The 2020 Epidemic Question Answering Track

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Motivation

Expert

"The longer I practice medicine, the more I realize the power of succinct, accurate information. In the era of mile-long problem lists and medication lists in the double digits, a clinician's ability to synthesize information and accurately convey it is more important than ever."
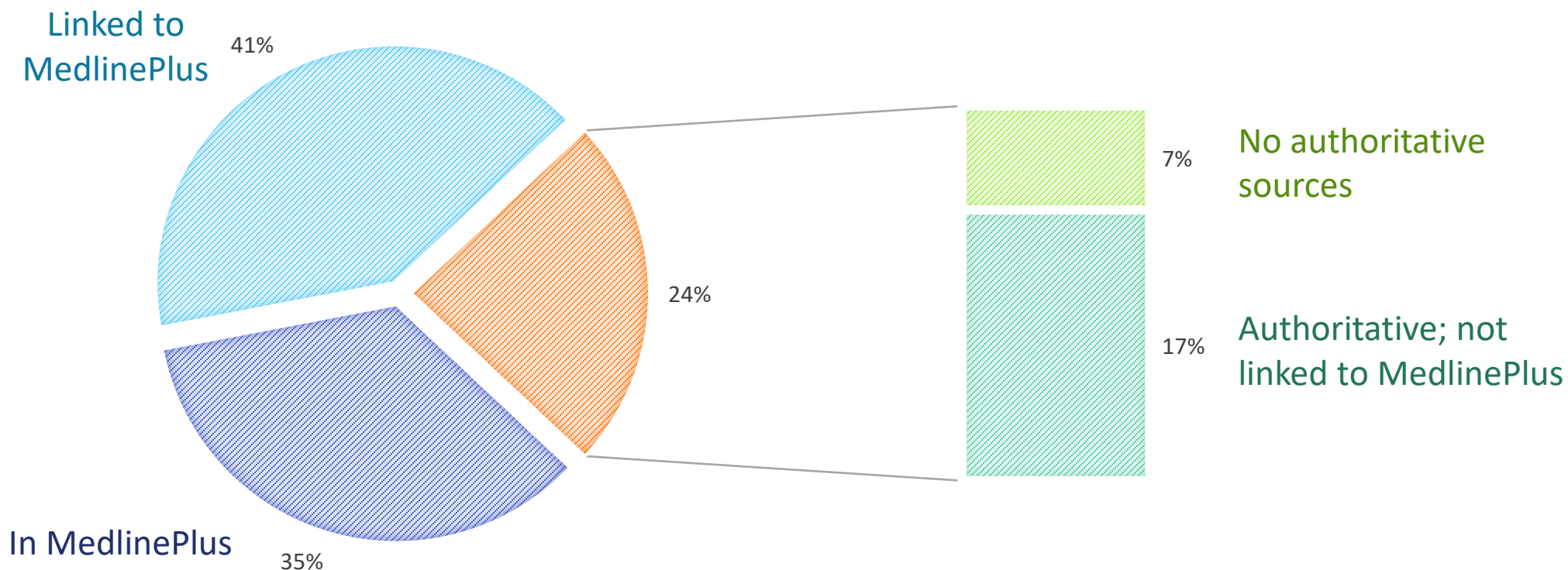
Vinay Choksi, MD, Annals of internal Medicine Jan 22, 2020

Consumer

"Consumers often consult online sources first, searching the Internet for health information and finding answers of varying degrees of quality that they are often unable to judge."

The Consumer Health Reference Interview and Ethical Issues, National Network of Libraries of Medicine

Do reliable consumer-friendly answers exist?

