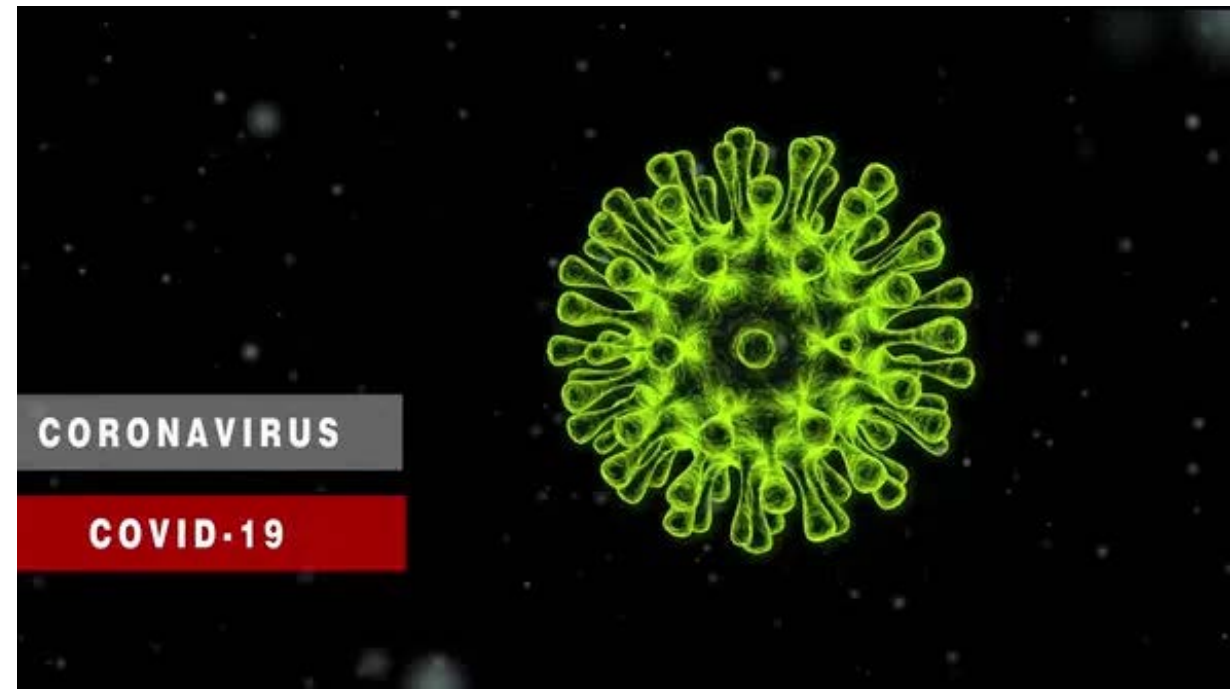


Minimum Costs to Manufacture New Treatments for COVID-19

[http://viruseradication.com/journal-details/Minimum costs to manufacture new treatments for COVID-19/](http://viruseradication.com/journal-details/Minimum_costs_to_manufacture_new_treatments_for_COVID-19/)

**Dr Andrew Hill,
Liverpool University,
United Kingdom**



Re-purposing drugs to treat COVID-19

CORONAVIRUS

COVID-19



We need treatments to use now, until vaccines or new experimental treatments can be developed

Take drugs previously developed to treat other diseases

Drugs need to be widely available and cheap, with a good safety profile

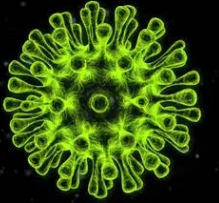
Evaluate whether they work against COVID-19

If they do work, they can be deployed immediately. For example dexamethasone (UK RECOVERY trial)

WHO Target Product Profiles for COVID-19 Therapeutics

CORONAVIRUS

COVID-19



Preferred:

Critical or minimal:

Effective at reducing mortality.

Effective at reducing progression of disease.
Endpoints include duration of hospital stay.

Once per day dosing.

Twice per day dosing.

Oral.

Oral or parenteral

Shelf life of at least 36 months.

Shelf life of at least 6 months.

