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Abstract | Twenty Tor darknet markets were surveyed on 3 April 2020 to conduct a census of COVID-19 related medical products and supplies. There were 645 listings, including 222 unique listings, of COVID-19 related products across 12 markets. Three markets accounted for 85 percent of all unique listings identified.

Of the 110 vendors identified, eight were active in multiple markets. A small proportion of vendors accounted for most listings. The estimated value of all unique listings was A\$369,000.

Personal protective equipment accounted for nearly half of all unique listings, and one third of products were antiviral or repurposed medicines. Supposed vaccines, tests and diagnostic instruments each accounted for nearly 10 percent of listings.

Availability of COVID-19 related products on Tor darknet markets

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Introduction

Since the World Health Organization declared the novel coronavirus (COVID-19) outbreak to be a public health emergency of international concern (WHO 2020), attention has focused on the capacity of health systems to respond. Significant concerns have been raised about the availability of vital medical supplies and personal protective equipment (PPE; Woodley 2020). As the pandemic sparks significant demand, shortages are being reported worldwide (Jacobs, Richtel & Baker 2020) and profit-motivated criminal groups and entities are seizing the opportunity to exploit gaps in the healthcare sector (Europol 2020; Global Initiative Against Transnational Organized Crime 2020).

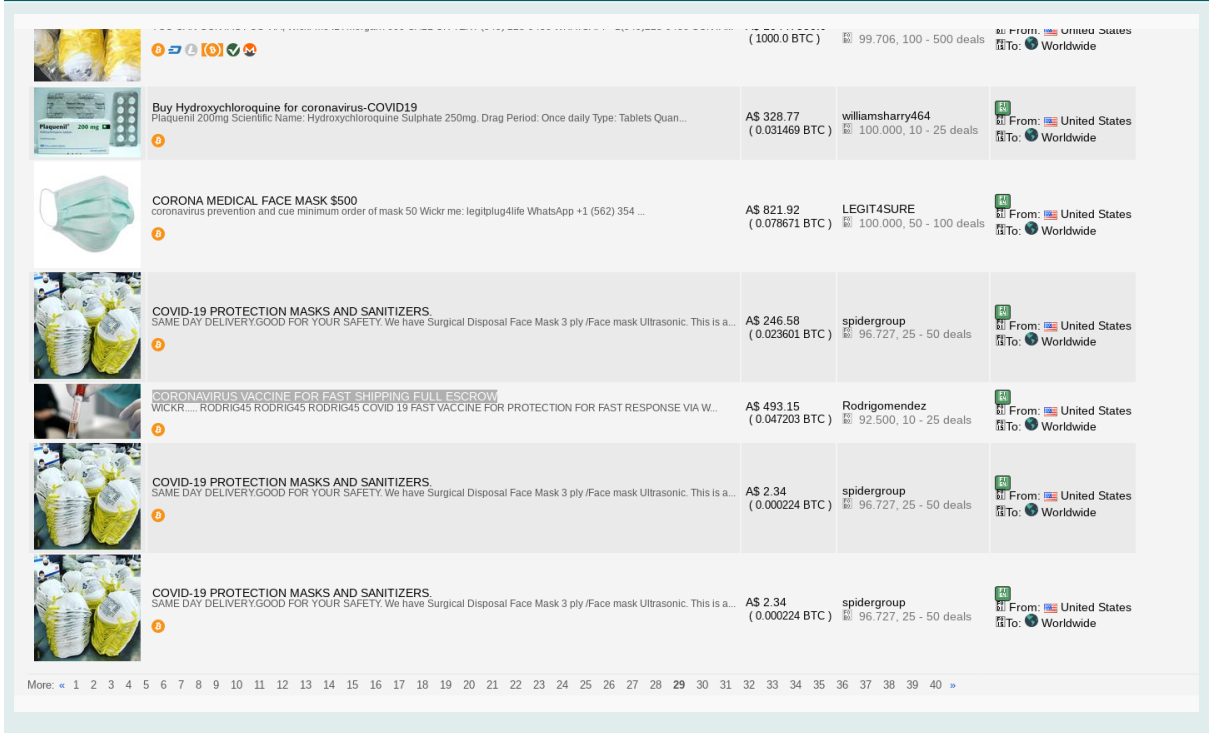
Tor darknet markets are frequently used as a litmus test of illicit drug and malware trends, as well as criminal novelty and entrepreneurship more generally. Surveys of darknet markets help track prices of narcotics and other drugs as well as surges or shortages in certain drugs or contraband. Crime follows opportunity and the COVID-19 pandemic offers profiteering arising from shortages and fear.



