Report on the research review according to the Standard Evaluation Protocol 2015-2021
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Preface

It is our great pleasure to present the results of the SEP-evaluation on the Diagnostics & Advice (D&A) Theme of Erasmus MC. On behalf of the committee, I would like to express our very positive impression of the sense of purpose, enthusiasm and willingness of the researchers to cooperate with the members of the evaluation committee. The discussions with senior representatives as well as with younger colleagues during our two-day virtual interaction have been constructive and very open, which gave us the possibility to get a deep insight into the work and plans of the theme and to provide a sound report.

In summary, we are impressed by the high quality of research within the theme. Based on the departments’ thorough self-evaluation reports, the committee members prepared this assessment report, which describes strengths and weaknesses of the complex clinical tasks and the translational and multidisciplinary research activities. We hope that the suggestions can be helpful to further optimize the combined efforts of all.

Finally, on behalf of the other committee members, I would like to thank the heads of department, the dean of Erasmus MC, the employees of the departments and in particular the excellent administrative support during the online visit.

Prof. Manfred Dietel
Committee chair, Theme Diagnostics & Advice
June 2021
I. Introduction

Assignment to the committee
The Executive Board of Erasmus University Medical Centre Rotterdam (Erasmus MC) initiated an assessment of the scientific research done at the institute during the period 2013-2018. This quality assessment was part of the regular six-year evaluation cycle of the research of Dutch universities and University Medical Centres (UMCs).

The primary units of research at Erasmus MC are its 48 departments, which are (financially) responsible for carrying out the institute wide research strategy. Each department is led by a head of department appointed by the Executive Board of Erasmus MC. The head of department is fully responsible for the core functions (research, education, and if applicable patient care) as well as for the atmosphere and working environment (diversity & research integrity) of the department. Historically, departments are distributed over nine overarching themes, including research, clinic and education:

1. Biomedical Sciences (6 departments)
2. Brain & Senses (6 departments)
3. Daniel den Hoed (3 departments)
4. Diagnostics & Advice (7 departments)
5. Dijkzigt (8 departments)
6. Health Sciences (4 departments)
7. Sophia (7 departments)
8. SPIN (3 departments)
9. Thorax (3 departments)

For the purposes of this assessment, the Executive Board of Erasmus MC appointed a separate committee of international experts for each of its nine themes, consisting of international experts in the fields of the departments involved. Each committee conducted its own assessment, amounting to a total of nine assessments. The respective digital site visits to Erasmus MC took place in the period September 2020 to April 2021.

Originally, the members of each committee were intended to meet with one another and with institute and department representatives during onsite meetings. These were scheduled to take place in the spring of 2020. However, due to the global Covid-19 pandemic, the site visits to Rotterdam were first postponed and later replaced by remote meetings via a digital platform. In order to partially compensate for the loss of interpersonal interaction during physical meetings, it was decided to schedule additional online meetings between committee members and use interactive working methods.

This report describes the findings, conclusions and recommendations of the committee that assessed the seven departments that are part of Theme Diagnostics & Advice. Each department is assessed in the context of research programmes and institutes worldwide in similar disciplines and on similar topics and without a formal quantitative comparison.

The committee did not attempt to draw a direct comparison between departments within the theme and Erasmus MC. Nonetheless, it has taken note of the results and strategies of the departments in Theme Diagnostics & Advice and discussed them in relation to each other. The committee emphasizes that the assessments made by the nine committees are not comparable; each committee assessed the theme in question on its own merits.

Assessment criteria
The assessment of Theme Diagnostics & Advice was guided by the Standard Evaluation Protocol 2015-2021 of the Royal Netherlands Academy of Arts and Sciences (KNAW), the Dutch Research Council (NWO) and the Dutch Association of Universities (VSNU). The three assessment criteria specified in the Standard Evaluation Protocol – (1) research quality, (2) relevance to society and (3) viability – formed the starting point for the assessment. In its report, the committee both qualitatively and quantitatively assesses these criteria, scoring them on a four-point scale, ranging from world leading/excellent (1) to unsatisfactory (4). The meaning of the scores is explained in appendix 4. In accordance with the Standard Evaluation Protocol, the assessment also includes a qualitative appraisal of Erasmus MC's PhD programme, and its research integrity and diversity policies and practices.

In addition to the Standard Evaluation Protocol criteria, the committee took three specific research-related targets into consideration. These are part of Erasmus MC's current strategy (Strategy23), which designates 'Technology & Dedication' as its guiding principles. In the Terms of Reference for the research assessment the Executive Board of Erasmus MC describes the three research-related targets as follows:

1. Positioning ourselves as a partner;
2. Using technology to lead the way in innovation;
3. Focusing on our staff and internal organization.

Committee composition
Members of the committee that assessed the departments of Theme Diagnostics & Advice are:

- Prof. Manfred Dietel (chair), Charité-Universitäts Medizin Berlin, Germany;
- Prof. Maurizio Ferrari, Vita-Salute San Raffaele University, Italy;
- Prof. Irene Krämer, Johannes Gutenberg-University, Germany;
- Prof. Andrea Rockall, Imperial College London, UK;
- Prof. Marie Wahren-Herlenius, Karolinska University Hospital, Sweden;
- Prof. em. Britta Wahren, Karolinska Institutet, Sweden;
- Prof. Heiman Wertheim, Radboud University Medical Center, the Netherlands.

Dr Meg van Bogaert and Dr Floor Meijer were appointed as independent secretaries to the committee. A short curriculum vitae of each of the committee members is included in appendix 1.

All members of the committee signed a statement of impartiality and confidentiality to ensure a transparent and independent assessment process. Any existing professional relationships between committee members and departments under assessment were reported. The committee concluded that there was no risk in terms of bias or undue influence.

Documentation
Prior to the site visit, the committee received the self-evaluation report of the theme and the departments involved, including the information and appendices required by the Standard Evaluation Protocol. The following additional documents were provided:

- Standard Evaluation Protocol 2015-2021;
- Terms of reference for conducting the site visit;
- A Beginner’s Guide to Dutch Academia (The Young Academy, 2018);
- Strategy23 (Koers23).

Working method
Prior to the site visit, the committee members were asked to read the documentation and formulate preliminary assessments and questions for the interviews. In an online kick-off meeting, approximately eight weeks prior to the site visit, the committee was introduced to the Standard Evaluation Protocol and agreed upon procedural matters. In a second online meeting, approximately five weeks prior to the site visit, the committee discussed preliminary assessments and formulated questions on relevant topics. These questions were afterwards sent to the heads of department in order to facilitate their preparations for the site visit. On the day before the start of the digital site visit, the committee held a closed online meeting to prepare for the interviews.

Each member of the committee was primarily responsible for the assessment of one specific department. As ‘first assessor’, he or she took the lead in preparing for the assessment of this department. Furthermore, this committee member took the lead in the online interviews with department staff and eventually drafted an assessment based on the Standard Evaluation Protocol criteria. For reasons of continuity, a ‘second assessor’ was appointed to each department. Contrary to the first assessor, the second assessor was not necessarily an expert in the field of the department.

The online site visit of Theme Diagnostics & Advice took place on 31 March, 1 and 2 April 2021. During the site visit, the committee met with the Executive Board of Erasmus MC, as represented by the dean, as well as with representatives of the departments. Each department was given a time slot, which it filled with presentations and interviews. Committee members also spoke with PhDs of the departments during two consecutive speed dates and at a plenary PhD session. During its final meeting, the committee jointly scored all of the departments. To conclude the visit, the committee presented the main preliminary conclusions to the dean of Erasmus MC and the heads of departments of Theme Diagnostics & Advice. The schedule for the site visit is included in appendix 3.

After the site visit, the chair and the secretaries drafted a first version of the committee report, based on the assessments drawn up by the first assessors. This draft report was circulated to the committee for all members to comment on. Subsequently, the draft report was presented to Erasmus MC for factual corrections and comments. In close consultation with the chair and other committee members, the secretaries used these comments to finalize the report. The final report
was presented to the Executive Board of Erasmus MC.

**Structure of the report**

This report contains the committee's findings and conclusions on the seven departments of Theme Diagnostics & Advice. In accordance with the Standard Evaluation Protocol, the committee details its assessments on strategy and targets, research quality, societal relevance and viability in separate chapters for all seven departments. These chapters also discuss particularities with respect to PhD training. Overarching and institutional dimensions of such aspects (e.g. policies that are developed at Erasmus MC rather than at the departmental level, general practices at Theme Diagnostics & Advice with respect to PhD training, diversity and research integrity) are assessed in a general chapter that precedes the chapters on the departments. Details on the composition of the committee, the assessment scale and the setup of the digital site visit can be found in the appendices.
II. General findings Theme Diagnostics & Advice

Organizational structure
Erasmus MC is organized on a decentralized basis, with 48 departments constituting the primary units for governance, HR and funding. Each department is led by a head of department, who reports directly to the Executive Board of Erasmus MC. Amongst other things, the head has to ensure a good atmosphere and working environment (pertaining to diversity and research integrity) within the department. For organisational and administrative purposes, the departments are grouped into nine themes. Themes are run by a Theme Board, which consists of the combined heads of departments. From their midst, the heads elect a director who leads the theme for a maximum period of four years. He or she is formally appointed by the Executive Board. The theme chairman is responsible for effective operational management of the theme.

The committee learned that existing clinical collaborations between departments were the main argument for the current clustering of departments in themes, which came about in 2012. The unifying principle for Theme D&A is sufficiently clear to the committee: a common feature of all seven underlying departments is that they play a supporting role in clinical care and research and focus (heavily) on diagnostics. This shared purpose results in a comparable departmental design and infrastructure. Nonetheless, the committee also observed significant differences between departments, not least in terms of their size. While some departments in the theme are rather small (e.g. Clinical Chemistry), others are powerful and large (e.g. Radiology and Viroscience). This difference in size as well as differences between departments in their involvement in clinical care, research and diagnostics, might cause a disbalance in the theme. The topics that the research of different departments focuses on also tend to diverge quite a bit. An example of divergence is the very limited overlap between clinical chemistry and imaging research. Furthermore, the committee observed that the Department of Pharmacy is focussing on applied sciences and less on fundamental research.

The documentation and interviews underlined that the theme is mostly an organizational unit. As such, the theme is not responsible for developing research strategies or distributing funds, as this is primarily done at the level of the underlying departments. In its conversations with staff members of Theme D&A, the committee explored the added value of the theme-level for the department’s research efforts. This mostly seems to reside in the sharing of support staff, research infrastructure and procedures. At theme level there are specialised (financial, HR, ICT and quality assurance) advisors that serve all departments. Some departments share specific facilities, such as pharmacogenomics and liquid biopsy analysis. Furthermore, (best) practices in terms of PhD guidance, research integrity and measuring research output are exchanged across departments. It was explained to the committee that the main responsibilities of the theme board are in the fields of organizational support and project management. The board interacts with central Erasmus MC services (i.e. Control and Compliance; HR) and engages in discussions with other themes at Erasmus MC that make use of diagnostics provided by D&A. Within such interactions, the emphasis lies on policy, not so much on the content of research or on fostering cross-connections.

Collaboration within the theme is not as widely developed as the committee had expected it to be. While some departments clearly do collaborate (e.g. Pharmacy and Radiology, who jointly initiated the radio pharmacy unit), other connections that would appear obvious are not well established (e.g. between Pathology and Radiology, the potential for research crossing radiomics and pathomics). A proposed collaboration between Medical Microbiology & Infectious Diseases (MMID) and Viroscience in a joint Institute of Infectious Diseases has not yet materialised and the departments concerned appear to have diverging ideas and interests. Since the pandemic, a new initiative towards a pandemic and disaster preparedness centre has been launched and the coming year will be used to explore whether these two ideas can coincide or could be combined. The committee understood that the new theme chairman, who took office in April 2021, has the ambition to strengthen cooperation within the theme. For example, joint initiatives are taken around a unifying theme such as Covid-19. The committee encourages this and suggests that the theme aims for synergy, despite apparent differences between departments.