Room temperature shipping

<https://www.who.int/publications/m/item/who-target-product-profiles-for-covid-19-therapeutics>

Calendar view of clinical read-outs by asset class

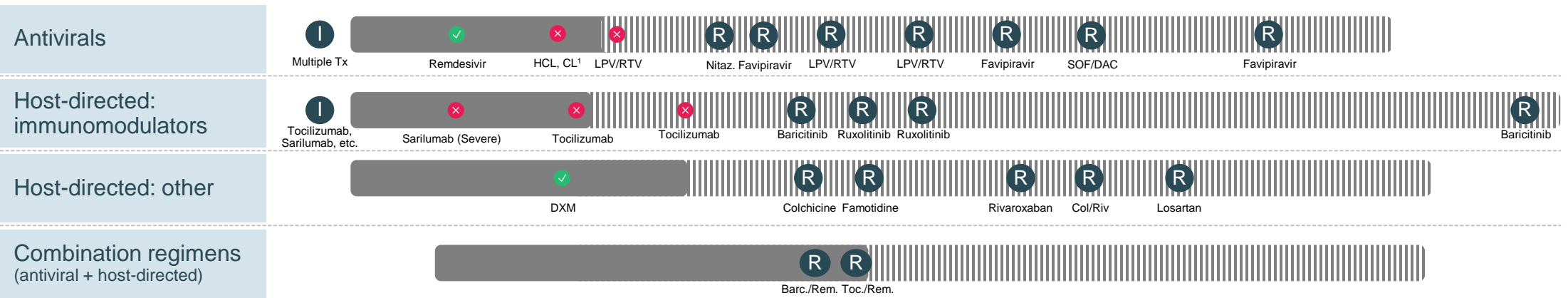
Legend

- I IND
- Read-out
- Most adv. RCTs
- Other RCTs
- Positive results
- Failed trials

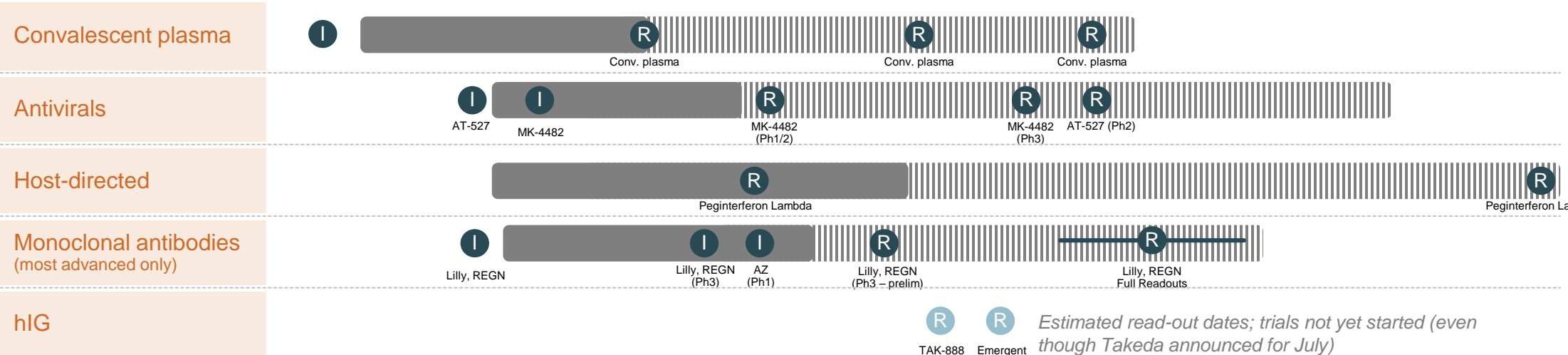
Analysis conducted on 8/19



Wave 1: Repurposed therapeutics



Wave 2: Clinical-stage novel therapeutics



Estimated read-out dates; trials not yet started (even though Takeda announced for July)

