

Transforming HIV treatment with nanoformulations



OPTIMIZE – a global partnership to accelerate access to simpler, safer and more affordable HIV treatment – is investing in bringing nanoformulated antiretroviral therapy from the laboratory to the market to improve HIV treatment for patients and programs.

Current reality

The Joint United Nations Programme on HIV/AIDS (UNAIDS) 90-90-90 targets and the World Health Organization's (WHO) "Treat All" guidelines require a rapid expansion of access to antiretroviral therapy (ART).



Applying new technologies, such as nanoformulation technology, can help close the gap between those who are living with HIV and those who need treatment.

How can nanoformulation technology improve HIV treatment?



Nanotechnology is the manipulation of matter at the nanometer scale. By improving pharmacokinetic and pharmacodynamic properties, nanoformulation enables a target medicine to achieve the same drug exposure as the conventional formulation while requiring less active pharmaceutical ingredient (API). Therefore, nanotechnology offers an exciting opportunity to lower the dose as well as the cost of HIV therapy such that more patients could be put on treatment with the existing resources.

OPTIMIZE is enabling the work of the University of Liverpool (UoL) and **Unitaid-funded** Medicines Patent Pool (MPP) to develop nanoformulations of key antiretroviral (ARV) drugs.

ARVs for nanoformulation are selected based on the recommendations of WHO guidelines and the potential to improve HIV treatment options for patients and programs.

Current ARV Treatment



Lower bioavailability, meaning lower proportion of active drug circulating in the body



More of the active drug necessary for the ARV to be effective



Larger pill, harder for patients to take



Higher cost of treatment

New Nanoformulations



Increased bioavailability, lower dose required to achieve equivalent drug circulating in the body



Less of the active drug necessary for the ARV to be effective

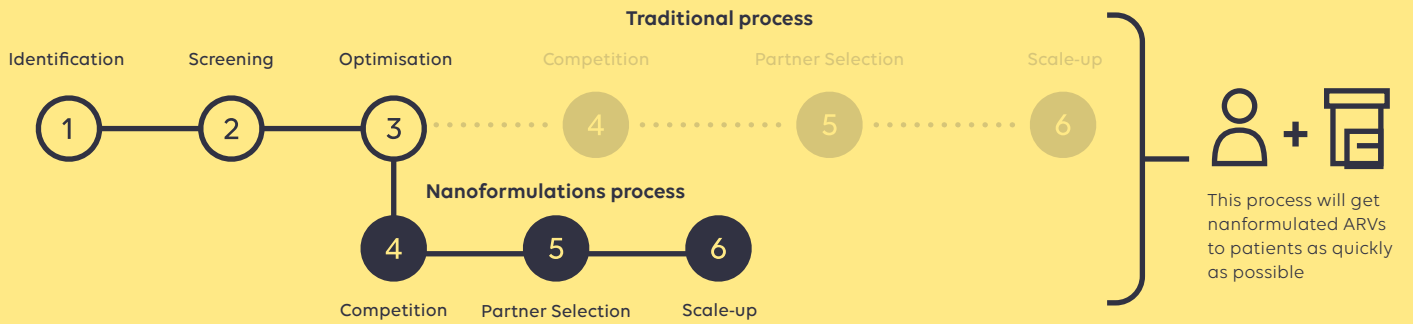


Potentially smaller pill size, easier for patients to take



Lower cost of treatment

How can competition, new partnerships and manufacturing efficiencies accelerate the introduction of nanoformulated HIV treatment?



1. Preclinical studies and mathematical modeling compare the pharmacokinetic properties of lead nanoformulations to standard drug formulations.
2. Nanoformulations – selected based on their dose-reduction potential – are tested for spray dry manufacturing.
3. Successful nanoformulations enter first-in-human trials for clinical evaluation.

4. UoL and MPP launches a competitive approach to engage Good Manufacturing Practice certified-pharmaceutical partners to produce nanoformulated ARVs for the first-in-human trials. This early engagement accelerates the identification of pharmaceutical partners with the capacity to develop nanoformulations at industrial scale.

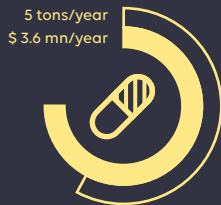
5. UoL and MPP select the pharmaceutical partners best-suited for the continued development, manufacture and distribution of nanoformulated ARVs.
6. Timely product development of nanoformulated ARVs at industrial scale leads to regulatory filing under licence from MPP and UoL.

How will these innovations impact treatment access?

Numbers below represent estimated annual savings in developing countries for every 100,000 patients who use nanoformulation instead of conventional formulation.

■ Dollars saved □ API Saved

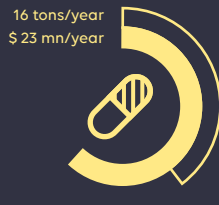
Atazanavir/ritonavir (ATV/r)



If countries continue to adopt ATV/r as the preferred second-line, which already has cost advantages over lopinavir and darunavir, its use in second-line treatment could surpass that of lopinavir/ritonavir as early as 2019, reaching over 50% of the second-line market share.

A nanoformulated ATV/r could reduce the dose from 300/100mg to 200/67mg, making ATV an even more economic option and protease inhibitors more accessible, at possibly less than \$100 per patient per year.

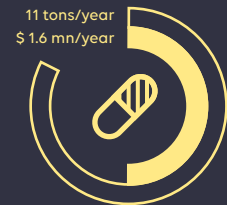
Darunavir/ritonavir (DRV/r)



Characterized by favorable efficacy and tolerability, DRV is a second-generation protease inhibitor with a very high barrier to the development of resistance, albeit with high dose and high costs. DRV/r is of high interest to the optimization of second-line treatment. Through dose reduction of DRV/r, nanoformulation could enable single-tablet regimen for second-line with low pill burden.

A nanoformulated DRV/r could reduce the dose from 800/100mg to 400/50mg.

Efavirenz (EFV)



While the uptake of dolutegravir will continue to grow as affordable generic fixed-dose combinations enter the LMIC market, a sizable number of patients could still use EFV going forward.

A nanoformulated EFV could reduce the dose from 600mg to 300mg. If EFV 400mg is proven effective in all patient groups, nanoformulation could further lower its dose to 200mg.

Conclusion

The UoL-MPP-USAID collaboration under OPTIMIZE is an innovative model for realizing the potential of academic research to benefit patients and country health systems.

Powered by OPTIMIZE, a global partnership unifying distinct voices to achieve a common goal: accelerating access to simpler, safer and more affordable HIV treatment.

For further information or to request technical assistance from OPTIMIZE, please contact Joanne (Jo) Sharp, UoL Program Manager, at momeejl2@liverpool.ac.uk or +44 151-794 5553.



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