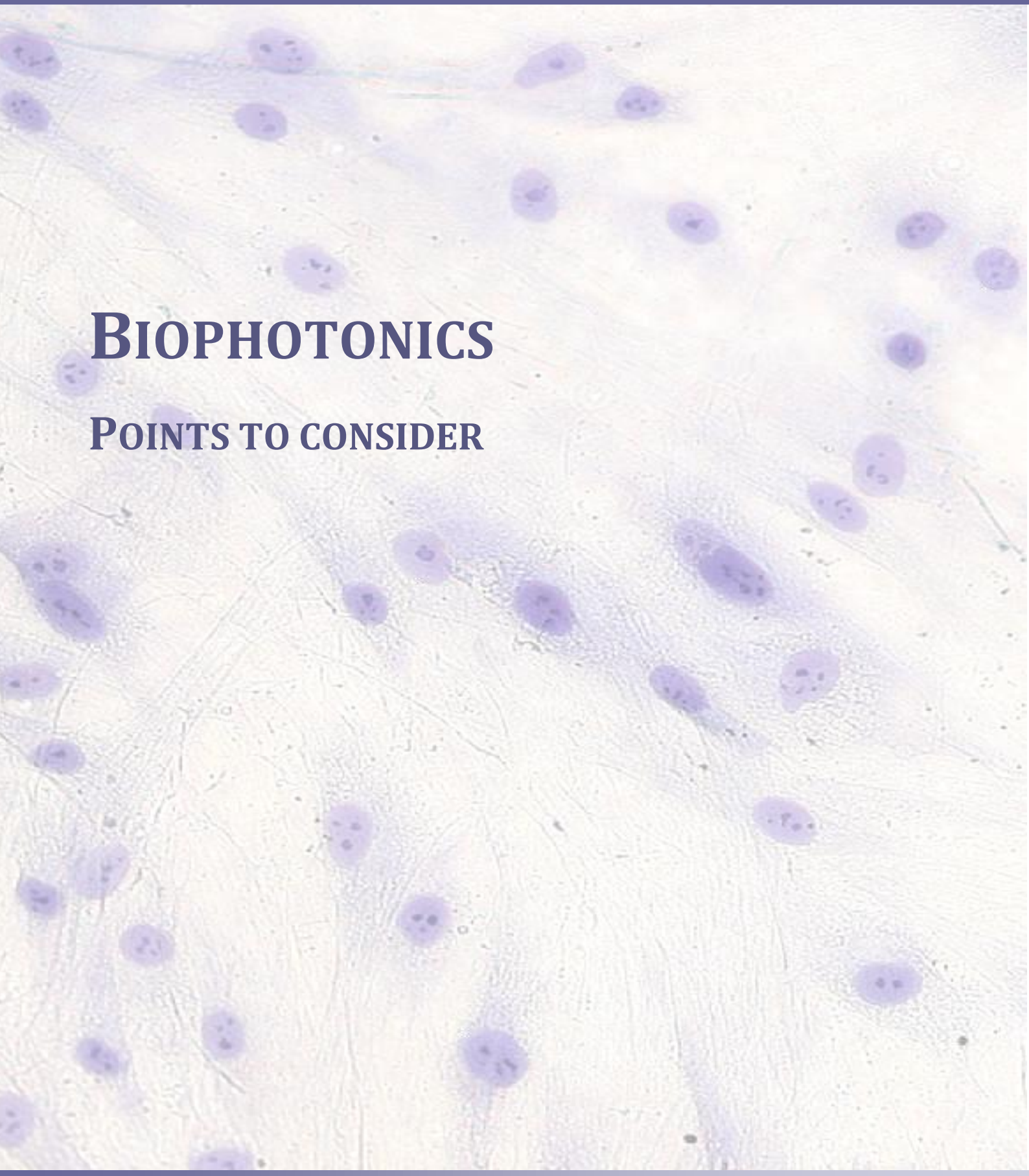

# BIOPHOTONICS

## POINTS TO CONSIDER

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centrum für bioethik

# Biophotonics

Bei der Biophotonik handelt es sich um einen multidisziplinären Forschungsansatz, in dem Licht-basierte Technologien in der Medizin und den Lebenswissenschaften genutzt werden. Der Begriff Biophotonik setzt sich aus den beiden griechischen Worten ‚bios' (Leben) und ‚phos' (Licht) zusammen.