Serious & Organised Crime
Research Laboratory

The Australian Institute of Criminology’s Serious and Organised Crime Research Laboratory commissioned the Australian National University’s Cybercrime Observatory to scan active darknet cryptomarkets on Tor for COVID-19 related products. A scan of 20 darknet markets was undertaken on 3 April 2020 (and verified on 6 April) to identify the scale and scope of ‘underground’ online sales of COVID-19 related products. Identified products included vaccines, antiviral or repurposed medicines for COVID-19 treatment, diagnostic tests and PPE such as surgical or N95 masks (see Figure 1). The available products were most likely diverted or stolen from factories, stores and warehouses or laboratories producing PPE or pharmaceuticals.

Figure 1: Screenshot of COVID-19 related products listed on Agartha



Method

The Tor darknet market environment is highly volatile and prone to disruption. We sought to capture the relevant data by selecting and searching available darknet markets in a single day. Crawlers designed for Tor sites were used to search known markets for the COVID-19 related products of interest. For further details of the search methods, see Ball et al. 2019.

Altogether, 20 omnibus darknet markets were identified as active on Friday 3 April 2020 and surveyed for COVID-19 related products. This represented a substantial, if unknown, proportion of active omnibus darknet markets in the Tor hidden service ecosystem. Niche markets were excluded. The authenticity of the markets included in this snapshot could not be fully ascertained. Many are prone to vendor swindles and market exit scams. Only 16 markets are listed and ‘vetted’ as genuine on the well-known Tor information clearing house Darknetlive (see <https://darknetlive.com/markets/>) but only nine out of the 20 markets included here met Darknetlive’s criteria. At the time of survey, 12 of the 20 markets (60%) returned at least one COVID-19 related product listing. These 12 darknet markets are listed below, with an asterisk (*) indicating markets ‘approved’ by Darknetlive:

- Agarthā
- Apollon (Another Tor clearing house, ‘The Hub’, stated that Apollon closed in an exit scam on 28 January 2020. Given the absence of product movement, this is likely. Only azithromycin was detected on Apollon.)
- Avior
- Cypher*
- DarkBay*
- DarkMarket*
- Dream Alt
- Empire*
- Square*
- Versus*
- White House*
- Yellow Brick*

The other eight markets (AlphaOmega, ASEAN, BlackRy, DarkFox, Europa, Monopoly*, Pax Romana and Venus Anonymous) returned no results for COVID-19 related product listings. Automated crawlers were not used to collect data from seven of these eight markets because they did not meet our threshold minimum of at least 1,000 listings per market. However, they were manually surveyed for this census or snapshot.

We searched each market for terms such as ‘COVID-19’, ‘coronavirus’, ‘virus’, and ‘pandemic’, and then inspected the listings identified. We then excluded listings where these terms were used as promotional devices for other products, notably drugs—for example: ‘Special—COVID-19 offer on MDMA’, ‘Coronavirus special price’ and ‘Free masks with every delivery of Oxy’. We noted that some malware and ransomware vendors promoted COVID-19 related social engineering scripts and these were also excluded from analysis. We also searched for specific terms relating to antiviral and other medicines (eg favipiravir, azithromycin and chloroquine, as well as their proprietary brand names) and PPE (eg N95). Three days after the first survey, market listings were verified and a decline in listings on Agarthā was observed. The listing title, price, vendor, market, shipping from location, and shipping to location were recorded for each listing identified.

We also reviewed six popular darknet forums or information centres for qualitative sources of information about the response of darknet markets and consumers to the pandemic. These information hubs were two 'clearnet' forums (dark.fail and Darknetlive) and four hidden Tor services (Dread, The Hub Forum, Envoy Forum and DNM Avengers Forum).

