

# IVERMECTIN

At 07/05/2021

1. Event: Initial submission.....	3
Action .....	3
Sources .....	3
Comment .....	3
Outcome .....	3
2. Event: CTAP Antivirals Sub-group10/12/2020 .....	3
Action .....	3
Sources .....	3
Comment .....	5
Outcome .....	7
3. Event: Auto-Immune and Anti-inflammatory Sub-group16/12/2020.....	7
Action .....	7
Sources .....	7
Comment .....	8
Outcome .....	8
4. Event: UK-CTAP 11/01/2021.....	8
Action .....	8
Sources .....	8
Comment .....	8
Outcome .....	8
5. Event: Prophylaxis Sub-group 13/01/2021 .....	8
Action .....	8
Sources .....	8
Comment .....	8
Outcome .....	9
6. Event: Additional information 19/01/2021.....	9
Action .....	9
Sources .....	9
Comment .....	10
Outcome .....	10
7. Event: Second submission.....	10
Action .....	10
Sources .....	10

Comment .....	10
Outcome .....	10
8. Event: UK-CTAP 10/02/2021 .....	10
Action .....	10
Sources .....	10
Comment .....	10
Outcome .....	11
9. Event: CTAP email 23/02/2021 .....	11
Action .....	11
Sources .....	11
Comment .....	11
Outcome .....	11
10. Event: Additional information 02/03/2021 .....	11
Action .....	11
Sources .....	11
Comment .....	12
Outcome .....	12
11. Event: Additional information 03/03/2021 .....	12
Action .....	12
Sources .....	12
Comment .....	12
Outcome .....	12
12. Event: Internal Horizon Scanning 05/03/2021 .....	12
Action .....	12
Sources .....	12
Comment .....	12
Outcome .....	12

## 1. Event: Initial submission

### Action

Due diligence request Ivermectin entry into CTAP database on 17<sup>th</sup> November 2020, no submissions made by manufacturer.

### Sources

NICE inform UK-CTAP due diligence: In w/c 09/11/20 the RAPID-C19 oversight group discussed Ivermectin and during those discussions it was suggested that this topic maybe one of interest for the CTAP team to look at and consider if it was suitable for entry into a UK trial.

### Comment

N/A

### Outcome

CTAP0113 Ivermectin is created in the database on 17<sup>th</sup> November 2020 and a comprehensive briefing is collated by the UK-CTAP Secretariat.

## 2. Event: CTAP Antivirals Sub-group 10/12/2020

### Action

CTAP due diligence team presented the comprehensive brief on Ivermectin to the antiviral sub-group.

### Sources

The studies used to inform this brief were:

1. Caly, L. (2020). The FDA-approved drug ivermectin inhibits the replication of SARS-CoV-2 in vitro. *Antiviral Research*, 178, 104787. <https://doi.org/10.1016/j.antiviral.2020.104787>
2. Campbell, W. C., Burg, R. W., Fisher, M. H., & Dybas, R. A. (1984). The discovery of ivermectin and other avermectins. In P. S. Magee, G. K. Kohn, & J. J. Menn (Eds.), *Pesticide Synthesis Through Rational Approaches* (Vol. 255, pp. 5–20). American Chemical Society. <https://doi.org/10.1021/bk-1984-0255.ch001>
3. Campbell, William C. (2016). Lessons from the history of ivermectin and other antiparasitic agents. *Annual Review of Animal Biosciences*, 4(1), 1–14. <https://doi.org/10.1146/annurev-animal-021815-111209>
4. Camprubí, D., Almuedo-Riera, A., Martí-Soler, H., Soriano, A., Hurtado, J. C., Subirà, C., Grau-Pujol, B., Krolewiecki, A., & Muñoz, J. (2020). Lack of efficacy of standard doses of ivermectin in severe COVID-19 patients. *PLOS ONE*, 15(11), e0242184. <https://doi.org/10.1371/journal.pone.0242184>
5. Chaccour, C., Abizanda, G., Irigoyen-Barrio, Á., Casellas, A., Aldaz, A., Martínez-Galán, F., Hammann, F., & Gil, A. G. (2020). Nebulized ivermectin for COVID-19 and other respiratory diseases, a proof of concept, dose-ranging study in rats. *Scientific Reports*, 10(1), 17073. <https://doi.org/10.1038/s41598-020-74084-y>
6. Chaccour, C., Hammann, F., Ramón-García, S., & Rabinovich, N. R. (2020). Ivermectin and covid-19: Keeping rigor in times of urgency. *The American Journal of Tropical Medicine and Hygiene*, 102(6), 1156–1157. <https://doi.org/10.4269/ajtmh.20-0271>