Over the review period, Erasmus MC has aimed to stimulate cooperation across themes and departments by offering staff the opportunity to establish academic centres of excellence (ACEs).
There are now around eighty of these ACEs, which are led by one or multiple principal coordinator(s). Relevant examples for Theme D&A are the ACE pharmacology & therapeutics, the ACE VICER (Virology Centre of Excellence Rotterdam) and the ACE antimicrobial resistance (ARTE). In addition, the departments in the theme participate in many other ACEs, both as support and in leading positions. In the documentation and interviews, ACEs were presented as bottom-up, virtual units, which do not receive structural funding for their activities. It is not mandatory for staff to be part of ACEs and in practice the level of participation seems to vary.

**Strategy23**

As part of the new institutional strategy for the 2018-2023 period ("Strategy23"), Erasmus MC aims to become the first technical academic medical centre in the Netherlands by convergence with Delft University of Technology (TU Delft) and Erasmus University Rotterdam. Technology and dedication are the dual focus points in realizing the institute's wide mission of ‘achieving a healthy population and pursuing excellence in healthcare through research and teaching’.

From a research perspective, the committee sees a lot of potential in Strategy23. The interviews made it clear that there are already some interesting collaborations with TU Delft which are focused on technological innovation – although in some departments more so than in others. Not all departments were able to fully clarify how their departmental strategies conform to the institute-wide strategy. Also, it was not entirely clear to the committee if and how the Erasmus MC Executive Board ensures that individual strategies of D&A departments align with Strategy23.

The committee encourages Erasmus MC to develop the full research potential of the liaison with TU Delft over the full range of departments in theme D&A. This also implies that departments should be actively aided in developing and improving their research strategy, as strategy formulation is not an intrinsic part of the work in all departments. Furthermore, the committee advises that, where possible, D&A departments align their strategies in order to strengthen the unity and impact of the theme as a whole. At present, such alignment is implicit at best.

**Funding**

Funding for research is administered and spent at the level of the department. Most departments have income from all three funding streams (i.e. government funding allocated to the departments by the Executive Board, grants and contracts). The extent to which departments share in the first stream funding awarded to Erasmus MC by the government appears to be a source of discontentment, especially now that first stream research budgets are under increasing pressure across the Netherlands. It was made clear to the committee that departments with a longstanding research tradition receive a relatively larger share of direct funding than departments which entered into research more recently. In the allocation model, historical factors outweigh the actual research performance of departments or Erasmus MC’s strategic choices for the future.

The committee believes that solving this difficult puzzle will ultimately be in the best interest of Erasmus MC and it therefore encourages the Executive Board to continue its efforts to set out a new road map for the distribution of direct government funding. The committee believes that a new allocation model should optimally fit the strategic choices that were made as part of Strategy23. Leading up to the development of a new allocation model for first stream funding, the committee suggests to the Erasmus MC Board to consider an increase of available seed money. Small and developing departments, and in particular the young, talented researchers in these departments, can kick-start their research career with a small amount of seed money, e.g. giving them access to a technician, a PhD student, or time to write proposals. A relatively small amount of seed money will help them gain independence.

The differences in funding affect the composition of the staff of the departments and thus the size of research efforts. Particularly, diagnostic and clinical work prevail over research activities. In some departments of Theme D&A clinicians have little time for research tasks. To connect research outcomes to clinical work, it is important to create redundancy in the time of clinicians and give them ample opportunity to connect to the (laboratory) research that is done. As the dean informed the committee, it is a strength that research and clinic take place at the same campus. At the same time,
it takes an effort (and money) to actively connect these activities.

**Infrastructure**

At the central level, Erasmus MC offers its departments a number of core facilities, like the Optical Imaging Centre, the Pathology Research Trial Centre and research suite. These are centrally operated facilities that staff can use for their research purposes, or where they can have specific services performed.

At the theme level, the committee learned about some tension concerning diagnostic laboratories versus clinical work. There are plans to connect laboratories and joint infrastructure. Although the committee understands the benefits of this endeavour, for some departments this is considered a threat. These departments consider the close connection between clinic and laboratory a strong and important feature and fear that this connection might weaken or get lost. The committee agrees that patient access for labs and lab-access for clinicians is crucial, in particular concerning translational research. It therefore recommends to continuously make sure that this connection is in place, specifically in case of merger of laboratories or joint infrastructure.

**Data management**

Erasmus MC aims to generate, store and publicize research data in accordance with legal, academic and ethical requirements and according to the FAIR principles (Findable, Accessible, Interoperable and Reusable) according to the Handbook for Adequate Natural Data Stewardship developed by the Federation of Dutch UMCs. In the review period, central data storage facilities provided by Erasmus MC were not necessarily suited to the needs of all departments. An Erasmus MC-wide data management plan and associated storage facilities with an audit trail and log (‘Research Suite’) started in 2018 and are currently in the final stages of development. A research management software application (‘PaNaMa’) is simultaneously being finalised. The goals of this initiative are:

- Providing the physical infrastructure for data storage and computing power (cloud service);
- Offering data stewardship and governance for the (re)use of different types of data;
- Creation of digital workspaces for researchers where they can safely collaborate with partners inside and outside the Erasmus MC;
- Implementation of data capture tool, electronic lab journal, study/project management (PaNaMa);
- Support with development of study specific data management plans.

Although the Research Suite is still in progress and its structure not yet fits the requirements of all departments, the committee thinks its implementation is a promising development. Clinical departments in particular are benefiting from this development. However, departments with large datasets and collaborative research with external parties require more than what is currently available. The committee encourages Erasmus MC to continue the development of the Research Suite to make it suitable for as many departments as possible.

According to the committee, a clear distinction should be made between IT-support (e.g. the trusted research environment of the Research Suite) and the Bioinformatics support. The committee did, however, not find an overarching structure for bioinformatics support. The merger of bioinformatics with pathology suggests that bioinformatics support for researchers is not centrally organized. The committee got the impression that the departments hire their own experts. This is understandable, if specific and expert knowledge is required by the department. On the other hand, this leads to a risk of isolated knowledge and not making use of the expertise that is present at Erasmus MC. The committee recommends looking for a hybrid construction to offer bioinformatics support. Part of the support should and could remain at departmental level, but the committee thinks that it is important to combine expertise within Erasmus MC in, for example, a Bioinformatics Institute.

**Talent management**

The staff members that the committee spoke with appeared to be in agreement that Erasmus MC is a good place to work. There are many opportunities and facilities. While staff satisfaction is high in many respects, staff members also flagged a number of concerns, particularly with respect to talent management. The committee noticed differences between departments in how they are dealing with retention of young, talented research staff. These concerns are less acute for some departments than for others. Nonetheless, there are a number of overarching challenges that should be addressed at theme level, or even Erasmus MC level.

A main concern that was raised and that is shared by the committee is that Erasmus MC has not (yet) adopted a tenure track programme, signifying that
departments lack a formal tool for making informed HR decisions. Also, it means that early- and mid-career staff members have only limited insight in their career possibilities within Erasmus MC. This may result in valuable and talented researchers pursuing opportunities elsewhere, while the succession of senior researchers who are due to retire is not secured. The committee understood that Erasmus MC is working on this issue, which is positive. Some urgency, however, is required. In the committee’s opinion, this is an important issue that requires attention in order to safeguard the viability of departments at Theme Diagnostics & Advice, in particular for non-clinical researchers.

Another point of attention is that many staff members would benefit from establishing formal mentoring and coaching programmes. The committee feels that having a mentor from outside the department is particularly helpful for early and mid-career researchers but could also benefit more established clinical-scientists.

**Diversity**

Erasmus MC is working on becoming a diverse and inclusive organization that reflects the diversity of its patient population and the wider urban context of Rotterdam. For now, diversity is narrowly defined. Policies and activities mostly focus on improving the gender balance amongst staff. More attention — and preferably targeted interventions — may be beneficial to promote diversity in the full sense of the word. The committee encourages Erasmus MC to keep pursuing diversity at all organizational levels and suggests that the leadership in the theme promotes diversity.

In order to achieve an equal gender balance, Erasmus MC specifically developed a number of policy initiatives to support female researchers. These include the Female Talent Class, consisting of various workshops and interventions intended for talented early career researchers (maximum of two years after PhD completion), and the Female Career Development Programme, developed for female early and mid-career scientists (between 4 and 8 years after PhD completion). The programmes are directed to those who have the potential and ambition to reach the position of associate professor (UHD). The committee met with several talented female researchers who made use of these initiatives and who said they had benefitted from them.

Despite these policy initiatives, the gender balance amongst senior researchers and in management is still skewed in favor of men. Most departments have a good ratio of women to men up to the full professor level. At the full professor and department head level some departments do very well, while other departments are unbalanced. At theme level, approximately 70% of PhD students, 50% of associate professors and approximately 25% of professors are women. Interviews with staff members underlined that there is clearly no shortage of female talent amongst early- and mid-career researchers. Yet, there is no reason to assume that achieving an equal gender balance is simply a question of time. In the committee’s opinion, proactive measures are required to establish an equal representation of women at professorial level and in management, thereby ensuring the presence of female role models and the introduction of valuable new perspectives and management styles that pave the way for others. The committee was pleased to learn that Erasmus MC is currently exploring new initiatives to create equal opportunities and encourages the institute to continue working on this. One option that the committee advocates is that Erasmus MC provides its departments with the necessary tools to fast-track ambitious female talent.

**Research integrity**

Erasmus MC endorses the Code of Conduct for research of the Association of Universities in the Netherlands (VSNU) and the revised European Code of Conduct for Research Integrity. As of early 2018, Erasmus MC has its own guidelines in case of scientific misconduct. Furthermore, Erasmus MC policies on academic/scientific integrity are outlined in the Erasmus MC Research Code that covers the following aspects:

- Research with patient data and biomaterial;
- Data management;
- Guidelines for publishing and authorships;
- Guidelines inducements by companies;
- Intellectual property.

As the committee understood it, the decentral implementation of the centralized integrity policy is work-in-progress. In anticipation of this policy, departments are responsible for their own research culture. All PhD candidates follow a mandatory one-day course on research integrity. For researchers who are involved in patient or human studies, a training requirement for clinical practice is the Basic Regulatory Course and Organization for Clinical Researchers.
Erasmus MC places great value on a comprehensive scientific culture. The committee has not received any signs that integrity is at risk.

**PhD training and supervision**

Erasmus MC offers three- to four-year (fulltime equivalent) PhD positions, which are most often funded through grants and industry. Projects are either individual or (partially) shared with other PhD candidates. From speaking to a number of PhD candidates, the committee concludes that Erasmus MC offers its PhDs a safe learning and working environment, in which there is room to communicate both successes and failures. Also, there appears to be a good balance between guidance by supervisors and individual autonomy for PhDs to pursue their own ideas and interests, even in pre-determined group projects.

Until recently, training and supervision took place at departmental level and varied significantly from department to department and from supervisor to supervisor. In recent years, initiatives have been taken to streamline procedures and practices across Erasmus MC. The most prominent (and imminent) change is the introduction of a Graduate School, which is operational since early 2021. This new Graduate School replaces the (five) local research schools (i.e. NIHES, Molmed, COEUR, MGC, ONWAR), that were formerly responsible for the training of Erasmus MC PhD candidates. The courses offered by these schools are integrated in three tracks, Clinical Sciences, Health Sciences, Biomedical Sciences, and available to all +/- 1500 Erasmus MC PhD candidates. The committee considers the new Graduate School a good development, which will help to counter some of the heterogeneity and informality in training and supervision that existed previously. The committee does advise Erasmus MC to allow individual departments sufficient space within this new setup to emphasize what is important for their discipline. This means that PhD candidates should be able to also follow courses outside the Erasmus MC graduate school.