Als sog. „enabling technology" soll die Biophotonik weitreichende Fortschritte in vielen Technologiefeldern und im Hinblick auf zahlreiche Anwendungsbereiche eröffnen. In der Medizin etwa verspricht man sich von der Biophotonik wichtige Beiträge zu einem besseren Verständnis von Krankheiten oder sensitivere und früher ansetzende Diagnosemöglichkeiten. Das hängt unter anderem damit zusammen, dass biophotonische Technologien es ermöglichen, dynamische Prozesse im Mikro- oder gar Nanometerbereich zu beobachten und zu kontrollieren.

Wie jede andere Technologie auch, wirft die Biophotonik eine Reihe ethischer, sozialer und rechtlicher Fragen auf. Diese waren Gegenstand eines Ethik-Workshops des Workpackage 11 „International contacts and cooperation, regulatory and ethical issues" des EU-Projekts „Photonics4Life", zu dem Prof. Dr. Gert von Bally (Centrum für Biomedizinische Optik und Photonik der Universität Münster und zugleich Leiter des WP 11) und Priv.-Doz. Dr. Johann S. Ach (Geschäftsführer des Centrums für Bioethik und Mitglied der WP 11 Task force) im Mai 2010 nach Münster eingeladen hatten. Photonics4Life (P4L) ist ein von der Europäischen Kommission im Rahmen des 7. Forschungs-Rahmenprogramms gefördertes European Network of Excellence für Biophotonik mit 13 Partnern aus 9 europäischen Ländern (http://www.photonics4life.eu/).

Die nachfolgend dokumentierten „points to consider" fassen, basierend auf einem Textentwurf von Johann S. Ach und Beate Lüttenberg, die Ergebnisse des Workshops in knapper Form zusammen.

# Points to consider

1. – Biophotonics is an ambitious, multidisciplinary research area that utilizes light-based technologies in medicine and life sciences. The term derives from two words of Greek origin: 'bios' means life and 'phos' light. Biophotonics refers to the interplay between light and biological matter. As an enabling technology biophotonics opens up hitherto inaccessible possibilities in combination with other technologies. Within medicine and the life sciences biophotonics promises progress and new developments with regard to a better understanding of the origins of disease, improving diagnosis and follow-up care, preventing disease and treating patients individually and specifically ('personalized medicine'). Biophotonics could therefore make a contribution to reducing the risks of patients (e.g. minimizing ionizing radiation diagnostics, permitting non-invasive real-time diagnostics or and controlled tumor removal etc.), reducing animal testing or reducing health-care costs. How realistic these expectations might be is, at present, difficult to say. If and how biophotonics can improve the benefit of patients and the society will at least depend on appropriate ethical, societal and legal frameworks.

2. – Biophotonics opens up new ways in the early detection of diseases and systems/tools for high-throughput multiparameter diagnosis. Therefore it will have its share in an already ongoing trend in medicine that brings with it – amongst other things – a deepening of the gap between diagnosis and possible therapeutic action, huge amounts of health-related personal data, a shift to presymptomatic testing and preventive medicine and so forth. These developments do obviously pose a number of severe ethical, legal and social challenges such as the right (not) to know, the problem of data protection, the issue of screening or the risk of 3rd party misuse etc. that have to be addressed properly. Although these ethical, legal and social issues are well known from other branches of modern medicine such as genetic testing, pharmacogenetics or nanomedicine and are not in any way specific to biophotonics this should not deceive anyone in thinking that dealing with these challenges could possibly be superfluous. Thus, technological risks and ethical standards have to be analyzed and set up systematically.

3. – Biophotonics opens up the possibility to understand and manipulate things at the micrometer or even nanometer level. Micromanipulation techniques for example will allow to sort, move or modify cells. This links biophotonics to areas such as gen technology, stem cell research, tissue engineering, neuroscience or systems biology. Some of these techniques might also possibly allow for new ways of enhancing human performance features. Although biophotonics as an enabling technology will clearly have some impact in these areas it seems too early at present to forecast what the contributions of biophotonics will really amount to. In any case developments in the field deserve to be observed carefully in this respect.

