COVID-19 Mutants Update

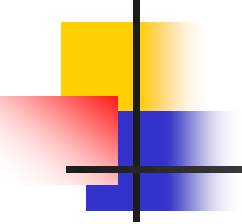**Silicon Valley Forth Interest Group**

Dr. Chen-Hanson Ting

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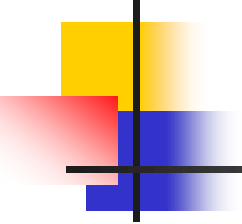
July 25, 2020

COVID-19 (CV)

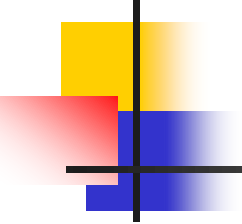- **Wuhan Coronavirus was named SARS-CoV-2, then COVID-19, and then China Virus, according to Mr. Trump.**

- **The pandemic now claimed 144,780 deaths in US and 635,086 deaths in the world, as of 7/24/2020.**

COVID-19 (CV)

- **This is a very scary pandemic.**
- **I downloaded 7,021 CV sequences from Genbank.**
- **There are 59,981 point mutations in these sequences.**
- **There are 6,557 unique point mutations.**

COVID-19 (CV)

- **I am sitting in the front of my computer and watching the evolution of this virus in real time.**

- **In 227 days, 6,557 point mutations are produced, as recorded in 7,021 sequences.**

- **I wish the vaccine manufacturers good luck.**

To Cure COVID-19

- **Infected people can be cured with intravenous infusion of vitamin C.**

- **Intravenous infusion protocol:**
  - **First day: 6 grams of sodium ascorbate at the rate 1 g/h.**
  - **Next 3 day: 1 grams of sodium ascorbate at the rate 1 g/h.**

To Cure COVID-19

- **Taking 10 grams of vitamin C daily protects you from the infection by COVID-19.**

- **Infected people can also be cured by taking 10 grams of vitamin C every 4 hours, until diarrhea.**

COVID-19

- **Rumors had that it was a biological weapon developed in the Wuhan P4 Lab in China.**

- **It is sequenced in many laboratories in many countries.**

- **It mutates continually.**

Compare Virus sequences

- **I have the best tools to compare sequences.**

- **My Exhaustive Pattern Search algorithm can be used to identify similarities and differences between sequences.**

Genbank Downloads

- **I downloaded and analyzed these sequences fronm the Genbank:**
  - **3/9/2020 51 sequences**
  - **3/25/2020 120 sequences**
  - **3/30/2020 320 sequences**
  - **4/16/2020 785 sequences**
  - **6/25/2020 4,058 sequences**
  - **7/15/2020 7,021 sequences**

Differences in sequences

- **I scan all 20 nucleotide patterns in a source genome.**

- **If a pattern appears in a target genome, it is marked as a match, else a mismatch.**

- **Matches and mismatches are collected in separated files and analyzed.**

Point Mutations

- **I compare all COVID-19 sequences against CV0, a Reference Sequence with genome ID MN908947 and NC_045512.**

- **Mismatches are point mutations and are tabulated for all COVID-19 sequences.**

Point Mutations

- **Up to 7/15/2020, three mutants CV1, CV2 and CV3 are identified.**

- **The most prevalent point mutations are:**

- **CV1:   T28144C**

- **CV2:   A23403G**

- **CV3:   G11083T**

Point Mutations

- **The most prevalent 45 point mutations are listed in the following table:**

Counts	Mutants	PM	Counts	Mutants	PM	Counts	Mutants	PM
4819	cv2	A23403G	420	cv2	C29870N	155	cv1	A29700G
4797	cv2	C3037T	376	cv2	G29553A	151	cv2	C11916T
4777	cv2	C241T	306	cv2	C2416T	149	cv1	T26729C
4766	cv2	C14408T	304	cv2	C27964T	148	cv1	T490A
3342	cv2	G25563T	234	cv2	C26735T	146	cv1	T18736C
2433	cv2	C1059T	202	cv3	C14805T	138	cv2	C2836T
1486	cv1	T28144C	191	cv2	C28854T	123	cv4	G29711T
1480	cv1	C8782T	186	cv2	A1163T	110	cv2	A23122R
1177	cv1	C18060T	182	cv3	G26144T	109	cv2	T833C
1166	cv1	A17858G	174	cv2	C22444T	108	cv2	G26233T
1162	cv1	C17747T	166	cv2	C379A	103	cv2	C15324T
752	cv2	G28883C	164	cv1	C24034T	103	cv2	G29540A
564	cv2	C18877T	164	cv1	G28077C	102	cv2	C18998T
431	cv3	G11083T	156	cv1	C3177T	100	cv3	G29742T

Point Mutations in CV1

- **The most prevalent 12 point mutations in CV1 are listed in the following table.**