A second initiative aimed at streamlining the PhD programme, is the introduction of the central database system Hora Finita (operational as of late 2019) in which the status of all PhD projects is registered. The committee notes that, before the introduction of Hora Finita, Erasmus MC did not centrally keep track of completion times, success rates and next destinations of PhDs. Therefore, it was – unfortunately – not possible to assess quantitative aspects of the PhD programme for the 2013-2018 period. Hora Finita will likely provide Erasmus MC and its departments with valuable information that can be used to monitor and adjust policies and practices.

PhD candidates are expected to obtain a total of 30 EC over the course of their project. These credits can be earned by taking courses, attending lectures and conferences and teaching undergraduate students. PhD candidates that the committee spoke with assessed the course quality as (very) good. There is a broad range of in-depth courses on relevant topics, although some specialist subjects (e.g. bioinformatics) are currently not covered and would be a good addition to the training programme.

Most of the PhDs that participated in the review have a personal training and supervision plan (TSP), usually drawn up by the PhD candidate him/herself, sometimes with help from the supervisor(s). In some cases, this was done retrospectively, after the introduction of Hora Finita, as this system demands having a TSP. It is not (yet) common that the TSP is updated annually or taken as the starting point for yearly progress meetings, but it is believed that this will become the norm for future cohorts. Having two or more supervisors seems to be established practice within Theme D&A. The PhD candidates with whom the committee spoke, were generally very satisfied with the quality of supervision, praising the accessibility, expertise and personal approach of individual supervisors. Within supervision, emphasis is placed on scientific matters. Some PhD candidates would appreciate to also have broader discussions about academia and/or on their personal development. The committee also signaled a need for external mentoring of PhDs. According to the committee, it is very important that PhD candidates have access to someone outside of their own department who has a fresh perspective on matters and can offer advice in case of problems.

PhDs are generally positive on their career options and on labour market preparation throughout the PhD project. Many supervisors encourage PhDs to think about future careers and inform them on potential options, but there are also some PhD candidates that miss such interaction with their supervisors. The Graduate School could in the future offer labour market orientation training to prepare PhD candidates for the job market. The committee also recommends that supervisors and their PhDs discuss possibilities for follow-up of the PhD research near the end of the appointment, as
this would help to identify potential options for further development of the research line.

The provision of information to PhD candidates seems to be a general point of attention. The committee noted that PhDs commonly rely on informal sources of information rather than on ‘official’ communication channels. Furthermore, PhDs reported that important information is scattered. This means that not all PhDs have the necessary information available to them at all times. An example that was highlighted in the interviews with PhD candidates is that the thesis requirements are not clear from the start of the project and that some candidates who are nearing the end of their appointment are still unsure of the publication criteria that they will have to fulfil in order to graduate. The committee recommends achieving clarity on what is expected/required and why, from an early stage on. The Graduate School can most likely play a positive role in providing this information. An on-boarding programme may be considered, as well as the introduction of e-learning modules for new PhD candidates (e.g. on Lab SOPs, research integrity, scientific writing).

The time that PhD candidates spend on their PhD varies. A majority spends more than 40 hours per week on their projects and reports a heavy workload, especially when doing lab-work. Maintaining a healthy work-life balance seems to be an issue that a large portion of the PhD population struggles with. Factors that were said to negatively influence work-life-balance include time pressure, (silent) expectations to work outside of office hours, the combination of the PhD with clinical work and the recent Covid measures. The committee was also told that the culture with respect to working hours varies between departments. Structurally working overtime seems to be the norm in some departments, while other departments are more mindful of limiting the workload to 36-40 hours per week. The attention that is paid to the wellbeing of PhD candidates also appears variable. The committee would like to see that open discussions on mental health and burnout prevention take place on a structural basis, and especially at the beginning of the PhD project, leading up to the one-year evaluation and stop/go decision, which PhDs appear to experience as particularly stressful.

A final topic that the committee touched upon with PhD candidates, is their access to general and specialised facilities, which received mixed reviews. Some students are quite satisfied with the services and material offered, while some other students need specialized equipment, which they say is not proactively supplied. IT and computing facilities are perceived as better in some departments than in others. Also, working with clinical data and retrieval from the Erasmus MC IT systems takes time due to ethical issues. This offers up challenges like getting good patient data from EPDs in database format. Also, the challenge for integrated clinical and imaging datasets in a trusted research environment relates partly to integration of different types of data from multiple sources - such that larger scale bioinformatics research approaches can be undertaken.
III. Department of Clinical Chemistry

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<th>Research quality</th>
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**Mission and strategy**

The well-described mission of the Department of Clinical Chemistry is to develop and offer an innovative and up-to-date biomarker package to support the correct diagnosis of complex diseases, and to monitor population health and the effect of therapeutic interventions tailored to the needs of patient and healthcare professionals in an efficient and cost-effective way. Given the small size of the department’s research staff – 7 clinical chemists, 1 molecular biologist, 1 pharmacist and 1 postdoc LC/MS with a total of 3.62 FTE in 2018 – the high degree of focus on innovative biomarkers and pharmacogenetics is appropriate.

Currently, the department has three research lines/groups:
1) Pharmacogenetics;
2) Folate & Vitamin B12 Metabolism;
3) Biomarker Innovation.

While the third line - on novel biomarkers - only started in 2016, it was described to the committee as the ‘core’ of the department’s research programme. It covers the department’s mission of the department in a broad sense: using mass spectrometry to develop an innovative biomarker package, including metabolic profiling.

According to the committee, the current strategic plan, which ambitiously focuses on growth and forging new research connections, is an improvement over its predecessor. Nevertheless, the department should consider adding clearly defined objectives, which would make it easier to map out a strategic pathway for the coming years. This particularly holds true for research line 3, which is still in development and seems to need more specific targets. Also, the committee advises to put more strategic emphasis on the innovative technologies (‘-omics’) that are rapidly transforming the field of laboratory medicine (see ‘Viability’).

Internal collaborations within Theme D&A and Erasmus MC are at a very good level. The Department of Clinical Chemistry developed many interactions with clinical departments, highlighting the transversal character of its research. The pharmacogenetics group collaborates closely with the Department of Clinical Pharmacology while the other two groups have partnered with several clinical departments for whom they perform or initiate tests (Rheumatology, Internal Medicine, Hematology etc). Regional and international collaborations are also at an appropriate level and in line with the extensive network of Erasmus MC as a whole.

The department has a management team that consists of the Head of Department, who also leads one of the research lines, and the leaders of the other two research lines. The management team meets regularly, monitoring progress on research every three months. The three groups meet frequently amongst themselves to discuss results. Governance of the research is relatively straightforward given the small size of the research programme. In 2021, after the review period, there was a change in leadership, but this does not seem to have major implications for the department.

Central (core) research facilities are well developed. All three groups interact with these facilities provided by Erasmus MC, which offer great advantages for clinical chemistry research. In particular, the department is very involved in the mass spectrometry facility.

**Research quality**

The quality of the department’s research is high, as is evident from the above average mean normalized citation scores (MNCS) of its publications. Over the review period, the department published several influential papers and more than 20% of its publications belong to the top 10% of most frequently cited articles. The academic reputation of the groups is very good. Senior researchers have large networks and are internationally known and respected. While they hold positions in several scientific associations, the number of scholarly awards and prizes is small.

The committee noted that the number and level of publications has been rather constant (slightly decreasing) for quite a number of years, which raises the concern that the department has reached a plateau in terms of scientific quality. Ideally, the committee would have liked to see an upward trend, in line with the high level of ambition of the management. Also, publications could have been more evenly spread across the research staff and across the three groups. The department appears to be rather reliant on the three group leaders and the contribution of the
Folate/Vitamin B12 group is somewhat less than that of other two groups.

An additional opportunity for improvement is that the department does not make a major contribution to the technological advancement of the discipline of clinical chemistry. Its current scientific relevance lies mostly in the clinical field, to which it contributes with publications, method development and guidelines. In the committee’s opinion, the department should consider moving into new ‘disruptive’ technologies, which would help to make the department more future proof. There are currently no patents, which is also something to keep an eye on while going forward.

The level of competitive funding is a bit worrisome. The committee was informed that direct funding is the department’s main source of income (i.e. 81% of the research budget in 2018). In the committee’s opinion, strengthening the department’s fundraising capacity is essential for realizing its strategic agenda and achieving growth. Due to funding limitations, the department shares/co-supervises most of its PhD candidates with other departments within Erasmus MC.

The committee found that research integrity is well-addressed, both at the level of Erasmus MC and at the departmental level.

Relevance to society
The committee assesses the relevance to society as very good. The department is strongly focused on delivering products that may be of benefit to society, thereby bridging the gap between the lab and the clinic. This is especially true for the Pharmacogenetics and Folate/Vitamin B12 groups. Products that have been developed by these groups (such as manuals, guidelines, media communications, documents for students) have proven to be very practical and are already being used by (groups within) society.

An impressive example that was highlighted in the interviews is that of the DNA passport for medication, which has acquired (inter)national attention. Members of the pharmacogenetics group worked closely with Dutch pharmacists in order to educate them on how to interpret genetics and guide patients in this field.

The department has good connections with governmental institutions, companies, civil society bodies and European agencies. Moreover, it is involved in (and committed to) educating students at different levels.

Viability
While the committee is convinced of the department’s ability to deliver scientifically sound and societally relevant research results, it also identified a number of threats to its viability. These will need to be dealt with to ensure a bright future.

Resources are the main issue when it comes to viability. The department’s research staff is small and income from competitive funding sources (research grants, contract research) is very limited. More human resources, in the form of talented young staff, and additional funds are prerequisites for achieving the goals described in the strategic plan. A promising development is that the programme has recently invested in its PhD policy and programme, thereby heightening its attractiveness to young research talent.

Furthermore, the committee determined that in its research, the department could look more directly to the future. As said, the department would do well to embrace the disruptive technologies that are rapidly gaining ground in laboratory medicine. In the committee’s opinion, future strategic plans should chart a course to bring in much-needed expertise on new -omics. Implementing automation technology and data analytics, as well as establishing a strong academic mass-spectrometry group are just some of the goals that should be addressed in a future strategic agenda.

An interview with the management clearly indicated to the committee that ambitions amongst senior researchers are at the right level, which is an encouraging sign. The team is conscious of existing threats and weaknesses, which were candidly described in the department’s SWOT-analysis. Moreover, the management appeared flexible and open to change.

The committee was not fully convinced that the aspirations of the management trickle all the way down to junior staff. There appears to be a gap between the ideals and expectations of established researchers and those of early career staff, with the latter category perhaps being held back by a lack of dedicated research time and perspective. To remedy this situation, the committee strongly
feels that the department should invest in coaching and career opportunities of younger staff.

**Recommendations**
The committee makes the following recommendations:

1. Work on increasing research productivity and quality, in order to become more competitive in earning grant income. Concentrate on external grants.

2. Further increase interaction with the clinical departments and make an effort to become part of national and international consortia, which will help with funding.

3. Bridge the gap in expectations and ambitions between senior and junior staff. Offering (external) coaching to young talent is a necessary first step.

4. Move into disruptive technologies. Innovation is highly important in laboratory medicine.
IV. Department of Immunology

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**Mission and strategy**
The mission of the Department of Immunology is to perform cutting-edge and outstanding fundamental, translational and clinical research, provide excellent teaching, and support patient care with high quality immunological diagnostic services. The ultimate goal is to improve health through research, education, diagnostics and patient care by connecting clinical, fundamental and translational immunology. While these are ambitious aims, the committee has no doubt that it is within the department’s reach to achieve them. The committee found the mission statement clearly presented, touching on the ways in which the department carries out its activities and identifying appropriate stakeholders.

The department’s organisational structure consists of three major divisions: research, diagnostics (Laboratory of Medical Immunology) and clinical immunology. Research activities can be classified into two major research lines:

1) Normal, deficient, and malignant leukocyte differentiation. This research line deals with the development of immune cells and molecular defects that lead to primary immune deficiencies and lymphoid malignancies.