Re-purposed antiviral drugs for COVID-19

Clinical benefits

No Clinical benefits

In clinical trials

No drugs

Hydroxychloroquine

Remdesivir

Lopinavir/ritonavir

Darunavir/ritonavir

Favipiravir

Nitazoxanide

Atazanavir/ritonavir

Sofosbuvir/daclatasvir

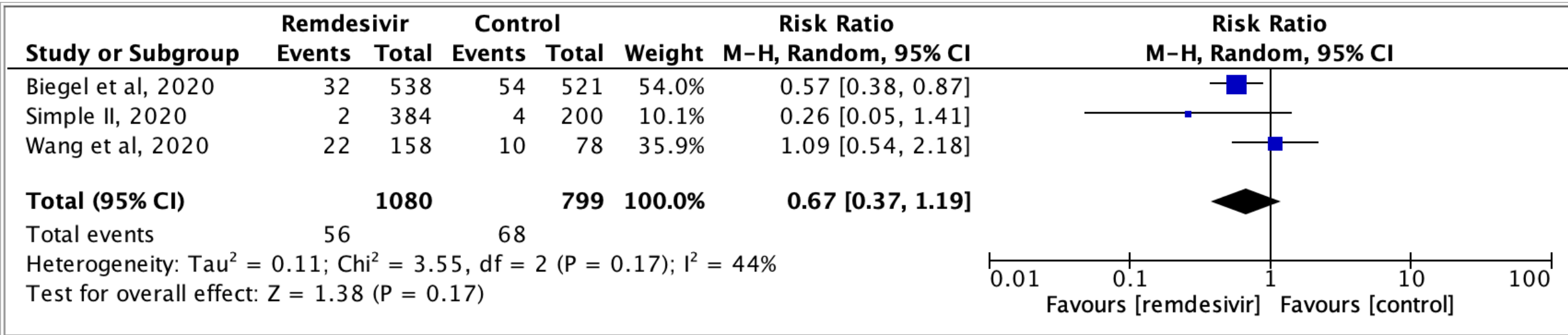
Velpatasvir

Tenofovir/FTC

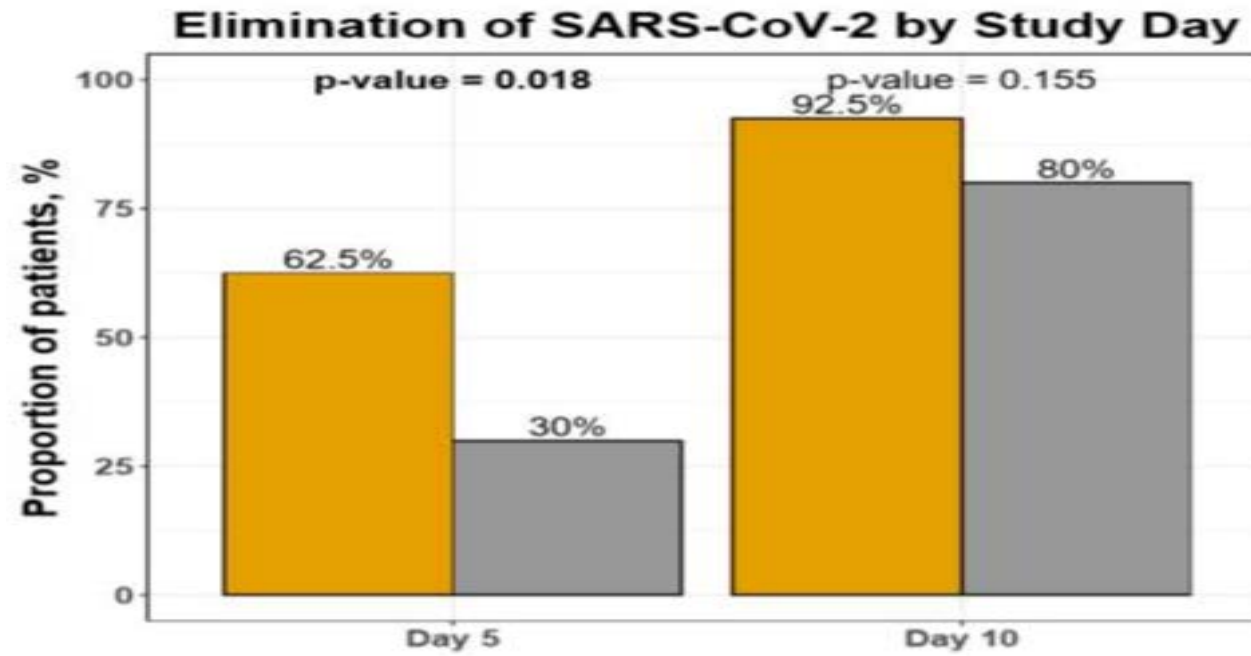
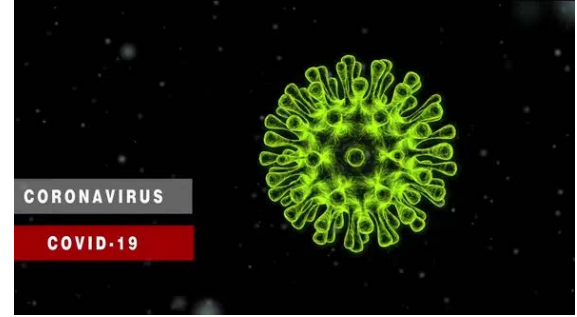
Amodiaquine