4. – One of the central features of biophotonics is that one can look at dynamic processes with micro- or even nanometer resolutions. This will not only foster a better understanding of the origins and the causal mechanisms of diseases but also contribute to better, faster, easier and cheaper diagnostic testing and follow-up monitoring based on understanding and control of molecular processes within the cell. In this respect biophotonics is part of a 'concert' of new medical technologies such as pharmacogenetics, nanomedicine, telemedicine, e-health etc.. This process requires more than the identification of particular technological trends. We are facing a shift from symptom to presymptomatic medicine, from medical care based on patient's family history, social circumstances, environment and behaviors to (genetically based) 'individualized' or 'personalized' medicine, from curative to preventive care. This will not only bring about new problems of data interpretation and translation into patient diagnosis and treatment. Time slots between diagnosis and intervention might get smaller or therapeutic action even automated. One can also imagine that there will be more and more areas, where patients could (and are willing to) interpret data themselves – without access being necessarily mediated by the physician expert. Together with other technologies biophotonics might give rise or contribute to a (cultural) shift in a way that alters our understanding of medicine and our conception of the physician/patient relationship.

5. – Various techniques used in biophotonics have been developed in an industrial or military setting before migrating to medicine and the life sciences. This is one reason why many techniques and applications used in biophotonics are open for dual use, i.e. can in principle be used for both civilian and military aims. Laser applications, high resolution analysis tools or microscopy technologies can for example serve military purposes as well as human (or animal) health care goals.

6. – Biophotonics by now is largely technology driven. As the experience of the P4L project shows it is really difficult to bring together the technological side on the one hand with clinicians on the other hand. As has been said there is 'a lot of photonics, but few life' at present. This situation has to be changed in the sense that more clinicians become involved. In the end biophotonics research should answer clinical needs and be fueled by these more than by scientific curiosity or technical feasibilities. One goal might be to set-up spin-offs to 'translate' the technology into products. Also further action should be taken that pave the way to get biophotonics (and any other medical-technical) applications to the single patient. On first view these are organizational and political problems primarily, but they do obviously carry ethical implications.

7. – Biophotonics is a highly interdisciplinary and international endeavor. Both features can bring about ethical challenges: As an interdisciplinary endeavor research in biophotonics is often done by nonmedical scientists such as physicists. This may for instance prove problematic in a clinical context where health related data are obtained and have to be interpreted. As an international endeavor researchers in biophotonics are likely to be confronted with a diversity of different ethical standards and ethical or legal requirements.

This holds true even within Europe, where researchers are confronted with varied regulations (e.g. there are very different regulations in European countries on stem cell research or clinical trials), but to a good deal more in a global context. On could even say that there is not a technological gap only but also an 'ethical divide'. The challenges to be met in this respect are more or less generic in research contexts and not unique to biophotonics. To be sure one could for several reasons not even wish to arrive at an international adaption or harmonization of research standards. But obviously the (ethical) challenges originating from different standards in a global context should be kept in mind by government authorities, sponsors, and single researchers properly.

9. – Ethical reasoning about new technologies is sometimes depicted as one part of an endeavor based on division of labor: Scientists and technicians on the one hand develop know-how and applications, ethicists on the other hand thereafter enter the stage assessing the ethical, legal and social implications of these developments (or even phrase the 'right' wording for the ethics slot in the next research proposal). This picture of doing ethics is clearly misleading. Instead of a division-of-labor-approach we are in need for an integrated approach of doing ethics. Ethical analysis cannot be realized as an appendix, but requires a collaborative effort bringing together scientists, technology developers, ethicists and policy-makers on all levels: education, research and development, clinical application etc.; local, regional, national and international. This is often time and money consuming and no easy task to do at all as it means to bring together 'citizens from different worlds' who are speaking different languages and do clearly have different aims and goals. On the other hand it may turn out to be an often fruitful and exciting endeavor – most notably one without any alternatives if ethics should play a crucial role at all.

