the Microbiology Division and acting director of the Center for Pandemic Vaccines and Therapeutics (ZEPAI) at Paul-Ehrlich-Institut. She is Associate Professor at the University of Bonn and holds a clinical specialization in Medical Microbiology, Virology and Epidemiology of Infection, and a research track record in immunology. Prof. Bekeredjian-Ding received Medical School training at the Universities of Heidelberg, Padova (Italy) and Mt. Sinai, New York, and clinical training in Munich and Heidelberg. Before joining PEI she was deputy director of the Institute of Medical Microbiology, Immunology and Parasitology in Bonn. Prof. Bekeredjian-Ding served as Chair of the Scientific Committee of the IMI2 JU program.

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September 14-15, 2022
Kunstmuseum, Basel, Switzerland

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Kunstmuseum, Basel, Switzerland

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Recently deigned as Deputy Director of the Cuban NRA, CECMED, has over 20-years of experience in regulatory science. Her experience from her Senior Scientific Evaluator and management roles, was related with Vaccines regulatory oversight and their development, manufacturing and quality controls assessments, especially for those locally manufactured vaccine, included those for covid-19.
She has received different post graduate courses and training on biological production, control and regulatory issues at national and international level.
As CECMED representative, she has participated in different informal consultations and workshops organized by the Pan-American Health Organization (PAHO) and WHO related with guidelines on vaccines manufacturing and quality controls and other regulatory issues. She also is member and coordinator of the National Containment Authority of Poliovirus.
Mrs. Mora Pascual has also participated as PAHO team member in the pre-evaluation of National Regulatory Authorities and have actively participated in capacity building for other NRA's in the Americas Region. She also coordinates and participate in technical bilateral interaction with other NRA out of the Region.

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Dr. Laurent MALLET obtained his Master Degree of Science in Biochemistry from Claude Bernard Lyon University in France. He completed his PhD work in Virology and Molecular Biology under the co-direction of Pr Michèle Aymard (National Reference Center for Enterovirus, Lyon, France) and Dr. François Pelloquin (Sanofi Pasteur, formerly Pasteur Mérieux Connaught). He obtained his PhD in 1996. After several positions within Sanofi Pasteur in France and in Canada, he has been the Global Head of Analytical Sciences within Sanofi Pasteur up to November 2019.

Since December 2019, he has joined the European Directorate for the Quality of Medicines & HealthCare (EDQM), Council of Europe, in Strasbourg, France. At EDQM, he is currently the Biological Standardisation, OMCL Network & HealthCare (DBO) Department Head.

He has been a member of several expert committees such as the EDQM Group 15 "Human vaccines and sera" at European Pharmacopoeia. In addition, he has been involved in several WHO working groups on vaccines including the WHO Study Group on Cell Substrates.

In his new role, he represents EDQM in the WHO Expert Committee on Biological Standardization (ECBS), in the NC3Rs working group to review animal testing requirements in WHO biologicals guidelines, in the COVAX Regulatory Advisory Group, in the IABS Board and in the ICH Q5 Expert Working Group.

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Tami Wu is the Director of Global QC Network, a core member of Specification Setting Committee at Seagen. She is responsible for establishing scientific strategies, global testing strategies, and standards to meet global regulatory requirements. She leads Analytical Method Lifecycle Management, and Reference Standard Lifecycle Management of Seagen products. She is interested in evaluating novel technology and implementing rapid testing in QC laboratory for a variety of products. Tami has more than 25 years of professional experience in biopharmaceutical field, her experience spans across early drug discovery target identification/validation, preclinical DMPK study, product development and Quality Control. In the past five years, she has mainly focused on developing analytical control strategy and specifications for Seagen products from first in human to post commercial.

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Yingmei (Mei) Yang joined Merck in 2021 and is working as analytical lead for biologics analytical commercialization strategy, and technical product council. She leads a biologics analytical working group, providing analytical oversight across QC nodes and biologics franchise. Prior to Merck, Yingmei worked in different technical and managerial roles at GSK , Sanofi and SSCI, all focused on QC release & stability testing operation, and program management, analytical method development including troubleshooting, validation and transfer from early phase to commercial projects.