New antivirals (Merck)

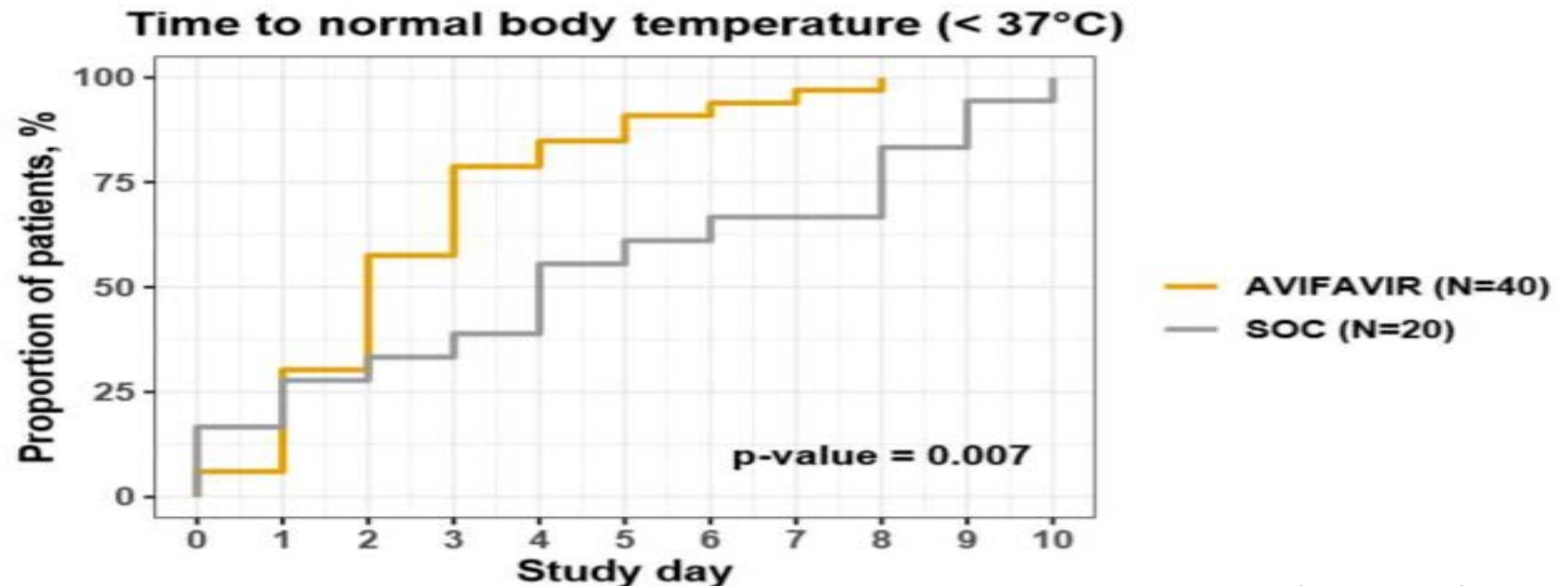
Death rates in randomized trials of remdesivir no significant benefits