2) Immunity, Inflammation and Autoimmunity. This research line includes the study of immune system cells in autoimmune and autoinflammatory syndromes, psychiatric diseases, infections and tumours.

The department is further subdivided into a substantial number of small workgroups headed by workgroup leaders. Ideally each workgroup is involved in several core activities (research, diagnostics, patient care). This structure is clear and well-described. As the committee understands it, it was purposefully set up to connect clinical routine and cutting-edge science in a well-integrated manner.

The committee concludes that the working groups have diverse foci and the intradepartmental co-publishing pattern reveals that scientific interaction between working groups is limited. On the other hand, the technical and method platforms are shared across groups, and joint meetings/seminars and retreats are held. In time, this should lead to increased cooperation between groups and further integration of the department. Leadership within the department seems strong. The management has the analytical ability to identify weaker points (such as the need for a shared focus) and develop strategies to address them.

A further strong point is that national and international collaborations are well developed. The department acts as a patient/sample reference centre and symposium host. Furthermore, it is the leader of several EU-based projects. With the strong immune-technology focus, the department is also well positioned for Strategy23 and future collaboration with TU Delft.

The department’s research facilities are high end. It has built a state-of-the-art flow cytometric core, including single cell sorting. A sequencing pipeline is currently being established as an add on, as well as a bioinformatics team. Additional research facilities include ample lab space for cell culture and molecular biology. The department also has access to, and uses, Erasmus MC core facilities.

**Research quality**
Measured against international standards, the department performs high-quality and original research within basic, translational and clinical areas. The committee particularly appreciates that the department connects basic and clinical research, thereby providing molecular understanding of clinical disease, and that it translates basic findings into clinical practice. This includes studies on neurologic, immune-mediated and hematologic diseases; both in terms of understanding the underlying pathogenetic mechanisms, and to develop diagnostic tools. The committee established that the department translates research results in meaningful knowledge that improves our understanding of basic mechanisms for helping humans towards better health.

The department is staffed by well-trained scientists with high levels of expertise. They regularly publish in the leading international journals within their respective fields, making a significant contribution to these fields and to further development of research areas. Amongst the department’s many accomplishments is the development of several novel tests for clinical use.
The academic reputation of the department is very good. Scientific staff members are invited to participate in national and international networks and consortia, and sometimes lead them. Also, they are frequently invited as speakers at international symposia. Several distinctions and awards have been given to scientists at the department.

The topics under investigation at the department are several, but these are logically organized into the abovementioned two research lines (Normal, deficient, and malignant leukocyte differentiation; Inflammation and Autoimmunity). The research strategy is clear, with high set goals. Although the department has undergone substantial alterations and faculty renewal over the years, productivity has essentially been kept up, which is a significant accomplishment. The committee also notes a recent increase in external, competitive income.

The department’s PhD programme includes around 25 PhD candidates, with a good turnover. A PhD guidance committee is established to follow and evaluate the progress of individual candidates. PhD candidates confirmed to the committee that relevant courses and training events are available. Also, PhDs are encouraged to attend national and international scientific meetings to present their data.

**Relevance to society**

The committee established that the department’s research makes an excellent contribution to society. Knowledge, methodology and products that are derived from the department’s research are brought back into society in a relevant, consistent and structured manner. The department’s outreach efforts cater to various groups of societal stakeholders, ranging from children to patients with chronic disease. Several appropriate channels and methods for communicating research results or products resulting from research are being used.

The committee appreciates that members of the department are deliberately encouraged to initiate and partake in interactions with society. Noteworthy examples of such interactions include media appearances and lectures for various age groups given at schools. Furthermore, there is active engagement with patients and patient organizations. Staff members give lectures and write articles aimed at these groups. Patient partners are also actively involved in research projects. In recognition of this interaction, academic staff have received awards from patient organizations.

Translation of research into clinical use for the benefit of society is also encouraged by the department management. The committee established that several novel assays for diagnostics have been developed and are currently in clinical use. The department also partakes in several networks for standardizing laboratory methods, equipment, or reagents for clinical use. Participation in clinical trials furthermore contributes towards drug development, which is important not least for the rare diseases that the department studies.

**Viability**

The review period of 2013-2018, and particularly the two years that followed it, saw the start of several positive trends that attest to the viability of the department. Weaknesses and challenges that were identified in the self-evaluation report, such as the necessary strengthening of internal collaboration and attracting more external funding, have been addressed, with impressive results being reported in the addendum to the report. Leadership within the department seems strong, with the ability to renew and further develop the research programme. Furthermore, there is a well-articulated strategy that spans from basic to clinical research.

An outspoken aim of the department was to increase external funding. At the end of the review period (2018) research contracts and grants respectively amounted to 58% and 3% of the department’s annual research budget. Since 2018, the department has significantly increased its efforts to apply for competitive grants. The committee was informed that the growing number of grant submissions resulted in competitive funding steadily increasing and reaching a record high in 2020, thereby improving the financial health of the research programme.

Research topics at the department are diverse. To create more unity, the committee advises to further develop those features that connect the different groups and help them benefit from each other. This includes a further strengthening of the research environment (methods, infrastructure, equipment etc). The department is involved in many national and international collaborations. While interactions are always beneficial, scientists at the department appear ready for the next step,
which would be to take charge of large collaborative projects rather than the current situation of mainly contributing to them under the lead of others. Its access to patient cohorts and biobank samples is a clear strength that could be more fully exploited within such collaborations.

The department is an attractive place to work, as is evidenced by successful recent external recruitment of new group leaders and promotion of internal talent. Hiring and promotions have also benefited female talent, thereby improving the gender balance at the department. With respect to HRM, the committee does advocate for establishing institutional recruitment packages. These would facilitate recruitment of senior outstanding talent. A particular wish expressed by the department and supported by the committee is to reinforce the area of molecular immunology.

Recommendations
The committee makes the following recommendations:

1. Keep working along the lines of the strategic development plan resulting from the SWOT-analysis;
2. Consolidate research lines within the department and reinforce intradepartmental interactions for building common platforms and workflows;
3. Identify and mentor/recruit strong junior and senior scientists with the capacity to attract external grants;
4. Create or identify possibilities to take leading roles in consortia, building on existing strengths of the department such as having access to unique cohorts and biomaterials;
5. Continue to strengthen external funding
V. Department of Medical Microbiology & Infectious Diseases

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Mission and strategy
The Department of Medical Microbiology & Infectious Diseases (MMID) aims to make a positive difference to the lives of infectious disease patients by providing both established and state-of-the-art solutions at regional, national and international levels for problems associated with the infectious diseases of today and tomorrow. Under the banner ‘from bench to bedside and back’, it conducts multidisciplinary, translational and clinical research into microbial infections at the molecular, cellular and population levels. A distinctive aspect is that the department combines microbiology and ID specialities. It encompasses both the clinical and the laboratory diagnostics work related to infectious diseases – except for research on viral diseases, which is done at the neighbouring Department of Viroscience, with which MMID collaborates closely.

The committee notes that the department is uniquely positioned to fulfil its mission; it is located in the large, internationally oriented port city of Rotterdam and within a medical centre that has links to many other hospitals and clinics. Furthermore, the department is adjacent to a strong virology group with global outreach, which provides a fertile ground for infectious disease work. Also, Erasmus MC offers scientists a good infrastructure and state-of-the-art facilities, including mass spectrometry to do innovative antibiotic resistance testing. For its work on tuberculosis, the department has access to the BSL3 animal facility, which is a unique asset.

The department’s research is organized in five themes/research lines:

1) Emerging antimicrobial resistance and optimizing antimicrobial therapy (ARTE);
2) Emerging infections of global importance (EIGI);
3) Health care-associated infections (HCAI);
4) Infectious diseases in immunocompromised hosts (IDIH);
5) Innovative diagnostics and IT solutions (ID&IT).

In the committee’s opinion, the themes are well-chosen and fit the work that is done at the department. The themes are linked to Erasmus MC wide Academic Centres of Excellence (ACEs), thereby promoting interdisciplinary cooperation with other departments. There are many internal and external scientific collaborations, but these appear quite heterogeneous and uneven. To improve future impact, the department could aim at more depth in its research lines and collaborations. The committee recommends strengthening the cohesion in the research programme, as there is currently a risk of the department overstretching itself.

The committee was informed of longstanding and recently revived plans to establish an Institute of Infectious Diseases at Erasmus MC, which would be a collaboration between the Departments of MMID and Viroscience. In the committee’s opinion, such an institute certainly has the potential to strengthen MMID’s research lines. However, it requires further thought by the various stakeholders, as expectations amongst the departments involved and the Executive Board seem to diverge. The committee notes that MMID and Viroscience are also both partners of the Netherlands Centre for One Health (NCOH), which focuses (amongst other things) on pandemic preparedness. The committee learned that Erasmus MC plans to establish a new consortium in this area in Rotterdam. Details of the arrangement were not yet available at the time of the site visit and the committee questions how this will work out.

As part of the institute-wide strategy of convergence (‘Strategy23’), ties with TU Delft are being tightened in order to stimulate technical innovation. The committee established that, for MMID, this holds particular promise in the area of infection prevention.

The governance structure of the department is clear, although in recent years there was a leadership gap, caused by the unexpected death of the head of the R&D unit and the subsequent departure of the head of department to another institution. At the time of the site visit, both had been replaced by ad interim leaders. The committee established that the department increased the capacity in middle management by appointing a project manager. The interviews highlighted that this has been beneficial, for
instance, in terms of grant applications and implementing projects. The committee agrees that it is a good strategy to relieve scientific experts from bureaucratic duties and to improve the quality of grant applications.

Research quality
A clear conclusion from the interviews is that clinicians and scientists work side by side on a daily basis. The department thereby lives up to its motto ‘from bench to bedside and back’. The committee appreciates this approach, but nonetheless slightly prefers the approach of sister department Viroscience (‘field-to-bench-to-bedside’). A key focus of MMID’s work is antibiotic resistance and infection control, spanning the full circle from the molecular level to epidemiology. In its research, the department involves low resource international settings like Indonesia and Zambia. Overall, the department has high-quality output, good impact and a solid academic reputation.

The infection prevention and antimicrobial drug dose-finding (PK/PD), work of the late head of the R&D unit, is internationally well-known, and his passing is a big loss for the department. The department is aware that it will be hard to truly replace him in his expertise. However, there are multiple opportunities to focus on including tuberculosis, mycetoma and other fungal infections, antimicrobial resistance and infection control. The positioning of PK/PD requires further consideration. In particular in the light of creating further depth of the other ongoing work.

Considering the favourable setting outlined above, the committee is convinced that the department could achieve even more than it currently does, especially with increased focus and ambition for larger, high-impact studies. While the current research strategy of strengthening the ‘middle layer’ will likely help to achieve further improvement, the committee also advocates for more collaborative effort on fewer projects. Based on reviewing the documents and the discussion during the visit, the committee has the impression that the department risks overstretching itself. For example, the department needs to reconsider what it wants to achieve with the bacteriophage project. The committee sees the appeal of experimenting with this type of research but emphasizes that it can require a lot of resources, while the outcomes are anything but certain. The committee advises the department to screen its activities and carefully consider which of these it wants to develop further, as time can only be spent once.

The department has a good-sized PhD population, which at the time of the site visit consisted of 38 PhD candidates (some of which are shared with other departments). The annual average of 4-5 PhD defences is favourable. From the interviews, the committee concludes that PhDs are happy with their working environment and with supervision practices at the department. They enjoy the academic freedom and the ample possibilities offered to them. A point for improvement is that – even though MMID has a Standard Operating Procedure for PhDs that outlines the consecutive steps in the PhD process – PhD candidates require more clarity on what is expected of them.

The committee has no concerns regarding research integrity. It established that procedures are in place to prevent plagiarism, the fabrication of research results and other integrity issues. No such incidents were reported at the department.