Linked to MedlinePlus 41%

24%

No authoritative sources 7%

Authoritative; not linked to MedlinePlus 17%
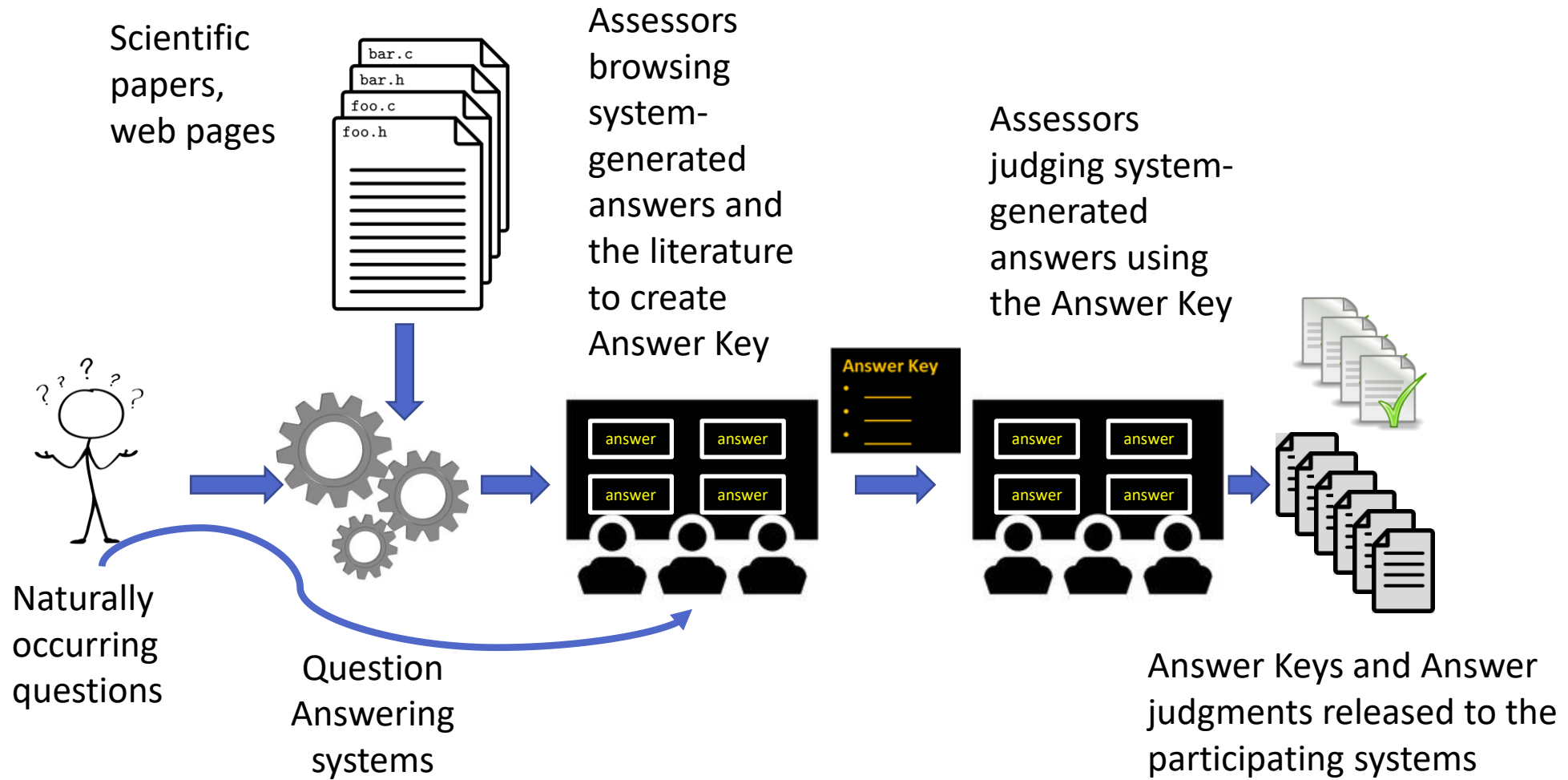
In MedlinePlus 35%

Deardorff A, Masterton K, Roberts K, Kilicoglu H, Demner-Fushman D. A protocol-driven approach to automatically finding authoritative answers to consumer health questions in online resources. Journal of the Association for Information Science and Technology. 2017 July;68(7):1724–1736

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EPIC-QA

- Systems that can automatically answer questions about COVID-19 by extracting answers in language and detail sufficient for experts, consumers, or both.

- Questions asked by different stakeholders often overlap

- The best answers – even for the same questions – may prioritize different information, present information in different language, and originate from different documents in order to best meet the varying goals and backgrounds of the user.

Finding Answers: Epidemic Question Answering (EPIC-QA)

Scientific papers, web pages

Assessors browsing system-generated answers and the literature to create Answer Key

Assessors judging system-generated answers using the Answer Key

Naturally occurring questions

Question Answering systems

Answer Keys and Answer judgments released to the participating systems

How does Tylenol work?

There is no consensus on the mechanism of action of acetaminophen, with the eicosanoid, endocannabinoid, serotonergic, and nitric oxide pathways implicated in the drug's analgesic effect. APAP's main mechanism of action is linked to its inhibitory effect on the synthesis of prostaglandins (PGs). PGs are lipids derived from the arachidonic acid pathway that act as mediators of inflammation, fever and pain. . .The more constitutively expressed PTGS1 and the more readily inducible PTGS2 (by cytokines and growth factors particularly) are commonly referred to as cyclooxygenase-1 (COX-1) and -2 (COX-2), respectively. Both traditional non-steroidal anti-inflammatory drugs (tNSAIDs) and those designed purposefully to inhibit selectively COX-2 block only the cyclooxygenase activity of the enzymes. However, acetaminophen inhibits both COX isoforms by acting on the peroxide site and reducing the amount of the PTGS oxidized form required for AA conversion.

Expert

Acetaminophen relieves pain by elevating the pain threshold, that is, by requiring a greater amount of pain to develop before a person feels it. It reduces fever through its action on the heat-regulating center of the brain. Specifically, it tells the center to lower the body's temperature when the temperature is elevated. (Medicinenet.com)

Consumer

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Tasks

Task A (Expert)

- Given:
  - Set of questions asked by experts
- Goal:
  - Ranked list of expert-level answers

Task B (Consumer)

- Given:
  - Set of questions asked by consumers
- Goal:
  - Ranked list of answers in consumer-friendly language

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What is the origin of COVID-19? (Systems)

CONSUMER PASSAGE

(1) COVID-19 is caused by a new coronavirus. **(2)** Coronaviruses are a large family of viruses that are common in people and many different species of animals, including camels, cattle, cats, and bats. Rarely, animal coronaviruses can infect people and then spread between people such as with MERS-CoV, SARS-CoV, and now with this new virus (named SARS-CoV-2).