7. Ci, X., Li, H., Yu, Q., Zhang, X., Yu, L., Chen, N., Song, Y., & Deng, X. (2009). Ivermectin exerts anti-inflammatory effect by downregulating the nuclear transcription factor kappa-B and mitogen-activated protein kinase activation pathway. *Fundamental & Clinical Pharmacology*, 23(4), 449–455. <https://doi.org/10.1111/j.1472-8206.2009.00684.x>
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9. DiNicolantonio, J. J., Barroso, J., & McCarty, M. (2020). Ivermectin may be a clinically useful anti-inflammatory agent for late-stage COVID-19. *Open Heart*, 7(2). <https://doi.org/10.1136/openhrt-2020-001350>
10. Gorial, F. I., Mashhadani, S., Sayaly, H. M., Dakhil, B. D., AlMashhadani, M. M., Aljabory, A. M., Hassan M Abbas, Ghanim, M., & Rasheed, J. I. (2020). Effectiveness of ivermectin as add-on therapy in covid-19 management(Pilot trial). *MedRxiv*, 2020.07.07.20145979. <https://doi.org/10.1101/2020.07.07.20145979>
11. Guzzo, C. A., Furtek, C. I., Porras, A. G., Chen, C., Tipping, R., Clineschmidt, C. M., Sciberras, D. G., Hsieh, J. Y.-K., & Lasseter, K. C. (2002). Safety, tolerability, and pharmacokinetics of escalating high doses of ivermectin in healthy adult subjects. *Journal of Clinical Pharmacology*, 42(10), 1122–1133. <https://doi.org/10.1177/009127002401382731>
12. Jermain, B., Hanafin, P. O., Cao, Y., Lifschitz, A., Lanusse, C., & Rao, G. G. (2020). Development of a minimal physiologically-based pharmacokinetic model to simulate lung exposure in humans following oral administration of ivermectin for covid-19 drug repurposing. *Journal of Pharmaceutical Sciences*, 109(12), 3574–3578. <https://doi.org/10.1016/j.xphs.2020.08.024>
13. Padhy, B. M., Mohanty, R. R., Das, S., & Meher, B. R. (2020). Therapeutic potential of ivermectin as add on treatment in COVID 19: A systematic review and meta-analysis: Ivermectin in COVID-19: A meta-analysis. *Journal of Pharmacy & Pharmaceutical Sciences*, 23, 462–469. <https://doi.org/10.18433/jpps31457>
14. Rajter, J. C., Sherman, M. S., Fatteh, N., Vogel, F., Sacks, J., & Rajter, J.-J. (2020). Use of ivermectin is associated with lower mortality in hospitalized patients with coronavirus disease 2019. *Chest*, S0012369220348984. <https://doi.org/10.1016/j.chest.2020.10.009>
15. Sen Gupta, P. S., Biswal, S., Panda, S. K., Ray, A. K., & Rana, M. K. (2020). Binding mechanism and structural insights into the identified protein target of COVID-19 and importin- $\alpha$  with in-vitro effective drug ivermectin. *Journal of Biomolecular Structure and Dynamics*, 1–10. <https://doi.org/10.1080/07391102.2020.1839564>
16. Sia, D. K., Mensah, K. B., Opoku-Agyemang, T., Folitse, R. D., & Darko, D. O. (2020). Mechanisms of ivermectin-induced wound healing. *BMC Veterinary Research*, 16(1), 397. <https://doi.org/10.1186/s12917-020-02612-z>
17. Smit, M. R., Ochomo, E. O., Waterhouse, D., Kwambai, T. K., Abong'o, B. O., Bousema, T., Bayoh, N. M., Gimnig, J. E., Samuels, A. M., Desai, M. R., Phillips-Howard, P. A., Kariuki, S. K., Wang, D., Kuile, F. O. ter, Ward, S. A., & Aljanyoussi, G. (2019). Pharmacokinetics-pharmacodynamics of high-dose ivermectin with dihydroartemisinin-piperaquine on mosquitocidal activity and qt-prolongation(Ivermal). *Clinical Pharmacology & Therapeutics*, 105(2), 388–401. <https://doi.org/https://doi.org/10.1002/cpt.1219>
18. SmPC Ivermectin (European generic). (n.d.). <https://mri.cts-mrp.eu/Human/Product/Details/52847>
19. SmPC UK Ivermectin cream. (n.d.). <https://www.medicines.org.uk/emc/product/6819>