Relevance to society
The department’s relevance to society is high. From a Global Health perspective, the research lines do important and impactful work on mycetoma, endoscopy, and aspergillus after influenza infection. In the interviews, the committee heard a number of telling examples of research results that changed practice (e.g. the work on contamination of endoscopes). Staff members of the department are active in several national and international committees, such as the Dutch Outbreak Management Team (OMT), International Society of Antimicrobial Chemotherapy (ISAC) and the Dutch Association for Medical Microbiology (Nederlandse Vereniging voor Medische Microbiologie, NVMM). Many of the staff combine a PhD with an MD, which guarantees that there is optimal collaboration between infectious disease units at the hospital and in the research departments.

A particular strength of the department in terms of societal relevance is research line five, Innovative diagnostics and IT solutions (ID&IT). MMID has access to samples from patients with bacterial, fungal and parasitic as well as viral diseases. This has permitted the development of a series of refined methodologies such as improved 16S sequencing, MS typing and rapid diagnosis for resistance to various agents, all of which are immediately beneficial for individual patients and society.

A weakness listed in the department’s SWOT-analysis is that the department does not optimally
use PR tools to communicate with the community. While the committee agrees that a good communication strategy can indeed be beneficial, it cautions against overemphasizing this particular aspect. In its opinion, good PR is just one of several pathways to achieving societal impact.

Viability
In the interviews and documentation, the Department of MMID described itself as a department in transition. After the loss of two leading figures, the department is in the process of reinventing itself and redefining its relations with relevant partners within and outside of Erasmus MC. After reviewing the evidence, the committee is convinced of the high potential of this well-positioned and well-resourced department. It expects to see a healthy growth in scientific impact over the coming years.

There are some remaining uncertainties regarding leadership, which have to be resolved. The department needs a strong, inclusive leader with a clear vision on microbiology and infectious diseases, who is able to make research more coherent and take it to the next level. This is especially important in the light of plans to establish a joint Institute for Infectious Diseases. Enhancing middle management is a sensible strategy and is therefore fully supported by the committee.

Over the review period, the department has been able to attract a healthy amount of funding. With the available expertise, networks and facilities there are sufficient opportunities to keep this up – although maintaining a good level of competitive funding will always remain somewhat of a challenge. An issue mentioned by the department is lack of time for medical staff to do research. In the committee’s opinion, this is an additional argument to make choices on what to work on and what not, to use limited resources widely and create the depth and impact desired.

The plans for increased collaboration with TU Delft are very promising, particularly in the area of infection control. The committee looks forward to seeing the results in the near future.

The gender balance in the team is appropriate and there is a good diversity in expertise as well, ranging from clinical to fundamental. Strong collaborations with low resource settings ensure an inflow of PhD candidates from other cultures into the PhD programme. Approximately 25% of staff members are international researchers from Africa, Asia, Latin-America and elsewhere in Europe.

Recommendations
The committee makes the following recommendations:

1. The committee encourages the department to develop a clear plan for appointing a visionary head of department with good links to the hospital/field, under whose direction the science can be taken to the next level;
2. The committee recommends that Erasmus MC and the department achieve clarity on their exact plans regarding an infectious disease institute, as current expectations amongst stakeholders seem to differ.
3. The committee encourages the department to keep strengthening its ‘middle layer’ in order to enable senior scientists to concentrate on scientific projects, to network and to apply for grants.
4. The committee recommends the department to – in a collaborative effort – refocus its research strategy and aim for more depth in its research and subsequent impact. By doing so, the department will make better use of the limited resources (mostly: time for research) experienced by the staff.
VI. Department of Pathology & Clinical Bioinformatics

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Mission and strategy
The mission of the Department of Pathology and Clinical Bioinformatics is to perform cell and tissue-based diagnostic of patients’ specimen, cell and tissue-oriented research for biomarker-driven patient care and the understanding of disease. The research is organized in a total of 16 research lines in three pillars: innovation, translational and basic fundamental. According to the committee, this general approach to serve as clinical diagnostic unit combined with research-only activities is valuable and should be strengthened as this is a major part of translational research as well as precision medicine in Erasmus MC in general.

Worldwide, the role of pathology has changed over the past fifteen years, from a diagnostic specialty to a more clinical specialty in which pathologists co-decide with clinicians which treatment is required, e.g. oestrogen receptor (ER) positive breast cancer and NSC lung cancer. These examples of molecular pathology require the involvement of pathologists.

The clinical workload at the department is high. Although the number of clinical cases is rather constant, the workload (activities per case) has increased significantly. As a result, it is difficult for the department to develop the research as well as it wants, which may be in part due to limited time and resources. Balancing both research and diagnostic work should continuously be discussed critically, e.g. the diagnostic workload should not increase in such a way that research activities suffer even more.

In 2017, the former Clinical Bioinformatics department became integrated within the department. This construction seems somewhat unusual. The committee fully acknowledges the need for an integrated bioinformatics group that is directly involved in particular questions and problems of the pathology research groups (e.g. establishment of new sequencing technologies, A.I. based evaluation and quantification of histological slides). At the same time, the committee suggests that Erasmus MC should have a general bioinformatics department or facility to serve other departments. This could be organized as an overarching institute with broader knowledge.

Following the organogram presented, the governance appears to be clear and result driven, research is structured with meetings on several levels, continuous exchange, lab sharing and transparency between different groups. The committee is positive about the talent programme with start-up fees for junior PI’s based on a submitted workplan. This is innovative and will contribute to stimulating and maintaining young talents. The institute’s management apparently places emphasis on a careful talent search process.

Data safety, good laboratory practice and scientific integrity are controlled by the Scientific Integrity Officer. This structure is appreciated both within the department and by the committee. The Scientific Integrity Officer also organizes e.g. the bi-weekly plenary pathology rotation meetings (PALMs), plenary weekly meetings with neighbouring departments (JNI scientific meetings), yearly research retreat and many other activities, which is clearly of added value to the department. This officer and the management team play a key role in communication and keeping research running.

There are interdepartmental, national and international collaborations that are widespread and fruitful. These collaborations and accompanying activities are crucial for translational research not only of this department, but of the Erasmus MC in general.

The committee found the meeting(s) with the PhD candidates of the department very informative. Although there are some differences with respect to the individual situation, no PhD candidate had fundamental criticisms on the general structure or their possibilities to do their research. They concordantly praised the engagement of their group leaders.

Research quality
The quality of the department’s research is good. The committee came across several interesting scientific publications that were published in high-ranking journals. The citation analysis (MNCS) shows a positive trend over the past five years although the number of first authorships is limited and the innovative and original contribution of
pathology staff is difficult to assess for the committee. The contributions to scientific knowledge in the different fields of the research groups show some significant new insights. Each research group has a good academic reputation and many researchers are known in the international community although the committee observes differences in research quality between the different research lines in the department. Most of the research is good, some even very good. An example of very good research is the urology work and the involvement in the WHO classification of prostate cancer. The committee recommends further strengthening this line of research in the future.

The productivity strategy promotes a diversity in research topics, due to the collaborative structure of the research strategy with other disciplines. This is typical for a pathology department but should be critically reviewed regularly. The department should discuss whether or not to focus on certain themes and improve the quality of the scientific output in those themes. A stringent structure regarding the cooperation with other departments is also required.

To the committee it is clear that time for research is very limited, the department is mostly doing diagnostic work. To develop into an innovative and exciting research department, more attention, resources and time should be given to scientific activities.

Over the past years, several PI’s left the department and the committee encourages the management team to replace them by young, talented and strong researchers to build up the research portfolio. On the basis of tissue-based analysis, the department is likely to strengthen the quality of the research in more breadth in the upcoming period.

Relevance to society
The impact and relevance to society of the research done in this department is very good. The committee came across several impressive examples, like studies on molecular analysis of patients with suspected Lynch Syndrome (LS), colorectal and endometrial carcinoma as well as prostate cancer. Also, the adaptation related treatment strategies are good examples of societal relevance.

The committee is impressed by the large biobank, but at the same time questions whether handling and organizing of a biobank should be a central task of a pathology department. It is suggested that such a biobank should constitute as a core facility of the Erasmus MC. The bioinformatics work reaches a large part of the research and clinical work at Erasmus MC. The wide-reaching support is impressive as is the international participation in Horizon 2020 projects.

To get to the next level of impact and societal relevance, the committee recommends to increase the number of products for societal target groups and to continue to work on the connection between research and clinical work.

Viability
The strategy of the department going forward is clear and includes sound ideas. The SWOT-analysis in the self-evaluation report is adequate but shows that research is a rather small part of the work in the department. This is not uncommon for pathology departments internationally.

Funding results over the evaluation period show fluctuations but with an increase in 2019 and 2020, this is promising considering future viability. Having several Horizon 2020 grants displays the fact that the department are welcome partners in international joint projects.

The work on molecular pathology was not extensively mentioned in the self-evaluation report but seems to be a significant part of the research performed by the department. Going forward, the committee is of the opinion that molecular pathology should be organized as an integrated part of tissue-based diagnostics. Combined reports mentioning both results as joint diagnosis are recommended.

The committee already mentioned the connection between research and clinical work as a point of attention. This includes the image and openness of the department; the viability will definitely increase if the connection with the clinic – and even with patients – is enhanced, e.g. initiate patient hours to inform patients about their tumour and have them ask questions.

Recommendations
The committee makes the following recommendations:

1. To clarify the structure of routine diagnostic, research, bioinformatics and biobank to optimize the department’s potency.
2. To make a clear distinction between the department’s own original research and supportive research of other groups and departments to avoid diffusion of its capacity.
3. To actively acquire samples from other universities to increase national relevance and to broaden research possibilities – of course, this must be accompanied by an adequate performance related reimbursement by Erasmus MC.
4. To substitute the PIs who left the department, as a clear priority.
5. To consider how to increase the visibility of the department inside Erasmus MC and beyond, with consideration of actively increasing local collaborations.
VII. Department of Pharmacy

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Mission and strategy

The Department of Pharmacy’s research aims at individualizing and optimizing patient drug therapy, both within and outside of the Erasmus MC. This goal is being achieved through research in the field of model-based dosing, (paediatric) clinical pharmacology and clinical decision support. The most effective teaching tools in these fields are also being investigated.

The department has three research lines:
1. Medication Optimization and Safety
2. Model-Based Dosing
3. (Paediatric and Perinatal) Clinical Pharmacology

The mission, strategy and targets of the department seem to fit in the Erasmus MC strategy to represent an excellent medical care and research centre. The young management team of the Department of Pharmacy is strong and ambitious, has a clear mission and vision for research in clinical pharmacology and clinical pharmacy. The middle- and long-term perspective for the department’s research perspective is clear: to consolidate and increase national and international scientific visibility in pharmacy.

The committee is confident that the attitude towards research in the department is very good. Clinical staff is encouraged to engage in research, e.g. all pharmacists are expected to do research and publish. Not all publications necessarily have to be top research publications, there is ample opportunity to also focus on application and medication safety issues.

The hiring of a statistician for research purposes supports the strategy of the department. The committee is furthermore very positive about the appointment of part-time professors, this is an innovative and successful approach to strengthen research in this relatively small (research) department. The current part-time professor is an important factor in mentoring young talents, is involved in meetings and present in the pharmacy about one to two days per week. This appointment also coincides with the Erasmus MC vision to collaborate internationally.

Collaboration with other departments in Erasmus MC is excellent, the department is clinically closely connected to other specialties. Increasingly, research cooperation is also established. The committee fully supports the ambition and wish of the department to further strengthen the interaction with other departments and groups in the D&A theme (e.g. with bioinformatics and nuclear medicine). According to the committee, one of the goals should be to strengthen the applied research on radiopharmaceuticals together with the Radiology Department. The committee furthermore encourages the department to strengthen research with innovative drug therapies, for example 3D-printing of individualized doses in cooperation with Delft University of Technology.

