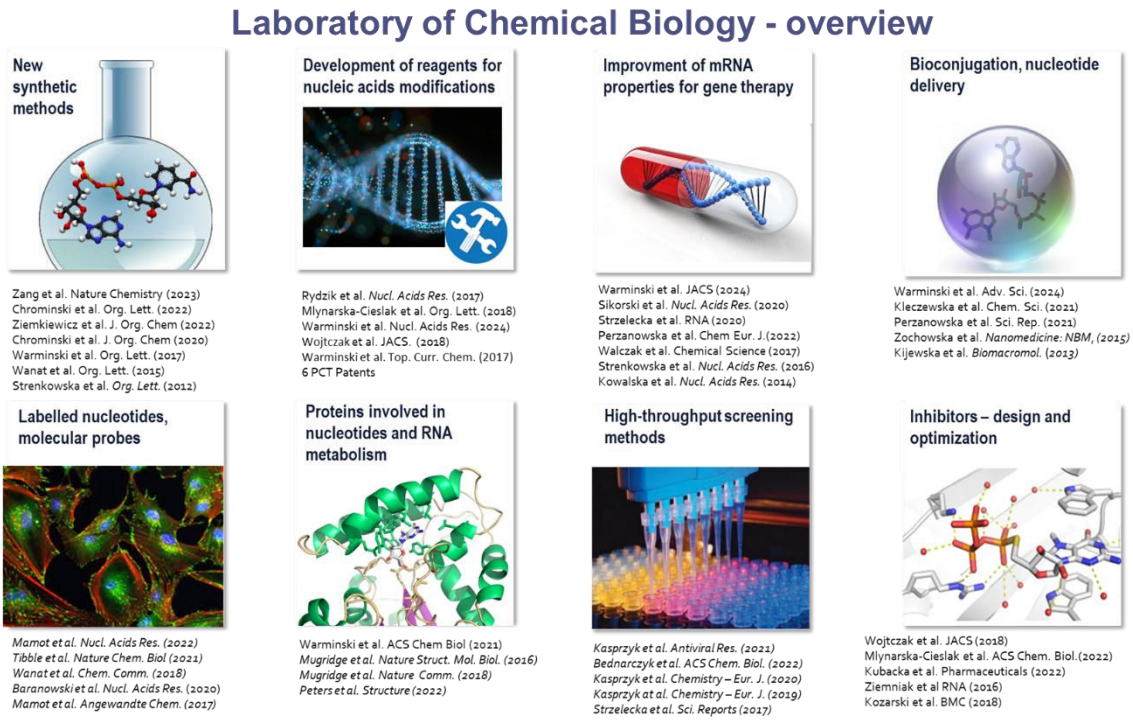
Chemically modified mRNA for therapeutic Applications

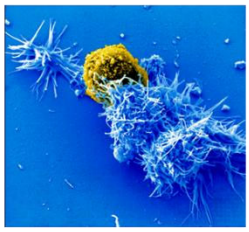
Prof. Jacek Jemielity

The Laboratory of Chemical Biology at Centre of Nw Technology University of Warsaw is interested in chemically modified nucleotides and nucleic acids (https://chembiobiochem.com). Due to the biological role of these molecules, their chemically modified analogs have tremendous applications in the development of molecular tools for research, diagnostic and therapeutic applications.



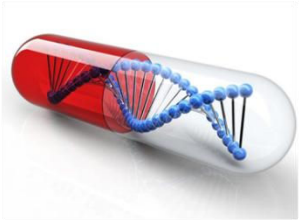
The team is particularly famous for modifying mRNA with a focus on improving its therapeutic properties. During the pandemic, mRNA technology had experienced its spectacular use in covidien vaccines, but its potential is much greater. For more than 20 years, Jemielity and his colleagues have been designing, synthesizing and studying the properties of nucleotide analogs of the 5' end of mRNA (so-called cap analogs). Their inventions are licensed to leaders in the field. One of them, beta-S-ARCA, an invention that increases mRNA persistence and translation efficiency, has been licensed to BioNTech, which is using it in a total of 12 clinical trials on anti-cancer vaccines. The potential of mRNA is much broader, encompassing not only preventive antiviral vaccines or therapeutic cancer vaccines, but can also be used in protein replacement strategies, genome editing, or cell therapies.