The total number of listings includes all products that were located on the 12 markets, including duplicated listings posted by the same vendor under different sub-categories (ie in drugs, services and drug paraphernalia) or in different markets. The number of unique listings excludes those product listings repeated within or across markets. We undertook no purchases and the veracity of products on offer could not be verified. Information on purchases was not available. Darknet markets are prone to scams and fake or substitute product deliveries are commonplace. COVID-19 related products are unlikely to be exempt.

Results

Table 1 summarises the types of products available and their approximate prices. A total of 645 COVID-19 related products were found, one-third of which ($n=222$) were unique listings identified after the removal of listings repeated across markets.

These COVID-19 related products made up less than one percent of all products available, which included thousands of listings across all markets for various drugs, services and digital products. There are fewer COVID-19 related products on darknet markets than products such as fentanyl (Ball, Broadhurst & Trivedi 2020) or firearms and other weapons (Broadhurst et al. forthcoming). Agartha listed 444 COVID-19 related products (0.3% of its 159,463 listings) while DarkBay's 118 COVID-19 related listings represent only 0.2 percent of its total of 63,596 listings.

Table 1: Summary of COVID-19 related products available on 12 Tor darknet markets

Products	All listings <i>n</i> (%)	Unique listings <i>n</i> (%)	Median price (A\$)	Mean price (A\$) ^a
PPE	224 (34.7)	99 (44.6)		
Surgical masks/sanitisers/gloves	118 (18.3)	50 (22.5)	100	780 ^b
N95/N99 masks	77 (11.9)	27 (12.2)	400	1,391
Protective suits/full PPE	7 (1.1)	6 (2.7)	1,158	4,939
Bulk masks/sanitisers/gowns	22 (3.4)	16 (7.2)	1,551	3,116
Tests/diagnostics	59(9.2)	19 (8.5)		
Quick/rapid/virus tests	28 (4.3)	12 (5.4)	313	937
Thermo-scanners/industrial	31 (4.8)	7 (3.1)	5,738	6,689
Vaccines/antidotes	41 (6.4)	22 (9.9)	575	5,393
Antiviral/repurposed medicines	313 (48.5)	74 (33.3)		
Hydroxychloroquine	105 (16.3)	11 (5.00)	200	383
Chloroquine	12 5(19.4)	35 (15.8)	308	549
Favipiravir	4 (0.6)	4 (1.8)	563	494
Azithromycin	79 (12.3)	24 (10.8)	43	103
Ventilators	1 (0.2)	1 (0.5)	2,000	2,000
Other	7 (1.1)	7 (3.2)		
COVID19 Handbook	5 (0.8)	5 (2.3)	15	14
3D printed masks app	2 (0.3)	2 (10.00)	1	1
Total	645 (100)	222 (100)	200	49,165

a: Prices are estimated for unique listings

b: An extreme outlier excluded

Note: Percentages may not total 100 due to rounding

COVID-19 related products and prices

Personal protective equipment

Personal protective equipment such as masks, sanitisers, gowns and gloves accounted for about half of all unique listings ($n=99$, 45%) and over a third of all listings ($n=224$, 35%). Prices and quantities varied significantly. For example, a vendor on DarkBay sold a 'Factory Supply Anti Virus Cotton Reusable N95 1860 Face Mask for Corona Virus' for US\$1 but did not specify quantities. Another vendor on Agartha offered 'CORONA MEDICAL FACE MASK \$500' but did not mention the number of masks.

Seven percent of unique listings of PPE products ($n=16$) offered bulk purchases and two (1%) offered computer applications for the 3D printing of masks. Examples of bulk offers include an Agartha vendor who sold '10,000 GOOD QUALITY LAB TESTED FACE MASK FOR CORONA' valued at A\$17,952, and another vendor on Yellow Brick who offered 'BULK anti corona virus mask ON SALES FAST DELIVERY' for A\$5,000.