Russian Study of favipiravir



(B)



Other re-purposed drugs for COVID-19

Clinical benefits

No Clinical benefits

In clinical trials

Dexamethasone

Tocilizumab

Interferon-beta

Losartan

Colchicine

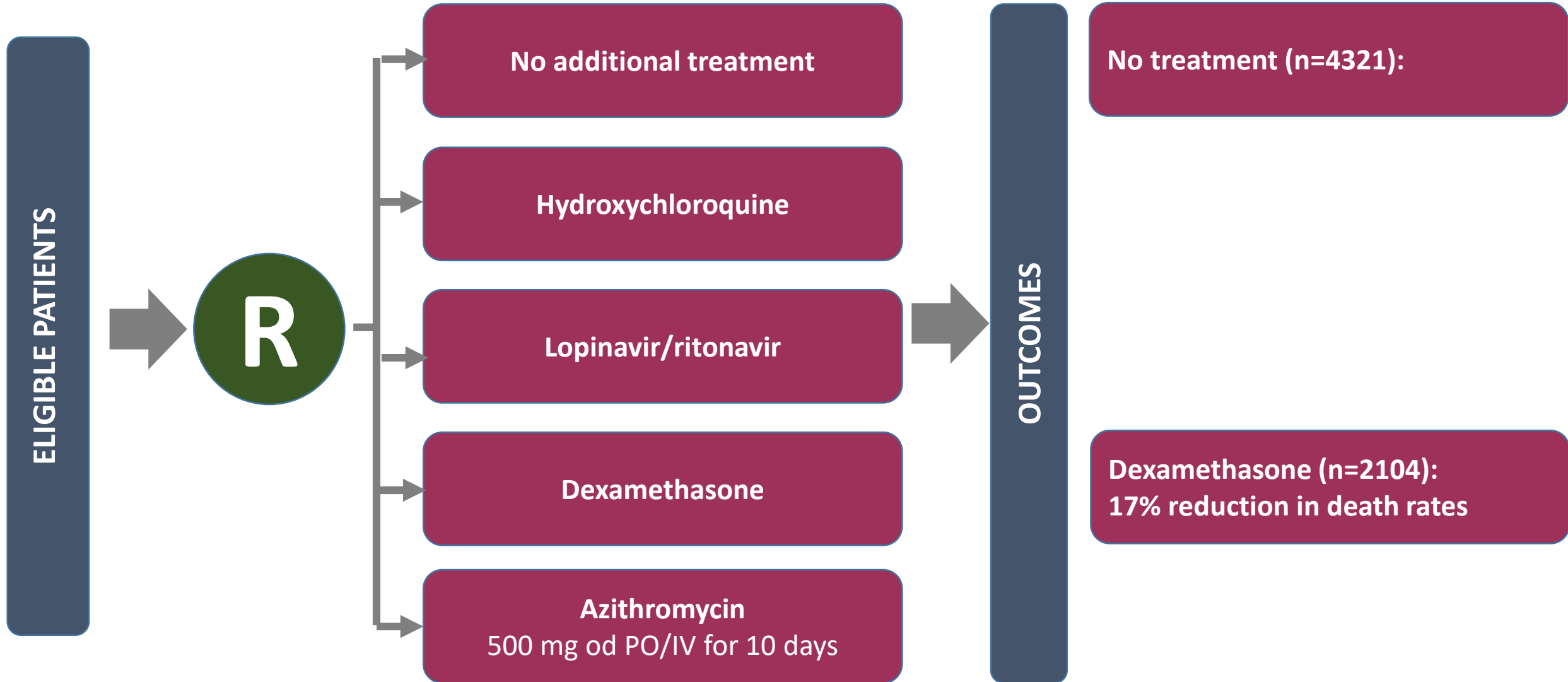
Famotidine

Imatinib

Baricitinib