Antigens delivery



Cancer: immunotherapies based on dendritic cells

Protein suplementation

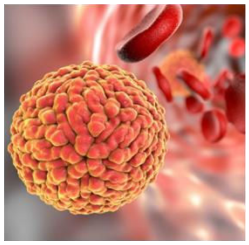


Genetic diseases
Metabolic diseases

Nuclease delivery

Gene editing by CRISPR/Cas9

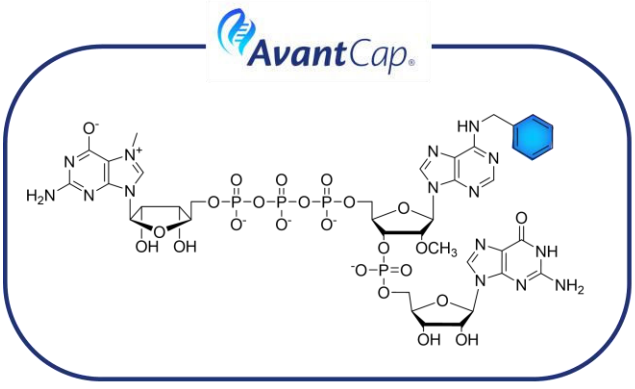
Regenerative medicine and cellular therapies

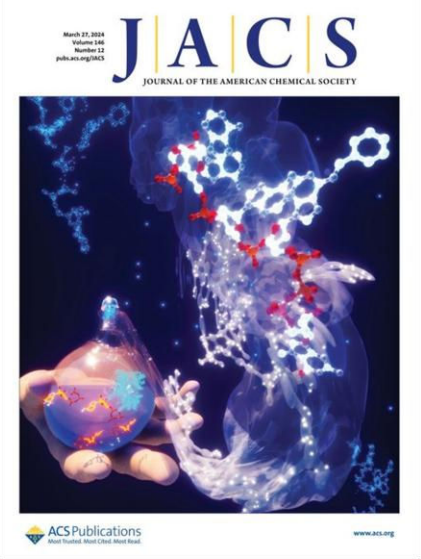


Vaccines against infecious diseases

Growth factor delivery (e.g. in cardiovascular diseases)
Generation and modification of stem cells or T cells

For these purposes, however, mRNA technology needs further refinement. Prof. Jemielity's team is creating new solutions, such as those that mimic post-transcriptional modifications, which further improve the therapeutic properties of mRNA to a much greater extent, increasing protein expression more than 10-fold in in vivo systems (AvantCap, https://doi.org/10.1021/jacs.3c12629). https://www.medexpress.pl/en/science-medicine/on-uw-done-over-in-research-mrna/





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A spin-off from the University of Warsaw, Explorna Therapeutics, was created based on some of these discoveries https://explorna.com. The company is developing new innovative solutions with focus on therapeutic applications. The company employs 30 people, 20 of whom are scientists, and has a strong focus on developing mRNA technology and developing proof of concept for new mRNA-based therapies, demonstrating the advantage of their inventions in this area. Prof. Jemielity's university team, on the other hand, has developed technologies for the chemical circularization of RNA, allowing the extension of protein expression under cellular conditions. This is particularly important for designing therapies against genetic rare diseases. Researchers are also developing research and diagnostic tools such as mRNA-based fluorescent probes for studying single mRNA molecules in complex biological systems. The long-standing experience of Warsaw University researchers in this area, documented by more than 150 scientific publications and numerous patents, as well as their experience in commercializing research, demonstrates their strong expertise in this area https://www.fnp.org.pl/en/prof-jacek-jemielity-laureat-nagrody-fnp-2021.

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