(Based on a draft by Johann S. Ach & Beate Lüttenberg, Centre for Bioethics, University Münster)

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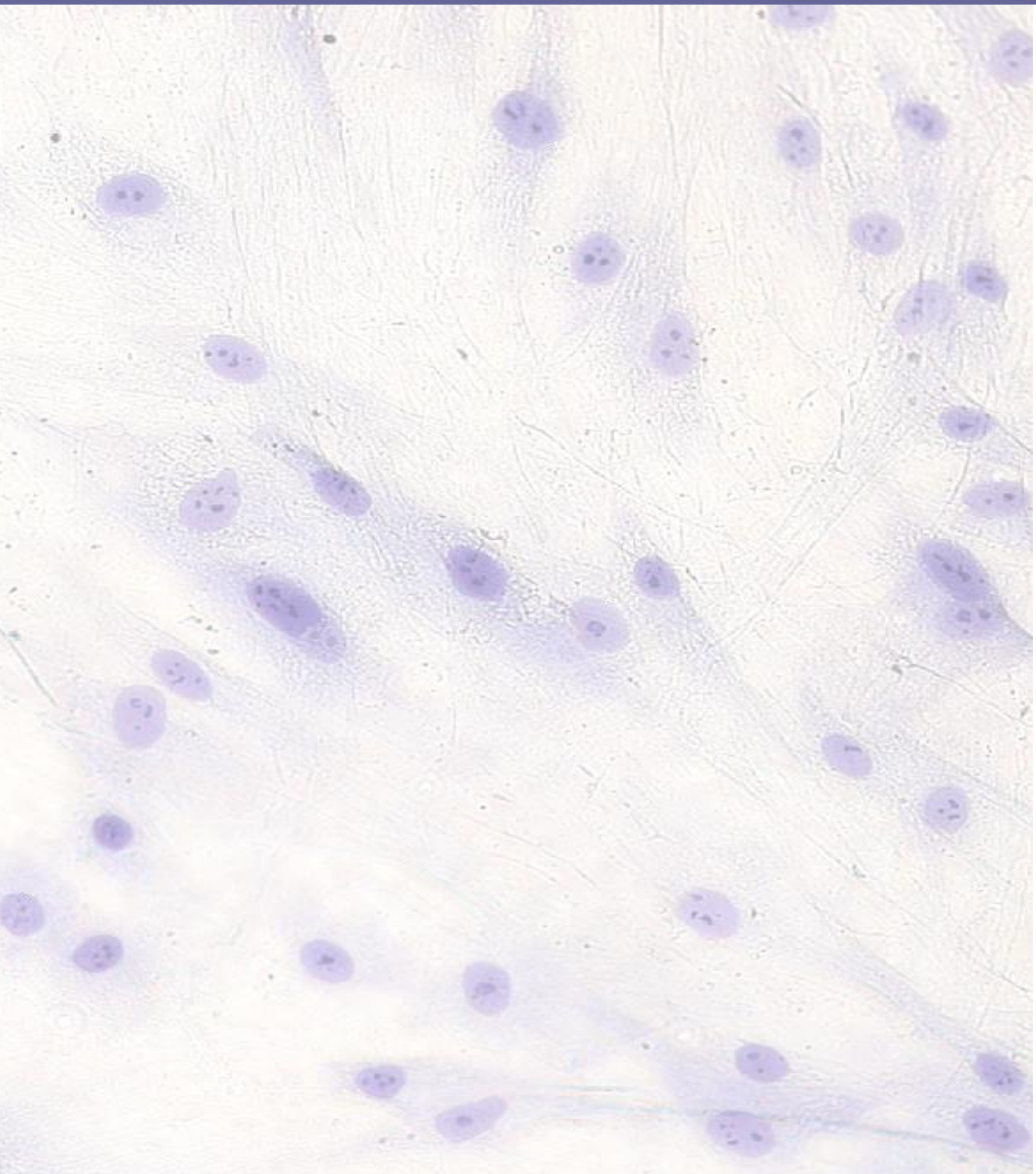

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