Eli Lilly MAb 555

RECOVERY – Dexamethasone



Active Pharmaceutical Ingredient



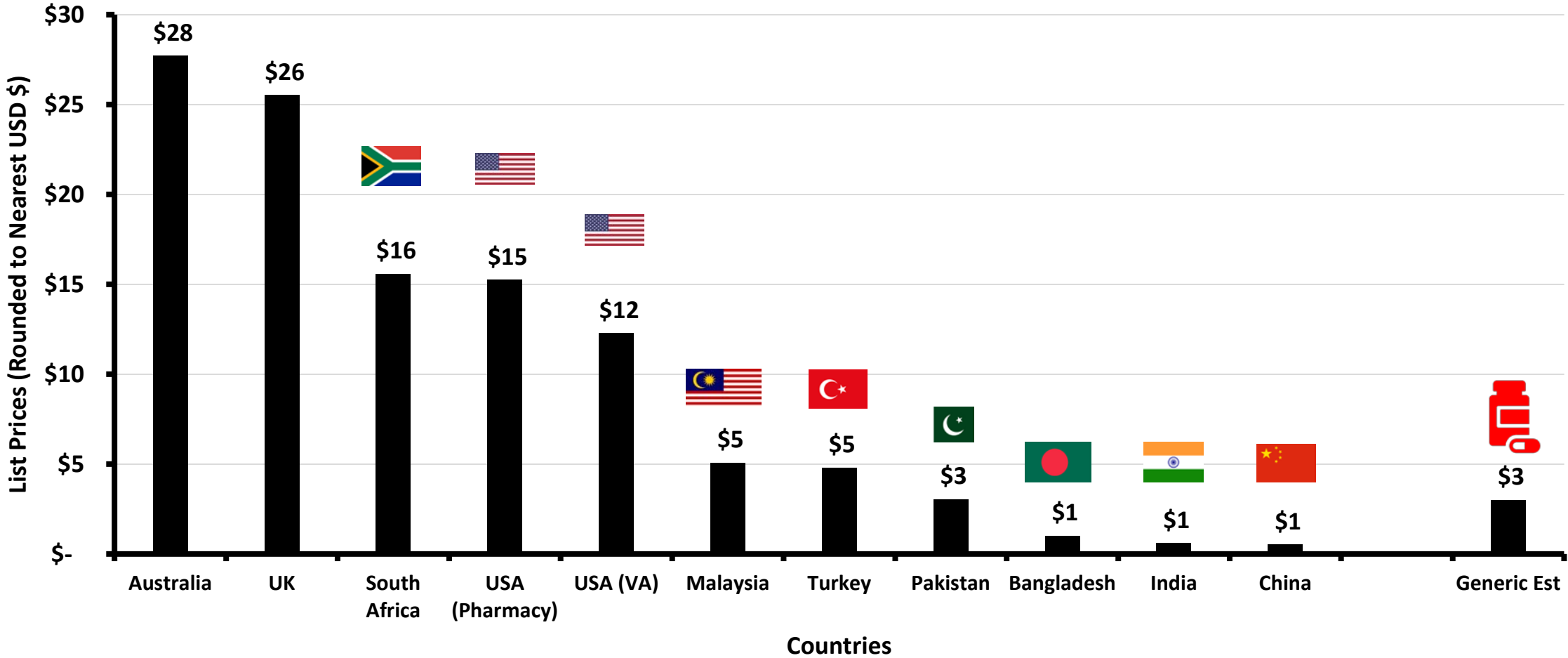
Raw drug substance

Database www.indiainfodrive.com shows exports of API from India to other countries, with costs per kilogram of API, for many drugs