20. Specialist Pharmacy Service Ivermectin. (n.d.).  
<https://www.sps.nhs.uk/medicines/ivermectin/>
21. Szente Fonseca, S. N. (2020). Risk of hospitalization for Covid-19 outpatients treated with various drug regimens in Brazil: Comparative analysis. *Travel Medicine and Infectious Disease*, 38, 101906. <https://doi.org/10.1016/j.tmaid.2020.101906>
22. US FDA label Ivermectin. (n.d.).  
[https://www.merck.com/product/usa/pi\\_circulars/s/stromectol/stromectol\\_pi.pdf](https://www.merck.com/product/usa/pi_circulars/s/stromectol/stromectol_pi.pdf)
23. Ventre, E., Rozières, A., Lenief, V., Albert, F., Rossio, P., Laoubi, L., Dombrowicz, D., Staels, B., Ulmann, L., Julia, V., Vial, E., Jomard, A., Hacini-Rachinel, F., Nicolas, J.-F., & Vocanson, M. (2017). Topical ivermectin improves allergic skin inflammation. *Allergy*, 72(8), 1212–1221. <https://doi.org/10.1111/all.13118>
24. Wagstaff, K. M., Sivakumaran, H., Heaton, S. M., Harrich, D., & Jans, D. A. (2012). Ivermectin is a specific inhibitor of importin  $\alpha/\beta$ -mediated nuclear import able to inhibit replication of HIV-1 and dengue virus. *Biochemical Journal*, 443(3), 851–856.  
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<https://www.who.int/publications/i/item/WHOMVPENPIAU2019.06>
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27. Zhang, X., Song, Y., Ci, X., An, N., Ju, Y., Li, H., Wang, X., Han, C., Cui, J., & Deng, X. (2008). Ivermectin inhibits LPS-induced production of inflammatory cytokines and improves LPS-induced survival in mice. *Inflammation Research*, 57(11), 524–529.  
<https://doi.org/10.1007/s00011-008-8007-8>
28. Zhang, Xuemei, Song, Y., Xiong, H., Ci, X., Li, H., Yu, L., Zhang, L., & Deng, X. (2009). Inhibitory effects of ivermectin on nitric oxide and prostaglandin E2 production in LPS-stimulated RAW 264.7 macrophages. *International Immunopharmacology*, 9(3), 354–359. <https://doi.org/10.1016/j.intimp.2008.12.016>
29. <https://zbib.org/c5db298230034d3fa9b55be16a4c9d82>

**NB: Panel and subgroup members will bring their own knowledge and research to discussion so this does not form a full list of references for the discussion.**

## Comment

As noted in the record of decisions, the antiviral sub-group commented:

Ivermectin	<ul style="list-style-type: none"> <li>From a virological point of view the panel questioned claims that the major mechanism of antiviral action was via inhibition of shuttling of viral nuclear capsid protein into the nucleus because in contrast to the influenza virus SARS-CoV-2 doesn't replicate in the host cell nucleus. The evidence presented appeared to be an extrapolation from influenza data.</li> <li>Additionally, the panel considered that the ability of ivermectin to inhibit syncytial formation may only be an in vitro phenomenon and as</li> </ul>	<p>It was felt that further pre-clinical data was required on Ivermectin's antiviral properties before it could be reconsidered in that space.</p> <p>It was agreed that Ivermectin could still be considered for a Phase 2 or 3 trial as a potential immunomodulatory compound if the meta-analysis of the studies on-going show a mortality benefit and the subpanel recommended these</p>
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	<p>such it was difficult to identify a specific antiviral mechanism of action.</p> <ul style="list-style-type: none"> <li>• Even at the highest doses achievable in humans, plasma levels would likely be an order of magnitude lower than that required for an antiviral effect. However, it was noted that the compound did accumulate in the lung.</li> <li>• Although widely studied worldwide, the studied doses may be insufficient for antiviral activity in SARS-CoV-2.</li> <li>• On the positive side, ivermectin's safety profile would make it suitable for Phase 2 or 3 trials.</li> <li>• Data from an in vivo study of ivermectin in Syrian hamster<sup>[1]</sup> suggest no antiviral activity of ivermectin but support an anti-inflammatory activity in the lung of the hamster.</li> <li>• It was noted that there are ongoing unpublished <a href="#">meta-analyses</a> <sup>[2]</sup>, which track the clinical ivermectin trials in COVID-19. Some early analyses indicate mortality benefit across the COVID disease pathway. The antiviral data seems less clear.</li> <li>• The group considered that the currently available evidence support an anti-inflammatory effect, while the potential antiviral efficacy in COVID-19 was doubtful. Therefore, the compound should be referred to the immunomodulatory subgroup for their assessment.</li> <li>• It was noted that there was a potential interaction between ivermectin and dexamethasone through Cyp3A4. If it were to be used in later stages of the disease in a hospital context this would need to be managed via the dosing regimen and measuring concentrations. Other DDIs may</li> </ul>	<p>data be shared with the immunomodulatory subgroup.</p> <p>It was also suggested that the immunomodulatory subgroup may wish to consider if there was a role for selective serotonin reuptake inhibitors with sigma-1 receptor agonist activity (e.g. fluvoxamine), acting as anti-inflammatory agents in the community setting.</p>
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	also need to be carefully managed in earlier disease, particularly given polypharmacy in older patients.	
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<sup>[1]</sup> <https://www.biorxiv.org/content/10.1101/2020.11.21.392639v1>