Antiviral and repurposed medicines

After PPE, antiviral and repurposed medicines were the next most common products, accounting for a third of the unique listings ($n=74$, 33%) and almost half of all listings ($n=313$, 49%). Antimalarial drugs, the antibiotic azithromycin and the antiviral medicine favipiravir have been featured in media reports about likely treatments for COVID-19.

While antimalarial treatments (eg chloroquine and hydroxychloroquine) are usually cheap and readily available, they were present at inflated prices in notable quantities in over a third ($n=230$, 36%) of all listings and nearly three-quarters of all medicinal listings. A vendor on White House who shipped worldwide offered 'Hydroxychloroquine Hcqs 400mg 100 Pills \$139 Miracle Drug For Coronavirus' and 100 200-milligram pills for \$US90.

The antibiotic azithromycin was also listed 79 times (12% of all listings) and accounted for 11 percent of unique listings ($n=24$). An Agarthia vendor shipping from the United States advertised 'Order Azithromycin for Coronavirus - COVID-19' for A\$329.

Four listings of the antiviral medicine favipiravir (also known as T-705 and sold under the brand name Avigan) were identified (2% of unique listings, <1% of all listings). For example, a vendor on Empire offered 'Favipiravir Pills 10 Pills Per Bottle COVID19 CURE' for A\$165 (shipping details not provided), but another vendor shipping from Italy offered 'High Quality Best Price Favipiravir (CAS 259793-9)' for A\$452. A vendor on Agarthia who shipped worldwide from Belgium offered a combination of 'Favipiravir, Chloroquine, Lopinavir and Ritonavir' from A\$674. Observed once, lopinavir and ritonavir are HIV/AIDS treatments noted as potentially useful for treating COVID-19.

Vaccines, antidotes and cures

Despite the absence of a vaccine for COVID-19, or any other coronavirus, purported vaccines and antidotes made up about six percent of all listings ($n=41$) and 10 percent of unique listings ($n=22$). The following listing titles are typical of those touting vaccines and cures: 'GET CORONA VIRUS VACCINE OVERNIGHT DELIVERY'; 'HELLO buy fast... CORONA-VIRUS VACCINE is out now'; 'COVID-19 ANTIDOTE IS HERE FROM CHINA'; 'COVID-19 CURE VACCINE. Keep quiet on this'; 'COVID-19 ANTIDOTE VACCINS FOR SALE'; 'BY CORONAVIRUS CURE WE ORDER WORLD WIDE VERY UNDERSTANDABLE PRIZES'; and 'CORONAVIRUS VACCINE FOR FAST SHIPPING FULL ESCROW'.

Details about the origin or composition of vaccines were sparse, but they are likely fraudulent. There may also be experimental vaccines illegally diverted from research laboratories conducting animal or human trials, or even sourced from patients who have recovered from COVID-19.

The median cost of a vaccine was A\$575, but vaccines offered by three vendors on DarkBay allegedly sourced from China were priced at US\$10,000 to US\$15,000. The most costly vaccine was 'COVID-19 Antidote for sale' at A\$24,598 on Dream Alt, shipped worldwide from the United States. **Vaccines were available only from Agarthia, DarkBay and Dream Alt.** Four Agarthia vendors offered free worldwide shipping of vaccines ranging in price from A\$657 to A\$739 ('GET THAT VACCINE FOR THE MOST VIRAL CORONA VIRUS'), and one included escrow at \$493 ('CORONAVIRUS VACCINE FOR FAST SHIPPING FULL ESCROW').

Tests

COVID-19 test kits (eg 'New rapid test kit to detect COVID-19') were also listed 28 times, but comprised only eight and a half percent of unique listings ($n=19$). A DarkMarket vendor shipping worldwide from Europe sold a 'COVID-19 Antibody Test Kit' for A\$71. A few listings offered test kits in bulk, such as an Agartha vendor who sold 500 'Corona Virus Test/COVID-19 Test Kits (500Pcs)' for A\$3,287. Industrial scanning thermometers were also available in 31 listings (5% of all listings; $n=7$; 3% of unique listings) including those titled: 'BUY CAMERA SCANNER FOR CORONAVIRUS DETECTION'; 'INFRARED THERMOMETERS, 3PLY MASKS, SURGICAL MASKS'; and 'free shipment COVID19 thermometer scanner'. One Agartha vendor, shipping worldwide from the United States, claimed to be a bulk supplier of 2,000 'Industrial Thermometers COVID-19 (2000Prd/\$4)', on sale for A\$52 each, but another offered all 2,000 'Industrial Thermometers' for A\$13,150. Another Agartha vendor, shipping worldwide from Hong Kong, offered 'BUY CAMERA SCANNER FOR CORONAVIRUS DETECTION' for A\$1,357.