The PhD candidates in the Pharmacy Department were very positive about their research, training and supervision, they especially appreciate the combination of clinical work and doing a PhD. The PhD candidates have ample opportunity to talk to their supervisors, not only about their research but also about their future career and plans after finishing their PhD. Intervention sessions, English writing training and the yearly discussions on the progress and future career perspectives are well organized at the Pharmacy Department.

Research quality

Since the current chair took over the position of Department Head, the department was reorganized and the management team was reassembled. Since 2019, emphasis was put on the remodelling of teaching, research and education. Structure and content of the research areas were evaluated and strengthened. The research field of the department is limited to clinical pharmacy/pharmacology, which is a subspecialty of pharmaceutical sciences as implemented at a Faculty of Pharmacy. This makes it difficult to directly compare the research of this department to that of a Faculty of Pharmacy. However, the department started with 3D-printing, which is a typical research topic of pharmaceutical technology. This 3D-printing will be done in collaboration with TNO, an independent research organisation. Currently, there are several collaborations with Delft University of Technology. For the future there are planned collaborations with Delft University of Technology and the Faculties of Pharmacy in Utrecht, Leiden and Groningen.

The Medical optimization and safety research line is closely related to clinical care and clinical
decision support systems (e.g. dashboard integration of clinical rules) to improve patient safety. The impact of new technologies like apps, videos in patient care and medical students’ education is investigated. The Clinical Pharmacometrics research line is historically justified and closely related to the therapeutic drug monitoring. There are several multicentre projects and clinical studies that are run by the department. Research facilities (like the TDM Lab, genomics) are excellent to facilitate this research. The associate professor who is leading this research line is a strong leader in this scientific area. The intensity of the work in pharmacometrics is at a very high level and internationally recognized. The third research line, Drug Innovation, includes radiopharmaceuticals (in cooperation with the Radiology Department), 3D-printing of individual doses and ATMPs. This research line comprises typical research topics of pharmaceutical technology. The committee strongly encourages the department to increase research in this new and innovative area. The collaboration with the Faculties of Pharmacy in Utrecht, Leiden and Groningen facilitates the inflow and availability of (talented) master and PhD candidates.

The quality and productivity of the department’s research is very good. Over the review period, this department, with its modest number of research staff, has generated a substantial and increasing research output of approximately 50 refereed publications per year (even up to 77 in 2018). The wish and ambition of the department is to publish over 100 articles per year, which is accomplished from 2019 onwards. Both MNCS and the percentage of publications that belong to the top 10% of most frequently cited articles in their research field are high and have increased over the review period. The committee is of the opinion that impressive research is being done, and the department is in an upward trend towards excellent research in clinical pharmacy and pharmacology research. Professors and other research staff of the department are represented in the boards of several national and international professional organizations and working groups. This way of networking strengthens research collaboration.

In conclusion, the committee remarks that, considering the limited amount of time and the restrictions of funding, the research portfolio is extensive and the output remarkable. The department might not yet be world leading but has made significant steps in the period of evaluation.  

Relevance to society
The Pharmacy Department is internally and externally recognized for making a very relevant contribution to society by improving medication safety and patient safety by its research projects. The optimization of medication therapy as a research topic typically comes along with high societal relevance. An impressive example is the HARM wrestling project. The research in this project is focusing on the optimum dosing of medication with a narrow therapeutic window and vulnerable patient groups (like organ transplant patients, paediatric patients, IC patients). Increased efficacy and safety of medication therapy is important for the individual patient, the healthcare system, and the society as a whole. The committee also noticed that some projects are visible in media aimed at a wider audience. The committee would particularly like to mention the ‘Medicine of the Week’ films that are used by medical students throughout the Netherlands and are even popular among pharmacy students. These innovative teaching activities improve safe prescribing of medication therapy.

Viability
Over the past period, the department improved efficiency enormously. A lot of effort was put into remodelling of the structure and organization of clinical care, teaching and research. Strategic planning is ongoing and the research coordinators are highly motivated.

It seems to be a financial challenge to continue on this path and to grow in the near future. The core budget of the department is limited, particularly the historical allocation of direct funding is a disadvantage for this department that is a relative newcomer to research within Erasmus MC. The department is rather successful in acquiring research grants. However, not only does the application for research grants require human resources, so does the administration. Acquiring additional competitive funding might be risky because of the weak and very modest core funding. To help this department fulfil its mission of growth and excellence, support is required to take the next step in grant acquisition. Seed funding by the Erasmus MC would make a major difference. More generally, the committee supports the plans of Erasmus MC to initiate a tenure track programme for post-docs. This seems necessary for this department to be able to proceed and excel.
The committee acknowledges the major progress that was made over the past years. The central board should encourage this ambitious and very good department and help it fulfill the vision of growth and reaching the intended level of excellence.

**Recommendations**

The committee has the following recommendations:

1. The committee encourages the Pharmacy Department to keep clinical care, research, and education well-balanced and to emphasize research aiming to increase medication and patient safety.

2. The committee encourages the Pharmacy Department to develop the research line **Drug Innovation** in close collaboration with internal (e.g. other members of the theme, clinics) and external partners (e.g. Delft TU, Faculties of Pharmacy).

3. The committee encourages the Pharmacy Department to follow the path of innovative teaching of medical students and mentoring master and PhD candidates in pharmaceutical sciences.

4. The committee recommends facilitating the research efforts of the department by increased core funding. Seed funding, direct funding of projects, and funding of tenure track positions for postdocs seem to be adequate measures.
VIII. Department of Radiology & Nuclear Medicine

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Mission and strategy
The mission of the Department of Radiology and Nuclear Medicine is to perform world-leading and biomedical imaging research across the full breadth of research areas and thereby advance disease prediction, precision diagnostics, theranostics and image-guided therapies. The department contributes to both disease prevention in healthy populations and improved diagnosis and treatment strategies in patients by investing in multidisciplinary collaborations, by creating a supportive infrastructure and by identifying and fostering talent at all levels and areas of expertise.

The department has thirty individual research lines that are organized within four main research focus areas:

1. Biomedical Image Acquisition & Analysis;
2. Molecular Imaging & Therapy;
3. Clinical Imaging;
4. Imaging in Health Sciences.

The stated mission of the department includes offering a full range of research from fundamental preclinical through to translational and clinical research for early precise diagnosis and image directed therapy. The aims are to develop multidisciplinary collaboration working in a supportive department that identifies and fosters talent. The committee found that the department meets this strategy, with clear evidence of breadth and depth of research from bench to bedside, including interventional and theranostic PET research. The clinical research focus seems to be predominantly neuro- and cardiovascular – with the data science topics appearing to support these areas.

There is excellent leadership, with an appropriate management structure and delegation within the department. The leadership is open to recognizing the strengths and weaknesses of the department. The department demonstrates excellence in clinical care as well as care for the members of department. There is clear evidence of diversity and inclusion. There are practical systems in place for rewards and recognition for members of staff that have made outstanding contribution or demonstrated improvements, by support for research and presentation activities. Talented junior and mid-career research staff recognize the difficulty related to the lack of tenure track or talent management on the science side (not so much on the medical, clinical side). It would be worth considering if improvements could be made in this aspect of supporting a talented group of scientists.

A current common problem in radiology departments is lack of access to a trusted research environment that incorporates imaging and clinical information. Academic health centres grapple to integrate confidential big data in a safe way. The department is working towards a trusted research environment and is on a good path. However, achieving this complex task does need wide collaboration across the institute.

The incorporation of the Biomedical Imaging Group Rotterdam appears to be an important strategic development allowing full integration of Medical Informatics into the department. Imaging departments often have many collaborations due to the cross-cutting nature of the specialty. The range of collaborations that have been developed in this department are extensive. There are good regional and national collaborations as evidenced by the work with the SME Quantib-U, Delft University of Technology, and participation in multicentre Dutch trials. International collaborations are equally extensive, including EORTC, COST action, and international consortia with Harvard, Stanford, Duke, UCLA, UCL, CHUV and King’s College London. There are commercial collaborations with both large imaging vendors and SMEs.

In particular, the committee observed a very strong collaboration with Pharmacy, with the recent developments of radiopharmacy. However, surprisingly, there did not seem to be significant research collaboration with the Department of Pathology at Erasmus MC, even though the connection between radiology and pathology is an obvious one in other institutes. This represents an opportunity for potential research interactions, for example in radiomics and pathomics.

Overall, facilities are very good. The use of dedicated research management software (PaNaMa) for human-centred studies demonstrates good research governance planning. The department also has an Imaging Trials Office in house. The IT infrastructure has been implemented.
by the BIGR group to support storage and standardization of analysis for large imaging data sets. The department furthermore has extensive availability of MR research scanners. More challenging is the access to the cyclotron research facility, which is limited and limits possible innovations in radionuclide tracer development and translation. The committee stimulates the department and Erasmus MC to work collaboratively with cyclotron providers to increase cyclotron access in the upcoming period, as this will enhance the development of tracers and research and translation of theranostics approaches.

The PhD candidates feel supported and valued. There is a reasonable structure for supervision and training and the support during the pandemic was reasonable. Several of the radiology PhD candidates have progressed to be appointed at Erasmus MC in their clinical field of expertise. The PhD candidates are closely linked to clinicians, both the engineers/scientists and the clinical research fellows.

**Research quality**

The department achieves the highest level of research output internationally over a sustained period. The high MNCS demonstrates the scientific relevance of the department’s publications, and the breadth and range of research undertaken is truly remarkable. The research includes major advances with clinical impact on brain, ageing, stroke, dementia, and prediction models of coronary artery disease. Furthermore, the committee commends the validation and use of developed imaging biomarkers in multiple population imaging studies and multicentre trials. The publications are cited within the highest level of global academic institutions. However, the publications quoted in the self-evaluation report are largely limited to neuro- and cardiovascular imaging. These are indeed published in high impact journals, but other clinical topics are not substantially included in the self-evaluation report.

The committee initially worried somewhat about a lack of in support between research groups in the department. However, in the discussion with the scientific staff, it appeared that there is adequate support for smaller groups with seed funding to develop innovative ideas. The committee concludes that despite the emphasis on neuro- and cardiovascular imaging, there is clear support for high quality research on other topic areas. The committee considers the new developments within nuclear medicine and theranostics to be really exciting work for the future.

The academic reputation of the department is high. Members of staff serve as chairs of various European initiatives (e.g. EORTC and advisory board EIBIR). Scientific staff furthermore received many awards.

Although productivity strategy is successful, considering the many high impact publications, the committee encourages collaborations between the PIs. The department has increased in size over the review period to 116 scientific staff in 2018. The committee learned about more promotions that are recent and the joint appointment of four PIs across imaging and the Department of Epidemiology.

**Relevance to society**

The department has very strong links with clinical care. The committee thinks that this really leads to the excellence of the research which is embedded in unmet clinical need and patient care. Members of staff across the department (even the engineering PhD candidate in machine learning) described regular meetings with the clinical teams. Clinical radiologists as well as scientist and engineers are embedded in the clinical care interaction, either in the MDT setting or close research collaborations, providing a model for convergence science research in this era of AI.

The department has an extensive research portfolio that includes common diseases (and thus highly impactful on society) in brain health, cardiovascular health and data science but also include some areas of less common disease for example neuroendocrine tumours. The research undertaken by the department indeed has been practice changing with an impact on patient outcomes. For example, the validated coronary artery prediction model now being included in QxMD ‘calculate’ app. Large epidemiology studies in brain health are outstanding and this work will provide fruitful research and impact for years to come. Furthermore, important societal impact of the research into endovascular treatment of occlusive stroke is observed, it led to FDA approval and is now part of the clinical care world-wide, transforming stroke outcomes.

The committee finally wants to mention the development of two commercially available quantitative imaging biomarkers (CE marked and FDA approved) and the development of theranostic somatostatin imaging and therapy,
FDA and EMA approved and commercially available.

These examples show strong evidence of societal relevance and many marks of recognition. There is one potential threat the committee observed, which is lack of sufficient dedicated research time of some of the clinical teams in order to follow through on some of the research fields that radiology needs to interact with.

