Epilogue
*Homo sapiens sapiens* have an urge to travel and explore. Travelling to remote countries and foreign cultures for leisure has become very popular and easy for the rich and with modern transport technology there are no limitations in this respect. However, wealth is very unevenly distributed amongst the world population. In 2014 eighty super rich owned as much as the rest of the entire world population. In contrast, more than a billion people earned no more than 1 Euro per day and in the last 15 years inequality in wealth has spiralled. Whereas the rich can travel and explore beyond imagination, the poor cannot afford to pay for their daily needs, including basic health care. Each year infectious diseases are responsible for the death of millions of people worldwide, most of them living in low- and middle-income countries and many occurring in children, due to a lack of medicines or improper therapies.

Migration is still one of the greatest threats for rapid spreading of infectious diseases and trend watchers in population mobility observed that internal migration (movement within a single country) occurs at even greater magnitude than international migration. By 2000, up to 185 million people lived outside their country of birth. In contrast, one billion people, or about one sixth of the world’s population, moved within their own countries, driven by various forces, including local conflicts, natural disasters, urbanisation and the search for economic welfare. Most economic migrants live in or come from low-income countries, but also in the industrialised part of the world poverty exists. In the Netherlands approximately 1 million people are living in relative poverty according to ‘Sociaal en Cultureel Planbureau’. As a result, annually nearly 300,000 people in the Netherlands fail to pay for their healthcare insurance, simply because they cannot afford to do so, also because of a high deductible. Therefore, many patients are not served well with the use of expensive medicines. Cheap and yet effective medication is needed and great challenges in this respect are faced in pulmonary delivery of particularly high dose drugs, like antibiotics. New developments like chip controlled (vibrating mesh) nebuliser systems may be very effective and reduce losses of expensive drugs; they are also very expensive devices and they need to be replaced on a regular basis. This, and many other drawbacks explained in the chapters 1, 4 and 7 makes them unsuitable not only for patients in low-income countries, but also for many patients in rich industrialised areas.

The design of the Twincer family of inhalers is a radical change in the strategy for development of high dose inhaler technology. The inhalers of this family are optimised to meet the physico-chemical properties of the compounds to be administered with regard to dispersion and retention. This is breaking with the habit of adding unwanted excipients to
the formulation or using complex and multi-step production techniques to make the drug formulation suitable for already marketed (and mostly capsule based) inhalers, that were not developed for high dose drug administration. The first two inhalers of this family are the Twincer™ and the Cyclops, which are designed for the administration of colistimethate sodium and aminoglycosides respectively, but they appear to be also suitable for many other compounds for which pulmonary administration could be beneficial. To reduce the manufacturing costs, the number of inhaler parts is kept low and moving parts are avoided. The Twincer™ and Cyclops have shown that this strategy can be very successful and this approach will therefore be further implemented in the Twincer family. This has also led to the idea of designing a so-called toolbox. This toolbox will partly be a modular system where parts can easily be exchanged to investigate the dispersion efficiency and inhaler retention of a particular compound. With this toolbox selecting the most appropriate dispersion principle based upon inertial forces, lift and drag forces or shear and friction forces for a specific compound will become less time consuming. In addition, compounds will be classified based upon their physico-chemical properties relevant to dispersion and inhaler retention. This will result in a library of compound characteristics associated with dispersion and retention properties like hygroscopicity, cohesiveness, adhesiveness, compactability, etc. As more compounds are included in this library, more knowledge is gathered with regard to what physico-chemical properties are most relevant for a certain dispersion mechanism. Therefore the more comprehensive this library becomes, the easier it gets to classify interesting new compounds and thus, to select the most appropriate dispersion principle for these compounds.

The potential of pulmonary drug delivery is enormous and the treatment of asthma, COPD and bacterial infections are only the beginnings. The lungs provide a large surface area for absorption for many types of existing drugs, but also for newly developed compounds. Furthermore, pulmonary vaccination, biopharmaceuticals like insulin, immunosuppressive drugs after a lung transplant and many more applications are worthy of investigation. In other words, this is only the beginning and the possibilities seem almost endless.