<sup>[2]</sup> <https://ivmmeta.com>

## Outcome

The antiviral sub-group asked the due diligence team to update the Ivermectin briefing with the Syrian hamster study and meta-analysis prior to the Immune meeting.

Ivermectin was sent to the 16/12/2020 Immune meeting.

## 3. Event: Auto-Immune and Anti-inflammatory Sub-group 16/12/2020

### Action

CTAP due diligence team presented an updated brief on Ivermectin to the immune and anti-inflammatory sub-group.

### Sources

The studies used to build this brief were those in the original brief, plus:

30. Ahmed, S., Karim, M. M., Ross, A. G., Hossain, M. S., Clemens, J. D., Sumiya, M. K., Phru, C. S., Rahman, M., Zaman, K., Somani, J., Yasmin, R., Hasnat, M. A., Kabir, A., Aziz, A. B., & Khan, W. A. (2020). A five day course of ivermectin for the treatment of COVID-19 may reduce the duration of illness. *International Journal of Infectious Diseases*, 0(0). <https://doi.org/10.1016/j.ijid.2020.11.191>
31. Andersson, U., Ottestad, W., & Tracey, K. J. (2020). Extracellular HMGB1: A therapeutic target in severe pulmonary inflammation including COVID-19? *Molecular Medicine*, 26(1), 42. <https://doi.org/10.1186/s10020-020-00172-4>
32. Kiki-Mvouaka, S., Ménez, C., Borin, C., Lyazrhi, F., Foucaud-Vignault, M., Dupuy, J., Collet, X., Alvinerie, M., & Lespine, A. (2010). Role of P-glycoprotein in the disposition of macrocyclic lactones: A comparison between ivermectin, eprinomectin, and moxidectin in mice. *Drug Metabolism and Disposition: The Biological Fate of Chemicals*, 38(4), 573–580. <https://doi.org/10.1124/dmd.109.030700>
33. McElvaney, O. J., McEvoy, N. L., McElvaney, O. F., Carroll, T. P., Murphy, M. P., Dunlea, D. M., Ní Choileáin, O., Clarke, J., O'Connor, E., Hogan, G., Ryan, D., Sulaiman, I., Gunaratnam, C., Branagan, P., O'Brien, M. E., Morgan, R. K., Costello, R. W., Hurley, K., Walsh, S., ... McElvaney, N. G. (2020). Characterization of the inflammatory response to severe covid-19 illness. *American Journal of Respiratory and Critical Care Medicine*, 202(6), 812–821. <https://doi.org/10.1164/rccm.202005-1583OC>
34. Melo, G. D. de, Lazarini, F., Larrous, F., Feige, L., Kergoat, L., Marchio, A., Pineau, P., Lecuit, M., Lledo, P.-M., Changeux, J.-P., & Bourhy, H. (2020). Anti-COVID-19 efficacy of ivermectin in the golden hamster. *BioRxiv*, 2020.11.21.392639. <https://doi.org/10.1101/2020.11.21.392639>
35. <https://zbib.org/01366e86332a4460ae6eca29482d8977>

**NB: Panel and subgroup members will bring their own knowledge and research to discussion so this does not form a full list of references for the discussion.**

## Comment

As noted in the record of decisions, the immune sub-group commented:

Ivermectin	<p>This submission was referred from the antiviral sub-group.</p> <p>The group also questioned the biological rationale. Anti-inflammatory effects have so far been observed in a hamster model but have not yet been confirmed clinically.</p> <p>Current clinical evidence and meta-analyses are not considered sufficiently robust to recommend ivermectin.</p>	<p>Advice from the subgroup to UK_CTAP was that ivermectin should not currently be recommended for UK publicly funded trials.</p> <p>UK-CTAP secretariat to monitor clinical trial landscape for more robust evidence of efficacy.</p>
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## Outcome

The immune sub-group advised UK-CTAP that it should not recommend ivermectin for UK publicly funded trials but asked the UK-CTAP secretariat to monitor clinical trial landscape of ivermectin in case more robust evidence became available.

## 4. Event: UK-CTAP 11/01/2021

### Action

CTAP discussed the last antiviral and immune meetings.

### Sources

N/A – Both the original and updated ivermectin brief and a supply and manufacturing document were made available to the panel.

### Comment

As noted in the record of decisions, CTAP raised an observation on the immune 16/12 immune record of decisions. CTAP specifically requested that Ivermectin be revisited subsequent to meta-analysis of WHO data.

### Outcome

CTAP awaited the WHO analysis.

## 5. Event: Prophylaxis Sub-group 13/01/2021

### Action

Both the original and updated ivermectin brief and a supply and manufacturing document were presented to the first prophylaxis sub-group meeting.

### Sources

See sources for Antiviral 10/12 and Immune 16/12 above.

### Comment

As noted in the record of decisions, the prophylaxis sub-group commented:



Ivermectin	<p>Concerns about the proposed antiviral efficacy:</p> <ul style="list-style-type: none"> <li>Concern that mechanism of action is not relevant for SARS-CoV-2 infection: SARS-CoV-2 replication takes place in cytoplasm, not in the nucleus where ivermectin is expected to inhibit viral replications</li> <li>In vivo data from a hamster model does not support antiviral efficacy</li> <li>Highly unlikely that it can be a potent antiviral against SARS-CoV-2 in the current dosing considerations</li> </ul> <p>Proposed anti-inflammatory mechanisms are of lesser relevance in the prophylaxis setting.</p> <p>Current clinical evidence base for treatment in COVID-19 is limited and of very low quality. Evidence generation and meta-analyses are still ongoing.</p>	<p>The group agreed to deprioritize ivermectin for the prophylaxis setting due to concerns on mechanism of action, pharmacology and efficacy.</p> <p>UK-CTAP secretariat to continue monitoring the evidence base for future re-consideration.</p>
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## Outcome

The prophylaxis sub-group advised CTAP and the Prophylaxis Oversight Group that ivermectin was not currently prioritised for prophylaxis trials but would stay under review.

## 6. Event: Additional information 19/01/2021

### Action

The Therapeutics Taskforce (TTF) forwarded additional information.

### Sources

36. [NL\_H\_3952\_001\_FinalSPC]
37. [HCV\_ivermectin\_info\_draft1]:
38. Anon SUMMARY OF PRODUCT CHARACTERISTICS IVERMECTIN SUBSTIPHARM 3 mg, tablets [https://mri.cts-mrp.eu/Human/Downloads/NL\\_H\\_3952\\_001\\_FinalSPC.pdf](https://mri.cts-mrp.eu/Human/Downloads/NL_H_3952_001_FinalSPC.pdf)
39. Caly L., Druce J.D., Catton M.G., Jans D.A., Wagstaff K.M. (June 2020) The FDA-approved drug ivermectin inhibits the replication of SARS-CoV-2 in vitro. Antivir Res. 2020;178:104787.<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7129059/>
40. Cepelowicz Rajter, J. et al (October 2020) Use of Ivermectin Is Associated With Lower Mortality in Hospitalized Patients With Coronavirus Disease 2019 The Ivermectin in COVID Nineteen Study <https://www.sciencedirect.com/science/article/pii/S0012369220348984>
41. Fink, D and A.G.Porras Pharmacokinetics of Ivermectin in Animals and Humans pp113-130 in Ivermectin & Abamectin William C. Campbell (ed ) Springer Verlag 0-387-96944-6

42. Greene, B.M. K.R.Brown and H.R.Taylor Use of Ivermectin in Humans pp311.323 in Ivermectin & Abamectin William C. Campbell (ed ) Springer Verlag 0-387-96944-6
43. Pandey S., et al (2020) Diabetes Metab Syndr. 2020 November-December; 14(6): 1921–1922. Published online 2020 Sep 28. Ivermectin in COVID-19: What do we know? <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7521351/>
44. Sparavigno, A.C. (September 2020) Researchgate Ivermectin for Covid-19 [https://www.researchgate.net/publication/342170742\\_Ivermectin\\_for\\_Covid-19](https://www.researchgate.net/publication/342170742_Ivermectin_for_Covid-19)

#### Comment

N/A

#### Outcome

The due diligence team are notified.