Other

Other COVID-19 related products identified included a single ventilator, priced at \$2,000, and five listings of a book titled 'Corona Virus Covid19 Epidemic Survival Handbook Medical Physical Social Economic and Financial Guide'. This handbook was the only product related to COVID-19 sold on Cypher.

Markets

Among markets, Agartha ($n=444$) offered over two-thirds (69%) of all available COVID-19 products, followed by DarkBay (18%, $n=118$) and Empire (7%, $n=48$). Each of the other nine markets offered five or fewer products and accounted for the remaining five percent of all product listings. One market, Cypher, offered only a single listing: the 'Corona Virus Covid19 Epidemic Survival Handbook'. Agartha's market share is much lower when unique listings are considered: Agartha comprised about a third (35%) of unique listings, followed by DarkBay (31%), Empire (19%) and other markets (16%).

Purported vaccines were available on Agartha, DarkBay and Dream Alt, and diagnostic tests and antiviral medicines could also be found on Empire and DarkMarket. These markets were the dominant sources of most products. PPE was sold on four markets, with Agartha selling 50 percent of supply, DarkBay 28 percent, Empire 16 percent and Square six percent.

Agartha was the dominant market in terms of capitalisation, making up 74 percent of the A\$879,000 estimated value, taking into account all listings. However, this value is reduced to A\$369,000 and Agartha's market share to 51 percent if only unique products are valued. Agartha has a reputation for scam risk among some forums but has grown since mid-2019 to over 150,000 listings. We observed a substantial decline in COVID-19 related products on Agartha by 6 April, three days after the 3 April census, indicating sales and/or removal. All other markets remained as observed on census.

Vendors

We identified 110 unique vendor handles. (A Jaro–Winkler Score ≥ 0.90 was used to merge three identical vendors.) Eight vendors were active in at least two markets, including one active across four markets and another across three markets.

Based on all listings, most vendors claimed they were shipping from the United States ($n=394$, 61%), or Europe ($n=56$, 9% including the UK), although over a quarter did not indicate their location ($n=182$, 28%). Some vendors indicated where they shipped products to. Two-thirds of listings ($n=430$, 67%) promised to ship worldwide, while nearly a third shipped only to the United States ($n=187$, 29%). The remainder ($n=24$, 4%) shipped within Europe or the United Kingdom. Four (1%) specifically mentioned shipping to Australia.

Three listings claimed to be shipped from Australia or China/Hong Kong (see Table 2). A vendor on Agartha shipped a 'New rapid test kit to detect COVID-19' to and from Australia for A\$1,643 and also shipped 'Protection from novel coronavirus Disposable medic' worldwide from China, priced at \$8,219. Another vendor claimed to ship worldwide from Australia, offering 'Corona Anti Virus Face Mask Ready and, gowns' priced at A\$57.

Table 2: Vendor shipping locations (based on all listings)

Shipping from	<i>n</i>	%
United States	394	61.1
European Union ^a	39	6.0
United Kingdom	17	2.6
Australia	3	0.5
China/Hong Kong	3	0.5
India	2	0.3
Worldwide	2	0.3
Turkey	1	0.2
Canada	1	0.2
New Zealand	1	0.2
Unknown/not stated	182	28.2
All	645	100.0

a: Sweden (10), Spain (8), Germany (7), Austria (4) Cyprus (1), Italy (2), Belgium (2), France (2), Denmark (2) and Finland (1)

Note: Percentages may not total 100 due to rounding

A relatively small proportion of vendors accounted for most of the listings and potential profit.