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Athena Nagi joined Merck in 2013 and has worked on biologics manufacturing science and commercialization, analytics, global technical operations, and technical product leadership. She leads a Comparability Forum, driving alignment across biologics franchises. Prior to Merck, Athena worked in different technical and managerial roles at Oncobiologics, Amgenin Longmont, CO, Abbott Bioresearch Center, Medarex, and Alexion, all focused on protein characterization, development and commercialization.

Kathryn M. Campbell
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Kathryn Campbell has been with Merck for over 20 years starting as a biologist focused on cell based assays and expanding her skillset throughout her career. Kathryn has extensive experience as a technical analytical leader with the ability to translate regulatory guidance and product understanding into a robust analytical strategy to enable clinical studies and product licensure. Kathryn is a Franchise Analytical Technical Lead.

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A Journey Toward Biologics Product Specification Harmonization: Look Back & Look Ahead

Yingmei YANG (Presenter at MSD),

Athena Nagi (Co-author at MSD),

Kathryn Mae Campbell(Co-author at MSD)

Abstract

Introduction - Proper biologics commercial specification setting is an evolving endeavor across industry. At MSD, we always aim to test/release our biologicsproducts against set specifications to ensure product safety and efficacy.

Challenges - However, we are facing expedited product development cycle which complicates specification setting. There are also focus and pressure to tighten specs based on process experience and capability. Furthermore, clinical qualification of ranges maybe limited combined with unexpected (or unintended) changes such as rawmaterial changes during commercial manufacture.

Approaches Taken/Being Taken - In this presentation, we will present 2 case studiesfrom our commercial products (1 mAb and 1 vaccine) where we share our successes and failures in attempts for a balanced approach leveraging process experience, product knowledge, statistical modeling power, and clinical relevance.

Conclusion - Our goal is to have open, scientific dialogues with industry leaders and regulators while seeking insights/feedbacks in an informal setting.

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PhD in Virology and Cellular Biology
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Since Jan 2020, head of a group of analytical and regulatory experts in charge of driving the New Vaccine Global Analytical Strategy and ensuring Regulatory Compliance group.

Switching from in vivo to in vitro potency: 2 case studies for setting new potency acceptance criteria

Main author and speaker: Patrice Riou

Co-authors: Carole Bourot, Elisabeth Niogret, Benedicte Mouterde, Emmanuelle Coppens and Sebastien Gaudin

Sanofi rabies vaccine portfolio is constituted of 2 commercialized vaccines (IMOVAXRABIES and VERORAB™) and one new vaccine under development (VRVg) aimed at replacing both current commercialized vaccines worldwide in mid-term.

The current Rabies vaccine potency is the NIH *in vivo* test. This mouse intracranial challenge test is variable and time consuming. In the context of the VRVg vaccine development, Sanofi initiated the development and validation of a Rabies G protein ELISA to facilitate production process development and optimization and to replace the *in vivo* NIH potency test on the final product.

In this presentation are presented the 2 approaches used to support the introduction of Rabies G protein ELISA test as potency test on both the new VRVg rabies vaccine and the commercialized VERORAB™ rabies vaccine.

For both vaccines, the use of Rabies G protein ELISA as surrogate of potency on final product is supported by a significant data package demonstrating the suitability of the Rabies G protein ELISA, which includes: mAbs characterization, ICH validation package, capability to detect G protein alteration and higher discriminating power of the Rabies G protein ELISA for the detection of subpotent lots in comparison to the NIH test.

The Rabies G protein ELISA has been developed for VRVg process and product development. Rabies G protein ELISA supports drug substance process monitoring and is done in parallel with NIH test on clinical batches. The strategy is to submit in the VRVg CTD, G protein ELISA as potency assay with acceptance limits both for release and stability supported by clinical data. In a second step to define in-house action limits based on historical to follow manufacturing process consistency.

For the VERORAB™ Vaccine, the implementation of Rabies G protein ELISA on final product is associated with the definition of release and stability ELISA acceptance limits based on manufacturing process consistency calculated on G protein ELISA results from 279 VERORAB™ lots. In addition, the Rabies G protein ELISA has been implemented for drug product formulation and for drug substance monitoring.