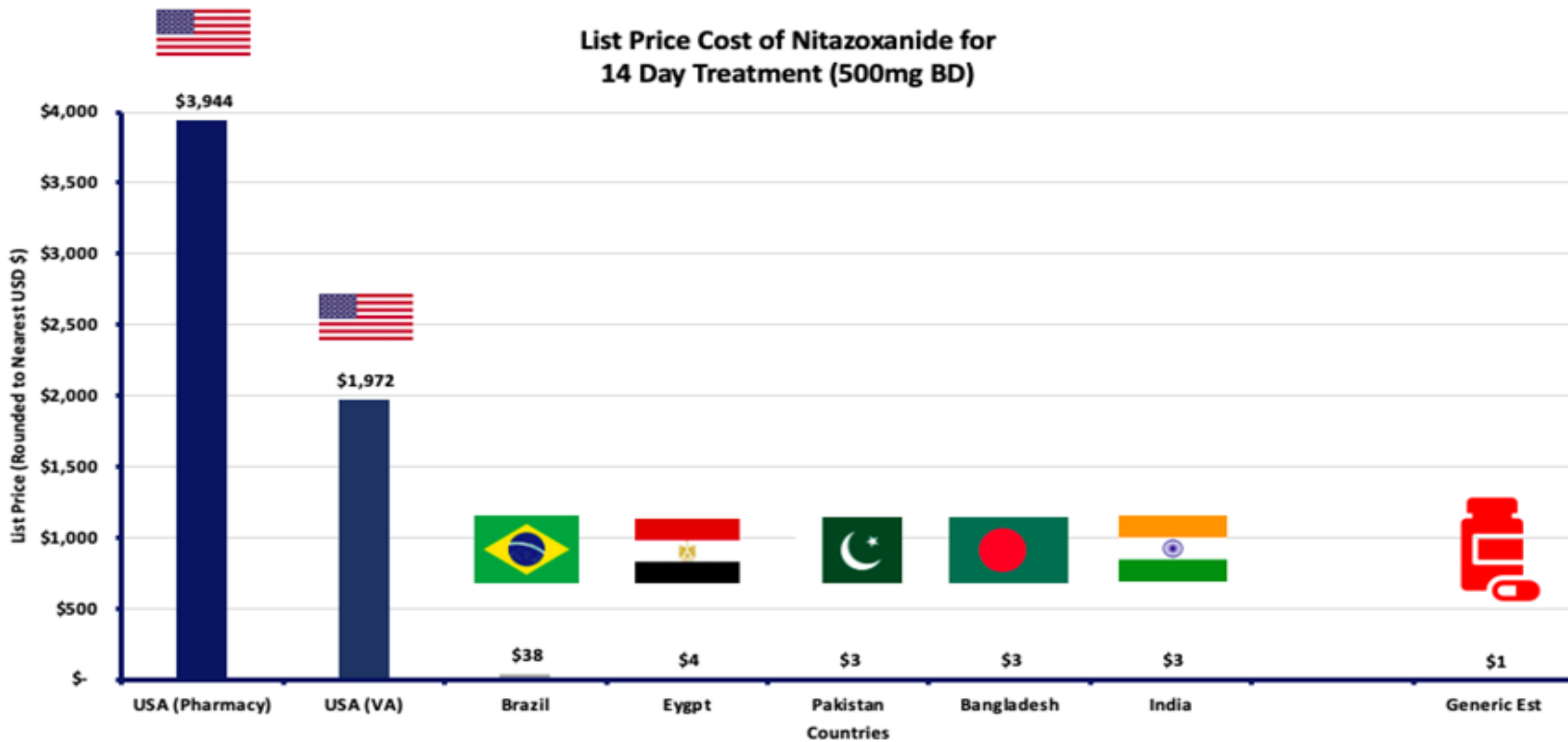
List Prices of 10-day Dexamethasone IV Treatment (6mg OD)

CORONAVIRUS

COVID-19



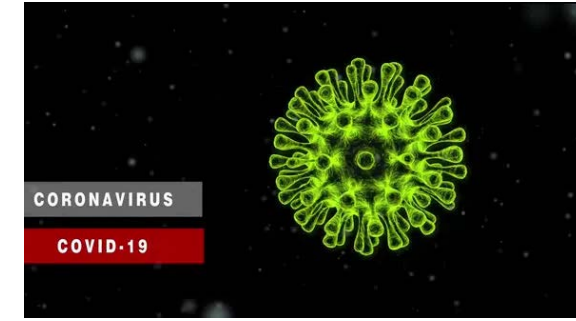
List Price Cost of Nitazoxanide for 14 Day Treatment (500mg BD)