**Viability**
The future direction and aims of the department are outstanding and the department is clearly viable and faces a bright future. The department has a vision to become an integrated diagnostic department and this is an important ambition for diagnostic themes.

The department has a young and very enthusiastic team of PIs. The management clearly recognizes the need to retain talent and works hard to do so. There is a plan to improve the researcher’s environment; simplifying and improving administrative procedures, to increase personal attention to staff and raise job satisfaction levels. Furthermore, there has been a recent appointment of a senior researcher in translational molecular imaging, with investment in GMP facilities for synthesis of new compounds. This will allow for development of the molecular imaging research programme. The appointment of a professor in A.I. in Medical Imaging Analysis and a professor in MRI Physics in Medicine, together with other appointments such as a head of Research and Training, demonstrate appropriate development of academic careers.

Clearly, the leadership of the department has been outstanding, displayed by the development of the clinical and academic outputs over time. As the current chair is due to step down shortly, there is a need for the Erasmus MC and department to carefully plan for hand-over, to ensure the viability of the department going forward. Following such a successful chairmanship, the transition may be challenging and recognizing this may allow the right support to be put in place to make this as seamless as possible, in order to avoid loss of impetus. In the department there is a breadth of young PI’s with very strong outputs, independent thinkers and a strong team supporting the department chair. The committee is confident that Erasmus MC will work hard with their search committee to find a next talented leader. This new chair will have challenges but to the committee it is clear that the current chair is willing to hand over very effectively and to support the new chair.

In the self-evaluation report, the strengths and opportunities are clearly described. The areas of threats and weaknesses are identified and are recognizable difficulties in imaging research generally. The range of research in the department is wide in some areas but appears limited in other areas (e.g. pulmonary, oncology, urogenital and abdominal). This is not explicitly mentioned as a weakness but according to the committee a point of attention. Clearly, the dept does need to retain research focus and cannot cover all areas but where a talented member of staff wishes to develop, the opportunity should be provided.

The facilities for population imaging are being upgraded and this is a strong area of future research. Financial stability is achieved by a range of funding sources and income from spin-off company (Quantib BV).

**Recommendations**
The committee has the following recommendations:

1. The committee recommends institutional support for developing a robust integrated trusted research environment that includes imaging and clinical data, together with appropriate access to expert bioinformatics support.
2. The committee recommends that the department consider the opportunities in collaborating with the Erasmus MC pathology department where there may be untapped potential, particularly in view of the ambition to become a department of integrated diagnostics.
3. The committee recommends that the career development support for scientists be reviewed with consideration of a possible tenure track in order to retain outstanding scientists at Erasmus MC.
4. The committee recommends a review of cyclotron access, which is critical in view of the radiotracer developments in the Departments of Radiology and Pharmacy.
5. The committee recommends significant attention and planning related to the upcoming change in chairmanship.
IX. Department of Viroscience

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**Mission and strategy**

The mission of the Department of Viroscience is to limit the clinical and public outcomes of major-impact virus infections through an integrated field-to-bench-to-bedside approach. Its research consists of studies focused on virus-host interactions from different perspectives (virus, individual host, host population) and on improving prevention and intervention strategies against virus infections, both at the patient and population level. In the opinion of the committee the objectives are well-chosen and well-defined. The department has developed suitable strategies and evidently lives up to its mission.

An important and welcome development that took place over the review period is that Viroscience has drastically reduced the number of research lines, from 28 to 7 principal lines of research:

1) Emerging infectious disease research preparedness and response in a One Health context;
2) Emerging disease (immune)pathogenesis, and medical countermeasures;
3) Influenza virus ecology, evolution, pathogenesis, and public health impact;
4) Immunopathogenesis of paramyxoviruses and pneumoviruses;
5) Neuroimmune Biology of Virus Infections;
6) HIV and HCV;
7) Clinical Virology.

The seven research lines are clustered into two main pillars of research: ‘One Health’ (lines 1-3, including both human and animal research) and ‘Personalised Health’ (lines 4-7).

The department has impressive collaborations with national and international partners. At the national level, it is one of the initiators of the Netherlands Center for One Health (NCOH), where key players in the Netherlands collaborate on infectious diseases with a one health approach. Indicative of its high international repute is that the department hosts three World Health Organization (WHO) national reference laboratories: influenza, measles and rubella and emerging infectious diseases (EID) – viral haemorrhagic fevers and arboviruses, in particular. The committee considers this an exceptional accomplishment.

Internal collaborations are essential for the clinical virology research line. The department describes that cooperation has also been established for the other research lines in the personalized health pillar. There is additional opportunity for collaboration within Theme D&A, but as the committee notes, the grouping of departments in the theme is more organisational than content based. Viroscience does strive to have collaborations but needs to be selective given the wide portfolio in Theme D&A. Current collaborations with the Department of Pharmacy on the design and production of oncolytic viruses are interesting and deserve to be taken forward.

The committee was informed that there are plans to join forces with the Department of MMID by founding a joint Institute for Infectious Diseases. Within Viroscience, the conditions under which this institute is established are seen as an important determinant of future success. The committee concludes that further conversations and alignment between stakeholders will be essential to maximize the potential of the planned Institute for Infectious Diseases.

The interviews confirmed that Viroscience is a coherent and well-run department, with strong leadership and broad support from its staff. Representatives of the department mentioned that there is a positive working environment, with sufficient opportunities for bottom-up initiatives. The culture within the department was described as ‘work hard, play hard’. This attitude has certainly contributed to the many accomplishments of the department but may also be somewhat of a pitfall during a global pandemic, when the work-life-balance of staff is easily compromised.

Overall, the department has access to state-of-the-art facilities, which enable scientific achievements at the highest level. In particular, the core-funded BSL-3 animal facility is a strong component of the department’s success. There were some signs that the department would benefit from advanced inhouse data science and increased computational power.

**Research quality**

The department’s research output is excellent. Over the review period, Viroscience has established itself as one of the most influential
research groups in the worldwide field of emerging infectious diseases, while its work on endemic diseases is consistently strong. The originality of publications is very high, and many publications appear in highly prestigious journals such as Science, NEJM, Nature and the Lancet, or in highly ranked specialized journals. The speed with which the department completes the research cycle and gets its results published is impressive. All seven research lines have contributed to the high-quality scientific output during the review period (2013-2018) and two subsequent years.

Viroscience has unique competences in animal/human interaction, with strong animal models/tissue cultures and is well placed for old and new studies of zoonotic viral infections. During the pandemic, the department was able to make an outstanding contribution to the research on the spread of SARS-CoV-2 in animals and humans. Similar high-impact studies were done for MERS and SARS-CoV-1. The research line on emerging diseases has concentrated on collecting agent sequences and merging data into feasibility, to be able to predict coming infections from animals which may infect and spread in humans. This effort is done together with national (NCOH) and European networks (COMPARE, SHARP and VEO), with Viroscience researchers taking leading roles.

The department has a biobank for animal samples which is used for specific topics. There are surveillance projects for avian influenza, Usutu and West Nile virus in wild birds, arboviruses in mosquitoes (in partnership), and dedicated surveys of wildlife in collaboration with the Dutch Wildlife Health Centre. The animal work is organised in collaborative projects, and ad hoc contracts in response to outbreaks. For instance, Viroscience has been deeply involved in the studies of SARS-CoV-2 in mink, cats and dogs, and wild animals over the past year. These activities are part of the joint efforts in NCOH.

The committee established that there is proactive financial management with 70% of income derived from competitive funding. The level of funding appears to be appropriate, with well-staffed research/clinical diagnostic lines and very active PhD recruitment. There is an active ambition to constantly apply for grants locally, nationally and internationally. A key issue is getting proper funding for doing more clinical virology research and there is a wish to receive more activity-related direct funding from Erasmus MC. Strategic collaborations both within the centre but also nationally may be a way forward.

There is a strong annual average of 3-6 PhD completions and the substantial PhD population seems appropriately diverse in terms of ethnicity and gender. The talent fund within the department can support new ideas or projects that have difficulty finding seed money. Viroscience coordinates a grant from the Netherlands Organisation of Scientific Research (NWO) that funds 26 PhD candidates working on arbovirus infections in nine partner institutes. All PhDs have supervisors in two different institutes in order to strengthen the collaborations.

Scientific integrity appears to be at the highest level, with the research culture emphasizing the sharing of ideas and data through frequent meetings at all personal levels.

Relevance to society

The department makes an excellent contribution to society, not just by conducting intrinsically relevant research, but also by way of targeted public health valorisation efforts and (inter)national advisory work. The department’s work on emerging viruses in both animals and humans (e.g. SARS, MERS, Ebola, Zika: research lines 1-3), as well as its longstanding research on the treatment and prevention of high-impact endemic diseases (e.g. influenza, HIV, measles, noroviruses: research lines 4-7) is highly visible and has resulted in world-wide recognition, not just from peers but also from society at large.

Individual staff members are recognized as world leading experts and have had a significant impact on policy. Most notably, the head of department has been a trailblazer in the Covid-19 pandemic response. She was part of the recent WHO mission to China and co-developed diagnostic assays used by many laboratories around the world. Similarly, for influenza and other viral threats, staff of the department are key players and important strategic advisors to national and international organizations.

The assays for the many viral pathogens that the department concentrates on are also performed for external institutions and protocols are widely shared. Sophisticated assays and reagents for viral diagnosis and immunoassays for prognosis are developed (e.g. for measuring viral HIV), both for animals and for humans/patients. These assays and reagents are shared with collaborating hospitals and centres locally, nationally, in Europe and through three WHO centres.
Notably, Viroscience is a national reference centre for emerging infections, influenza and measles. As such, the department routinely contributes to the development of guidelines, under the coordination of the National Institute of Public Health. The reference role is fulfilled by linking the highest quality of diagnostic work to clinical advice, through the unit clinical virology and specific research on the different topics through the unit research. Worth mentioning is the department’s participation in clinical attempts to cure HIV with Spanish collaborators through immunotherapy or eradication of latent viral reservoirs. Findings of a therapeutical HIV study paved the way for therapeutic HIV vaccine strategies based on antigen-encoding RNA to specifically target antigen-presenting cells. These studies were one of the first to use viral messenger RNA as vaccines in humans. Twelve patent applications have so far been submitted and three of those have given rise to a wider application at the department. This has resulted in some money flowing back, which is invested in the abovementioned talent fund.

Viability

From the documentation and interviews, the committee established that Viroscience faces the future from a position of strength. The department has an excellent reputation and is well staffed by scientists who participate both in the research lines and in clinical diagnostics. The team is strong, with an energetic climate full of ideas and actions. A SWOT-analysis performed by the department rightfully identifies the research capacity, the funding portfolio, the national and international collaborations and extensive networking as strengths that contribute to viability.

The current Covid-19 pandemic has highlighted that the department is ideally positioned for pandemic research related to the animal/human interface. The department was clearly well prepared for, and delivered world class science on, SARS-CoV-2. The committee sees a continuously strong need for such studies to be performed to inform about risks and prevention against previous (SARS, MERS), ongoing (SARS-CoV-2) and coming (unknown) zoonotic viruses. The department has a collaboration through the Coalition for Epidemic Preparedness Innovations (CEPI), which further enhances its excellent position for contributing to novel vaccines for yet unknown pathogens.

The scientific and societal demand is not limited to the work on new viruses. There is a similarly strong and continuous need for high quality identification and treatment of common viral diseases that today have no specific treatment. This is obvious in both developed and developing countries, and specifically in vulnerable patient populations such as those with underlying chronic diseases, i.e. diabetes, immunomodulating diseases and tumours. Viroscience has the potential to lead the way to true one health research and the committee looks forward to seeing more of this in the future.