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Andrew Lennard is in the Global Regulatory Affairs CMC team at Amgen and is based in the UK. Within CMC Regulatory Affairs, he is part of the External Engagement and Advocacy team with responsibilities in advancing approaches to accelerate CMC in product development. Andrew has over 15 years' experience in CMC Regulatory Affairs, with a special interest in control strategy and using prior knowledge, in which he has participated at the EMA workshops on Prior Knowledge, and on CMC acceleration in Breakthrough/PRIME. He is also an active member of EFPIA leading several initiatives relating to CMC acceleration, including 'Stability' for which Andrew is the EFPIA topic lead on the Expert Working Group for the ICH revision of the stability guidelines. Prior to Regulatory Affairs, Andrew was a Principal Scientist in drug discovery for large pharma and small biotech start-up companies and holds a PhD from the University of Cambridge (UK).

BioTherapeutic Case Studies
George Klein & Andrew Lennard, Amgen

Background/Challenges: Ideally, ICH guidelines would define expectations for development of globally harmonized specifications for pharmaceutical products. However, the goal of a globally harmonized specification has not been realized for most biotechnology products due to conflicting criteria in existing guidance and regulatory practice that are considered in establishing acceptance limits.

Approach Being Taken: This presentation will provide case studies where inconsistency between major regulatory regions in the acceptance of patient centric specifications has resulted in regional specification variants, and the impact having regional differences has had, including shorter shelf-life and rejection of batches that met quality expectations in other regions. While still a challenging area, there have been successes in developing a globally harmonized specification and the session will also provide examples of such successes and how they were achieved.

Conclusions: Revision to ICH Q6A/B to account for QbD development approaches would provide a harmonized framework for establishment of science and risk-based specifications.

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Manfred Mäder is VP Global Device & Packaging Development in TRD (*Technical Research and Development*) at Novartis.

Prior to this, he held the position Head of Global Compliance & Audit for Devices & Combination Products overseeing all Alcon, Pharma, and Sandoz sites producing this type of products and Global QA Head of Technical Research and Development at Novartis Pharma starting in February 2011.

Prior to this position he was Senior VP of Quality Management & Regulatory Affairs, at Ypsomed, a company producing Medical Devices and Combination Products starting in 2007. Previously, he was responsible for Quality Assurance Management at Sanofi-Aventis for the Frankfurt Injectables site. Before then, being based in Kansas City/ US, he had a global responsibility for Quality and Regulatory for one of the Aventis Blockbuster products. Prior to that, he held several positions in QA and QC.

By training he is pharmacist and holds a doctorate in pharmaceutical analytics and statistics by the University of Wuerzburg/ Germany.

Harmonizing Specifications for Drug-device Combinations / Devices

Manfred Maeder, Novartis

BACKGROUND—"Combination Products" or "Drug Device Combinations" are arriving at the global markets. Currently, with the significant increase of biologics and cell- and gene-therapy products, combination products have become mainstream for the pharmaceutical industry, as more than 50% of all pipeline products are of this class (Drug or Biologic combined with a Device)

CHALLENGES—being a fairly new class of products, there are multiple definitions of combination products or DrugDeviceCombinations across jurisdictions worldwide. In most cases there are no definitions at all within the regulation of countries. This becomes a very significant challenge for Medical Device or Pharma companies developing products for the global market.

RELEVANT GUIDANCE/ PROPOSED SOLUTION—harmonization of definitions and expectations – regulatory and GMP-wise – would be of utmost importance. First attempts have been made to work on overarching standards, like ASTM definitions for Combination Products.

CONCLUSIONS—there is quite some ways to go to establish harmonized approaches globally. It would be great to have more representatives of authorities at the table to discuss the next steps in order to align global expectations. First steps could be an alignment on GSPRs (Global Safety and Performance Requirements), EPRs (Essential Performance Requirements), HFE (Human Factors Engineering) and risk management for the device constituent parts and the final, marketed combination product.