Prices versus costs for re-purposed drugs

Drugs (10-days)	US	UK	India	Cost
SOF/DCV	\$13,293	N/A	\$5	\$4
Nitazoxanide	\$2817	N/A	\$2	\$0.70
Remdesivir (5-days)	\$2340	\$2340	\$320	\$5
ATV/RTV	\$137	\$136	\$14	\$4
Imatinib	\$34	\$407	\$43	\$4
Colchicine	\$17	\$3	\$0.50	\$0.40
Losartan	\$2	\$1	\$0.60	\$0.70
Favipiravir	N/A	N/A	\$31	\$15

Why should these drugs be sold at close to cost price?

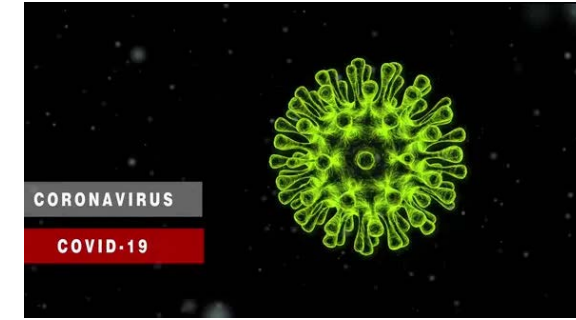


Clinical trials mainly funded by government grants and donors (e.g. NIH, Gates Foundation, UK National Health Service)

If companies donate drugs for trials, they are given a tax rebate and do not actually spend money

These drugs are working “by accident”. Very little R&D for coronavirus with re-purposed drugs by companies in past 14 weeks.

How much drug do we need?



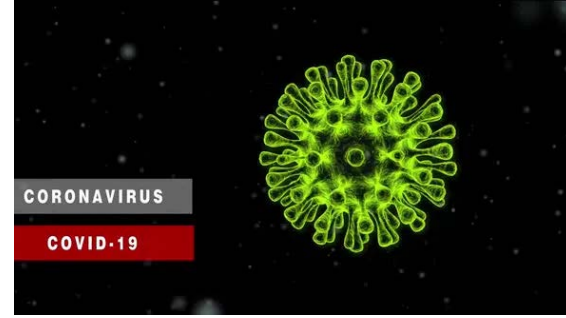
1.2 million deaths in 2020, worldwide. Death rate in moderate / severe infection is approximately 10%

Therefore 12 million courses of treatment needed in 2021 for full access to a treatment for moderate / severe infection

40 million diagnosed cases of COVID-19 infection worldwide

Can we manufacture 40 million courses of treatment if drugs work in all stages of infection? More would be needed if drugs showed a role in preventing new infections.

Implications for mass production



We need to start planning to supply drugs which could be effective against COVID-19

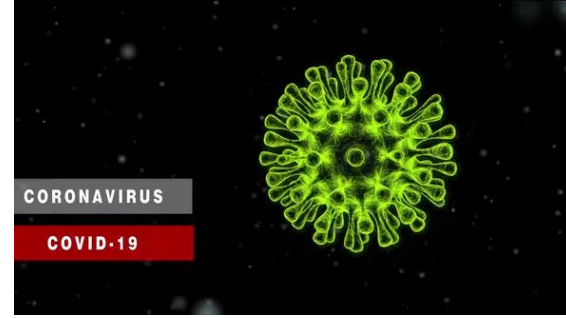
We should know the results from confirmatory Phase 3 trials in Oct-Dec

If a drug works for moderate or severe COVID-19, we could need 10 million treatment courses to supply all patients worldwide (10% death rate, 1 million deaths so far).

If a drug works for mild COVID-19, we could need far more drugs – 20 million courses per year as a minimum,

If successful, how much drug could current generic suppliers produce?

Conclusions



The main treatments in clinical trials to treat coronavirus could all be mass produced for approximately \$1 per day, often much less.

If proven to be effective, these treatments could be mass produced so that anyone with coronavirus in any country could afford them.

The Global Fund and PEPFAR programmes have shown how mass treatment for HIV, TB and malaria is feasible, with drugs sold to millions of people worldwide at prices close to the cost of production.