Contributing to the department’s position of strength is its involvement in many networks and consortia. As mentioned, Viroscience hosts three WHO collaborating centres, which come with world-wide collaboration and influence. New networks and consortia are constantly being planned for, which is admirable. The committee points out that coordinating current and future partnerships will require a good level of middle management. It found that the department perhaps underestimates the difficulties with respect to high quality recruitment. Putting in place an Erasmus wide tenure track system could facilitate things at the departmental level. Also, the committee would like to see more cohesive interaction between departments of Erasmus MC. The research line on HIV and HCV was struck by the recent death of a senior researcher, who was a strong leader in the HIV field. His loss, however, seems to be mitigated well.

While the committee sees a strong potential for further growth, it stresses that expansion will have to be supported by increased funding. Like other departments, Viroscience has found that there is a constant difficulty to fund expensive clinical research – if it is not financed by industry. Verifying the stability of long-term funding and finding a healthy size is thus important. A particular issue that was mentioned in the interviews is that income from patents (which finance the talent fund) might run dry, while at the same time the moral obligation to be critical when applying for patents appears to be more strongly felt than before. The committee concludes that policymaking on this issue is needed, as it would be a shame if important work that benefits us all is not carried out because of not getting patents.

Finally, the committee remarks that the department relies on expensive facilities. Particularly important is the core funded BSL3 animal facility. Going forward, this facility will require more support from the central level to remain innovative and ahead of the field. Investing in inhouse biometrics and genetics is also advised.
**Recommendations**

The committee makes the following recommendations:

1. Strengthen the existing interdepartmental collaborations within Theme D&A and Erasmus MC. The committee specifically advises to encourage interactions with Immunology for vaccine development and Pharmacy for GMP substance productions.
2. Continue to use WHO centres to further widen international collaboration.
3. Aim to retain and even enlarge the animal facility, as animals provide unique models for investigating viral pathogenesis and immune response and facilitate preclinical studies of vaccines and antivirals.
4. Consider strategies for long-term funding to obtain stability at a high level.
5. Achieve clarity (both at Erasmus MC and department level) on the exact plans regarding an Infectious Disease Institute, as current expectations amongst stakeholders seem to differ.
Appendices
Appendix 1: CVs of committee

**Prof. Manfred Dietel (chair)** is a pathologist specializing in molecular tumour pathology, evaluation of biomarker, targeted therapy, drug resistance and telepathology at Charité-Universitäts Medizin Berlin. Previously, Dietel worked at the University of Hamburg and Christian Albrecht’s University in Kiel. Throughout his career, he researched the chemoresistance of malignant tumours and was involved in the WHO classification of gynaecological tumours. He is also a former dean of the Medical Faculty of the Charité, medical director and managing director of the Charité and president of the German Society of Pathology. Dietel (co)authored more than 200 peer reviewed articles and book chapters. He received several scientific awards and honours, including the Rudolf Virchow Medal (2015). He is editor and reviewer of several scientific journals.

**Prof. Maurizio Ferrari** is full professor of Clinical Pathology, director of the Clinical Molecular Biology and Cytogenetics Laboratory, and head of the Genomic Unit for the Diagnosis of Human Pathologies, Division of Genetics and Cell Biology at University Vita-Salute San Raffaele in Milan, Italy. He is also the president of the European Society of Predictive Medicine. In 2004, he received the IFCC-Abbott Award for Significant Contributions in Molecular Diagnostics. Ferrari’s scientific interests are oriented mainly on molecular diagnostic methods, nucleic acid circulating in maternal plasma, molecular studies of several genetic pathologies. In the last 4-5 years he has focused his research on the detection of foetal DNA in maternal plasma for non-invasive prenatal diagnosis and for diagnostic application in the genetic and oncology field. At present, his research is focused on the development of diagnostic tests with the application of the next generation sequencing and on liquid biopsy applications in oncology with specific focus on new technologies and methods standardisation.

**Prof. Irene Krämer** is the Director of the Pharmacy Department at the University Medical Center, Johannes Gutenberg-University, Mainz, and is also Professor of Clinical Pharmacy in the Pharmacy School at the same institution. She obtained her doctorate in pharmaceutical chemistry and continued her postgraduate education at the Pharmacy Department of Johannes Gutenberg-University and went on to complete her postdoctoral thesis in Pharmaceutical Technology. She became Associate Professor at the Pharmacy School at Johannes Gutenberg-University before receiving her professorship in 2006. Krämer’s special interests and research areas include oncology pharmacy, infectious diseases, and aseptic drug preparation. She is currently conducting research projects in the field of physicochemical and microbiologic stability of cytotoxic medicinal products, compatibility of admixtures of nebulizer solutions, and monitoring of medication compliance and the impact of pharmaceutical care.

**Prof. Andrea Rockall** is Clinical Chair of Radiology at Imperial College London and Hon Consultant Radiologist at Imperial College Healthcare NHS Trust and at The Royal Marsden Hospital. Following graduation from King’s College Hospital, London in 1990 she trained in radiology at St Mary’s Hospital and University College Hospital, London. She was awarded the Rohan Williams Medal for the FRCR examination. Prior to her current appointment, she worked at Queen Mary University London, the London NHS Trust, Imperial and Royal Marsden Hospital. Her special interests are in genitourinary cancer, image-based clinical trials, functional imaging in response assessment and machine-learning applications in radiology. She is currently the Chief Investigator of the CRUK MAPPING trial in cervix and endometrial cancer and three NIHR trials MALIBO, MALIMAR (machine learning studies) and MROC (multicenter UK trial evaluating multi-parametric MRI in suspected or confirmed ovarian cancer).

**Prof. Marie Wahren-Herlenius** is professor of Experimental Rheumatology at Karolinska Institutet, Sweden and head of the Experimental Rheumatology Unit at the Department of Medicine Solna. Furthermore, she is president of the Scandinavian Society for Immunology. In 2010, she received the Göran Gustafsson prize in Medicine for scientific accomplishments. Her research is focused on autoimmune, rheumatic diseases, and aims at understanding the pathogenesis and disease mechanisms. Projects of her research group include basic investigations of cell and molecular biology character, studies in experimental models as well as clinical, patient-based investigations.

**Prof. em. Britta Wahren** trained as a virologist at the Karolinska Institutet in Stockholm, Sweden. For many years she has worked at the Department of Microbiology, Tumour and Cell Biology at the Karolinska Institutet as a specialist and later as a
professor of Clinical Virology. She and her group are designing and trying out vaccines against colorectal cancer and IV/AIDS. The group has shown experimentally that mainly antibodies but also the cellular immune system can destroy tumour cells and HIV-Infected cells expressing antigen-specific proteins, on the cell surface.

**Prof. Heiman Wertheim** is a professor of clinical microbiology and heads the clinical microbiology department at Radboud University Medical Center. He is also chair of the Radboud Center of Infectious Diseases. Until 2015, Wertheim was director of the Oxford University Clinical Research Unit in Hanoi, Vietnam. He coordinated laboratory capacity strengthening and conducted research in Southeast Asia. He worked on a broad range of infectious disease issues, varying from zoonoses to hospital acquired infections. One of his main interests is antibiotic resistance in both resource rich and resource constrained settings and does this through a multidisciplinary approach: health systems, policy development, behaviour, surveillance, prevention, genomics, and clinical trials. In the region of Nijmegen he is active in the Gelderland Antibiotica Resistentie en Infectiepreventie Netwerk (GAIN). Wertheim is also a board member of the International Society of Chemotherapy (ISC), advisory board member of RIVM/Cib – the National Center for Infectious Disease Control Netherlands and board member of the Dutch Society of Medical Microbiology (NVMM).
Appendix 2. Quantitative data

Clinical Chemistry Department
Composition of the department

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Immunology Department
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Medical Microbiology & Infectious Diseases Department
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Financing of the department

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Pathology & Clinical Bioinformatics Department
Composition of the department

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## Pharmacy Department
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## Viroscience Department
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## Financing of the department

### Pharmacy Department

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### Radiology & Nuclear Medicine Department

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### Viroscience Department

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## Appendix 3: Schedule of the site visit

### Wednesday 31st March

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<th>Topic</th>
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<td>10.00-11.00</td>
<td>Informal meeting of complete committee. Purpose: The complete committee is introduced to each other. Preparation site-visit, everyone clear on the agenda etc. Last minute questions are addressed.</td>
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### Thursday 1st April 2021

<table>
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<th>Time</th>
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<td>Dept. Pathology &amp; Clinical Bioinformatics</td>
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<td>08.45-9.45</td>
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<td>Management/Leading staff</td>
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<td>Programme: Presentation of 10 minutes, thereafter open to questions and discussion with the committee</td>
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<td>11.35-12.05</td>
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<td>Feedback with committee members and discuss concept report department</td>
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<td>Department of Pharmacy session 1</td>
<td>13.45-14.45</td>
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<td>Programme: Presentation of 10 minutes, thereafter open to questions and discussion with the committee</td>
<td>Programme: Presentation of 10 minutes, thereafter open to questions and discussion with the committee</td>
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<td>14.25-14.40</td>
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<td>14.40-15.40</td>
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<td>15.50-16.05</td>
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<td>Feedback with committee members and discuss concept report department</td>
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<tr>
<td>16.35-16.50</td>
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<td>17.20-17.50</td>
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Friday 2nd April 2021

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic parallel committee 1</th>
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<th>Topic parallel committee 2</th>
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<td></td>
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<td>09.00-09.15</td>
<td>Introduction and preparation</td>
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<td>9.00-9.10</td>
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<td>9.10-9.25</td>
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<td>10.25-10.40</td>
<td>Debriefing first session Radiology &amp; Nuclear Medicine</td>
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<td>9.25-10.25</td>
<td>Department of Clinical Chemistry session 2</td>
<td>10.40-11.40</td>
<td>Department of Radiology &amp; Nuclear Medicine session 2</td>
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<td>Feedback with committee members and discuss concept report department</td>
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<td>11.25-12.25</td>
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<td>12.35-13.10</td>
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<td>13.55-14.00</td>
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<td>Department of Immunology session 2</td>
<td>14.10-14.20</td>
<td>General session PhD-students and committee members</td>
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<td>14.10-14.20</td>
<td>Break</td>
<td>14.35-15.05</td>
<td>Feedback with committee members and discuss concept report department</td>
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<td>14.20-14.35</td>
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<td>14.45-15.05</td>
<td>Speed date round 1</td>
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<td>15.25-15.50</td>
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<td>16.15-17.15</td>
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<td>17.15-17.30</td>
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<td>17.30-17.45</td>
<td>Feedback session heads of department and committee (Dean present)</td>
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<tr>
<td>17.45-18.00</td>
<td>Time for questions by heads of department (Dean present)</td>
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<tr>
<td>18.00-18.15</td>
<td>Final appointments/conclusion of site-visits</td>
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## Appendix 4: SEP Assessment Scale

<table>
<thead>
<tr>
<th>Meaning</th>
<th>Research quality</th>
<th>Relevance to society</th>
<th>Viability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 World leading/ excellent</td>
<td>The relevant research unit has been shown to be one of the few most influential research groups in the world in its particular field.</td>
<td>The relevant research unit is recognised for making an outstanding contribution to society.</td>
<td>The relevant research unit is excellently equipped for the future.</td>
</tr>
<tr>
<td>2 Very good</td>
<td>The relevant research unit conducts very good, internationally recognised research.</td>
<td>The relevant research unit is recognised for making a very good contribution to society.</td>
<td>The relevant research unit is very well equipped for the future.</td>
</tr>
<tr>
<td>3 Good</td>
<td>The relevant research unit conducts good research.</td>
<td>The relevant research unit is recognised for making a good contribution to society.</td>
<td>The relevant research unit makes responsible strategic decisions and is therefore well equipped for the future.</td>
</tr>
<tr>
<td>4 Unsatisfactory</td>
<td>The relevant research unit does not achieve satisfactory results in its field.</td>
<td>The relevant research unit does not make a satisfactory contribution to society.</td>
<td>The relevant research unit is not adequately equipped for the future.</td>
</tr>
</tbody>
</table>