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Biological Standardization

Globally Harmonized Specifications: Current State and Future Opportunities
January 10-12, 2023
Kunstmuseum, Basel, Switzerland

Shawn Novick

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Shawn Novick graduated from New York University and has been working in various positions in the Biotechnology industry for over 30 years, primarily focused on analytical development, characterization, and quality control. She has worked on several clinical and commercial products, including mAbs, ADCs, and other therapeutic proteins. Currently Shawn is a consultant with BioPhia Consulting and is Chair of the IABS Biotherapeutics Committee.

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Koen Brusselmans received a master degree in Bioengineering Sciences from the University of Leuven (Belgium) in 1996. Afterwards he started a PhD in medical sciences in the laboratory of Transgene Technology of Prof. Dr. Peter Carmeliet and Prof. Dr. Désiré Collen (University of Leuven), which focused on the role of hypoxia-inducible factors in the induction of angiogenesis during embryonic development and tumorigenesis.

After having obtained his PhD in 2001, he worked for 7 years as a post-doctoral fellow in the laboratory of Prof. Dr. Johan Swinnen and Prof. Dr. Guido Verhoeven (University of Leuven) on a research project studying the role of lipogenesis in cancer.

In 2008, he joined the group of 'Quality of vaccines and blood products' at Sciensano (the former Institute of Public Health, Brussels, Belgium), where he is currently working as senior quality assessor for biological medicines. He is involved in assessment of scientific advices and registration files of biological medicines (including vaccines, plasma-derived products and recombinant proteins), in collaboration with the Belgian Medicines Agency (FAMHP) and the European Medicines Agency (EMA). He also participates as expert in GMP inspections of manufacturers of biotech products and plasma-derived products.

Koen Brusselmans is Plasma Master File coordinator and alternate member for Belgium in the CHMP Biologics Working Party at the EMA.

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Kelley Burridge, PhD

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Dr. Kelley Burridge currently serves as a product quality team leader in the Office of Pharmaceutical Quality (OPQ) in the Center for Drug Evaluation and Research (CDER) at the US FDA. She leads a team of reviewers in the assessment of chemistry, manufacturing, and controls (CMC) information for pre- and post-market human therapeutic biologic drugs. Dr. Burridge is a member of the OPQ Emerging Technology Team and OBP Q12 working group.

Previous FDA positions include a chemistry reviewer in the Office of Life-cycle Drug Products (2014-2019) and lead reviewer of plastic and reconstructive surgery devices in the Center for Devices and Radiological Health (CDRH, 2010-2014). As a chemistry reviewer she assessed the quality of liquid-based drug products including topical semisolids, injectables, and peptides. Device review experience includes tissue adhesives, tissue markers, wound dressings, hemostatic agents, sutures, surgical meshes, and negative pressure wound therapies. Prior to joining the FDA, she obtained postdoctoral training experience and worked as an industrial process engineer. Dr. Burridge received a B.S. in Chemical Engineering from Cornell University and a Ph.D. in Biomedical Engineering from Boston University with special training in Biomolecular Pharmacology.

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Emmanuelle CHARTON holds a PhD in biochemistry from the *Institut National Agronomique de Paris-Grignon*. Since 2006 she is Head of Division B in the European Pharmacopoeia department at the European Directorate for the Quality of Medicines and HealthCare (EDQM). The Scientific Secretariat for the elaboration of European Pharmacopoeia texts related to **biologicals and microbiology chapters** fall under the responsibility of her division. Her work experience includes QA/QC in a facility for the production of parenteral products and preparation to GMP inspections in a global pharmaceutical company, research and development in biochemistry in a global company selling food and chemicals. She has over 27 years' experience at the EDQM, including as scientific administrator to the groups of experts in the fields of biology and microbiology and as a supervisor to the corresponding work in the EDQM laboratory.

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Dr. Juliana Kretsinger achieved her Ph.D. in Organic Chemistry at the University of Delaware, where she was a Chemistry and Biology Interface Scholar. She joined the Biopharmaceutical Research and Development department at Eli Lilly and Company in 2004. In her tenure at Lilly, Juliana has led the analytical development for multiple bioproduct projects, with an expanding role to provide broad technical oversight for CMC development. She has supported projects in all phases of development, including synthetic peptides, monoclonal antibodies, and fusion proteins.