- **The earliest sampling date and the location of the samples are also listed, to show the evolution of CV1.**

CV1 Mutations

Counts	Point Mutations	Virus ID	Locations	Earliest Sampled Date
1486	T28144C	MT291826	China: Wuhan	2019/12/30
1480	C8782T	MN938384	China: Shenzhen	2020/1/10
1177	C18060T	MT291826	China: Wuhan	2019/12/30
1166	A17858G	MT598633	USA:	2020/2/20
1162	C17747T	MT598633	USA: WA	2020/2/20
164	C24034T	MN988713	USA: Illinois	2020/1/21
164	G28077C	MN988713	USA: Illinois	2020/1/21
156	C3177T	MN988713	USA: Illinois	2020/1/21
155	A29700G	MT325571	USA: GA	2020/3/1
149	T26729C	MT325571	USA: GA	2020/3/1
148	T490A	MT325571	USA: GA	2020/3/1
146	T18736C	MT325571	USA: GA	2020/3/1

Point Mutations in CV2

- **The most prevalent 45 point mutations in CV2 are listed in the following two tables.**

- **The earliest sampling date and the location of the samples are also listed, to show the evolution of CV2.**

CV2 Mutations

Counts	Point Mutations	Virus ID	Locations	Sampled Date
4819	A23403G	MT270104	Germany	2020/1/28
4797	C3037T	MT270104	Germany	2020/1/28
4777	C241T	MT270104	Germany	2020/1/28
4766	C14408T	MT358640	Germany	2020/2/1
3342	G25563T	MT755883	Saudi Arabia	2020/2/3
2433	C1059T	MT304484	USA: NH	2020/2/29
752	G28883C	MT358640	Germany	2020/2/1
564	C18877T	MT755883	Saudi Arabia	2020/2/3
420	C29870N	MT358640	Germany	2020/2/1
376	G29553A	MT627616	USA WA	2020/3/8
306	C2416T	MT470105	France	2020/3/1
304	C27964T	MT739473	USA VA	2020/3/1

CV2 Mutations

Counts	Point Mutations	Virus ID	Locations	Earliest Sampled Date
234	C26735T	MT755883	Saudi Arabia	2020/2/3
186	A1163T	MT745740	Australia	2020/3/19
174	C22444T	MT755888	Saudi Arabia	2020/2/13
166	C379A	MT325610	USA: UT	2020/3/7
151	C11916T	MT434782	USA: NY	2020/3/5
110	A23122R	MT451051	Australia	2020/3/17
109	T833C	MT252741	USA: WA	2020/3/12
108	G26233T	MT325629	USA: MA	2020/3/5
103	C15324T	MT358643	Germany	2020/2/1
103	G29540A	MT434782	USA: NY	2020/3/5
102	C18998T	MT434782	USA: NY	2020/3/5
191	C28854T	MT027062	USA: CA	2020/1/29
138	C2836T	MT435085	India	2020/4/22

Point Mutations in CV3

- **The most prevalent 4 point mutations in CV3 are listed in the following two tables.**

- **The earliest sampling date and the location of the samples are also listed, to show the evolution of CV3.**

CV3 Mutations

Counts	Point Mutations	Virus ID	Locations	Earlies Sampled Date
431	G11083T	MT114414	Hong Kong	2020/1/24
202	C14805T	MT730002	South Korea	2020/2/26
100	G29742T	MT114414	Hong Kong	2020/1/24
182	G26144T	MT730002	South Korea	2020/2/26

Mutant Statistics

- **The COVID-19 Genbank collection of sequences is ever expanding.**

- **There are 7,021 sequences in the 7/15/2020 download.**

- **There are 59,980 point mutations found in these sequences and 6,881 of them are unique.**

Mutants Statistics

	Download 3/30/2020	Download 4/17/2020	Download 6/25/2020	Download 7/15/2020
Total Sequences	**205**	**785**	**4085**	**7021**
CV0	**3%**	**12%**	**1%**	**1%**
CV1	**63%**	**37%**	**19%**	**21%**
CV2	**34%**	**46%**	**68%**	**69%**
CV3	**0%**	**5%**	**7%**	**6%**

Mutant Statistics

- **New point mutations are continually added to the CV1 and CV2 mutants.**

- **It is important for the vaccine designers to recognize these point mutations, and hopefully to have a single vaccine effective for all these mutants.**

Evolution of CV

- **Do not expect that a new vaccine will be available shortly, as the COVID-19 is a moving target.**

- **We can coexist with it like other mammals. Just give the body enough vitamin C.**

Take Vitamin C and Go Back to Work!

- **Take 10 grams of vitamin C to protect yourself from infection.**
- **If infected, take 10 grames of vitamin C every 4 hours until diarrhea to suppress the CV virus.**

Thank You!