Among the most active was 'DrugLord22', a vendor with 23 listings on Agartha, including 'industrial thermometers' in bulk, with an estimated total value of A\$302,467. A vendor known as 'Safetrade' sold bulk N95 masks (16 listings worth A\$8,350) and 'kinghacks' sold vaccines and was active on DarkBay and Dream Alt, with eight listings with an estimated total value of A\$99,598.

Darknet forums and information centres

Posts on darknet forums and information centres about how vendors should approach the COVID-19 pandemic are highly visible. Some provide guidance for vendors. For example, dark.fail (<https://dark.fail/>) instructs:

Respect lockdowns. Self-quarantine if you are feeling symptoms. Wash your hands regularly, disinfect packages when interacting with mail.

The same forum tells consumers to read Yale's *Guidance for people who use substances on COVID-19 (Novel coronavirus)*, which educates about harm reduction.

The Darknetlive forum's 'Corona Timeline' (<https://darknetlive.com/corona>) provides information about disruptions to international postal services. Figure 2 presents examples of typical posts about these delays, as posted or reposted by forum members.

Figure 2: Darknet community posts

April 3

Coronavirus: Domestic updates - AusPost

With significant measures being taken across the country to combat the spread of COVID-19, our priority at Australia Post is to protect our people, customers and community.

April 1

Orders delayed until further notice - dutchkingz (Vendor)

We had some trouble shipping out orders placed between 28 March and April 1st. orders placed on and before 28 march 2020 have all been shipped out

March 31

Clarity about Corona || Small Update regarding no full lockdown in NL - DutchDrugz (Vendor)

So far shipments are arriving, also in lockdown countries, but delays can be insane. Destinations which usually arrive within 5 to 10 days, can now take over 4 to 6 weeks, no joke.

March 26

DCdutchconnectionUK (DCUKConnection) COVID-19 UPDATE (Vendor)

Over the next few weeks we really don't know if we can stay online and ship products, this would depend on the lockdown and if the postal service carries on running.

Discussions about COVID-19 on the darknet from mid-February have mirrored those on the clearnet, with the same surges as found in Google searches (Guirakhoo 2020a). In darknet forum discussions about criminal opportunities in a pandemic, a Digital Shadows analyst also observed (Guirakhoo 2020a):

...some atypical discussions from users including:

- *Discouraging other users from profiting off the pandemic*
- *Expressing solidarity with countries affected (particularly Italy)*
- *Providing health and safety information*

Nevertheless, COVID-19 related opportunities have been identified across the spectrum of cybercrime from malware, phishing, online sales of drugs and contraband, fraud, fakes and deception.

Darknet players are profiteering, and not only are we seeing 'coronavirus sales' but on the flip side 'ethical' market actors are threatening anyone trying to conduct scams. For example, a user with the handle Ganymedes posted on the Envoy forum: 'Anyone who runs coronavirus scams I will personally make it my mission to blow their doxx wide open to the entire darknet and the entire LE [law enforcement]'. In a recent post, the darknet market Monopoly banned COVID-19 related products for ethical reasons:

You do not, under any circumstances use COVID-19 as a marketing tool. No magical cures, no silly fucking mask selling, toilet paper selling. None of that bullshit. We have class here... (Haig 2020)

Monopoly also warned buyers:

You are about to ingest drugs from a stranger on the internet - under no circumstances should you trust any vendor that is using COVID-19 as a marketing tool to peddle tangible/already questionable goods... (Haig 2020)

As yet, discussions related to purported cures or vaccines for COVID-19 have not been found, but this could be due to the strict moderation on these forums. Discussions on 'The Hub' cover both harm reduction (especially misinformation) and opportunities for profit.

Conclusion

The availability of COVID-19 related products on darknet markets is relatively insignificant compared to the availability of other contraband. However, the presence of fraudulent or untested vaccines and medicines warrants closer attention. Indeed, the underground sale of vaccines, real or not, is the key risk presented by darknet sales of COVID-19 products and raises two key concerns. First, fake vaccines could worsen the spread of the virus because users may behave as if immune but nevertheless become infected. Second, the premature release of vaccines undergoing animal or human trials would also misguide users as to their immunity, but may also impact on the success of these crucial clinical trials.

Acknowledgements

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