## 7. Event: Second submission

#### Action

A proposer submits ivermectin on 22nd January 2021.

#### Sources

N/A

#### Comment

N/A

#### Outcome

CTAP0212 ivermectin is created.

## 8. Event: UK-CTAP 10/02/2021

#### Action

[Briefing Ivermectin update 141220], [Ivermectin update Feb21] and [Ivermectin meta-analysis Jan 9 DRAFT FOR REVIEW] were sent to the 10/02/2021 CTAP meeting.

#### Sources

N/A, see meta-analysis doc for their sources

#### Comment

As noted in the record of decisions, UK-CTAP commented:

Ivermectin	<ul style="list-style-type: none"> <li>The chair introduced the item highlighting the meta-analysis provided in the papers and asked the panel whether this analysis would cause them to review their recommendation not to prioritize Ivermectin.</li> <li>The group noted the Merck statement on Ivermectin<sup>[1]</sup>.</li> <li>The panel agreed that the meta-analysis supported the panels original recommendation not to prioritise Ivermectin.</li> </ul>	<ul style="list-style-type: none"> <li>CONFIRMATION of the recommendation that Ivermectin is not currently prioritized for inclusion in UK Publicly Funded Trials</li> </ul>
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	<ul style="list-style-type: none"> <li>• The panel expressed discomfort at any potential inclusion of Ivermectin into a UK publicly funded trial, reconfirming its view there was no plausible rationale for inclusion and noting there was an opportunity cost in terms of patient numbers that could be recruited into a trial with a more plausible expectation of efficacy.</li> <li>• The panel noted that if a drug were taken into trial to specifically to provide a definitive outcome of “no efficacy” it had ethical implications.</li> </ul>	
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<https://www.merck.com/news/merck-statement-on-ivermectin-use-during-the-covid-19-pandemic/#:~:text=Merck%20Statement%20on%20Ivermectin%20use%20During%20the%20COVID%2D19%20Pandemic,-Save&text=KENILWORTH%2C%20N.J.%2C%20Feb.%204,during%20the%20COVID%2D19%20pandemic.>

## Outcome

CTAP confirmed ivermectin was not recommended for publicly funded trials.

Active on-going monitoring tags from specific sub-groups was ended as CTAP confirmed ivermectin was not currently prioritised.

CTAP0212 ivermectin’s proposer was sent an ‘already considered’ email.

## 9. Event: CTAP email 23/02/2021

### Action

CTAP chair circulated Airfinity population mapping paper which references ivermectin.

### Sources

Airfinity

### Comment

N/A

### Outcome

N/A - reference only.

## 10. Event: Additional information 02/03/2021

### Action

TTF forwarded additional information.

### Sources

45. <https://covid19criticalcare.com/videos-and-press/flccc-lecture-for-ypo-gold-on-ivermectin/>

46. <https://covid19criticalcare.com/wp-content/uploads/2020/11/FLCCC-Ivermectin-in-the-prophylaxis-and-treatment-of-COVID-19.pdf>

#### Comment

N/A

#### Outcome

The due diligence team confirm that there is no significant information in this email that has not been considered by the team and panels already.

## 11. Event: Additional information 03/03/2021

#### Action

TTF forwarded additional information.

#### Sources

47. <https://academic.oup.com/qjmed/advance-article/doi/10.1093/qjmed/hcab035/6143037>  
48. <https://www.frontiersin.org/articles/10.3389/fphar.2021.643369/abstract>

#### Comment

N/A

#### Outcome

The due diligence team confirm that there is no significant information in this email that has not been considered by the team and panels already.

## 12. Event: Internal Horizon Scanning 05/03/2021

#### Action

The due diligence team circulated a study amongst themselves.

#### Sources

49. <https://jamanetwork.com/journals/jama/fullarticle/2777389>

#### Comment

N/A

#### Outcome

The due diligence team confirm that there is no significant information in this email that has not been considered by the team and panels already.