The SARS-CoV-2 virus is a betacoronavirus, like MERS-CoV and SARS-CoV. **(3)** All three of these viruses have their origins in bats. **(4)** The sequences from U.S. patients are similar to the one that China initially posted, suggesting a likely single, recent emergence of this virus from an animal reservoir.

From **the CDC.**

EXPERT PASSAGE

(1) It is improbable that SARS-CoV-2 emerged through laboratory manipulation of a related SARS-CoV-like coronavirus. As noted above, the RBD of SARS-CoV-2 is optimized for binding to human ACE2 with an efficient solution different from those previously predicted.[7,11] **(2)** Furthermore, if genetic manipulation had been performed, one of the several reverse-genetic systems available for betacoronaviruses would probably have been used. [19] **(3)** However, the genetic data irrefutably show that SARS-CoV-2 is not derived from any previously used virus backbone. [20] **(4)** Instead, we propose two scenarios that can plausibly explain the origin of SARS-CoV-2: (i) natural selection in an animal host before zoonotic transfer; and (ii) natural selection in humans following zoonotic transfer.

From **Andersen et al. (2020).**

Participation

Team	Task A	Task B	Task A	Task B
CORONAWHY (CoronaWhy)		✓		
covidbert (Johns Hopkins University / New York University / Korea University)	✓	✓		
Dindadiel (Unaffiliated)	✓			
h2oloo (University of Waterloo)			✓	✓
HLTRI (Human Language Technology Research Institute at the University of Texas at Dallas)	✓	✓	✓	✓
IBM (IBM Research AI)	✓	✓	✓	✓
ixa (Ixa NLP Group at the University of the Basque Country (UPV/EHU))	✓			
nlm_lhc_qa (Lister Hill National Center for Biomedical Communications at the U.S. National Library of Medicine)	✓	✓	✓	✓
UPC_USMBA (Universitat Politécnica de Catalunya / University Sidi Mohammed Ben Abdellah)	✓	✓	✓	✓
vigicovid (Universidad Nacional de Educación a Distancia / University of the Basque Country (UPV/EHU) / Elhuyar)	✓		✓	
Yastil_R (Centre for AI Research South Africa / University of KwaZulu-Natal)			✓	

What is the origin of COVID-19? (Contexts)

Expert

The species of origin of SARS-CoV-2 has not been fully identified, but the virus seems to be related to SARS-CoV and other **coronaviruses found in bats** and other mammal species, although different from them. The SARS-CoV-2 genome size is around 30 kb with the typical gene structure known in 36 other **betacoronaviruses**: starting from the 5', more than two-thirds of the genome 37 comprises orf1ab encoding polyproteins (nsp1 to nsp15), while the last third consists of 38 genes encoding major structural proteins; including spike (S or ORF2), envelope (E or 39 ORF4), membrane (M or ORF5), and nucleocapsid (N or ORF9) proteins.

Consumer

Some coronaviruses that infect animals can sometimes be spread to humans and then spread between people, but this is rare. Severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) are examples of diseases caused by coronaviruses that originated in animals and spread to people. This is what is suspected to have happened with the virus that caused the current outbreak of COVID-19. However, we do not know the exact source of this virus. Public health officials and partners are working hard to identify the source of COVID-19. The first infections were linked to a **live animal market**, but the virus is now spreading from person to person.

What is the origin of COVID-19? (Nuggets)

Expert Nuggets

- emergence
- species of origin
- virus adaptation
- Bats
- Mammal species
- Chinese province of Hubei
- molecular evolution
- viral fitness
- Beta-coronaviruses
- interspecies transmission
- pangolins
- evolutionary constraints
- seafood wholesale market in Wuhan

- zoonotic origin
- bat coronavirus genome
- ancestral haplotypes
- Codon usage bias
- bat reservoirs
- animal-to-human transmission
- genetic recombination
- potential mutations
- the species barrier
- positive selection pressure
- spillover

Consumer Nuggets

- live animal market
- newly emerged coronavirus
- experimentally infected animals
- testing of animals
- Wuhan
- exposure to wild animals
- wild animal traders

Annotation Interface

Preliminary Round: Data

Documents

- CORD-19 from June 19, 2020
- NIH, WHO, CDC documents

Topics

- 45 topics used in TREC COVID-Search
- Document-level relevance judgments (produced by TREC) are available

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Preliminary Round Results: Task A

	NDNS-Partial			NDNS-Relaxed			NDNS-Exact	
1	0.305	ixa_3		0.307	ixa_3		0.341	ixa_3
2	0.303	ixa_2		0.304	ixa_2		0.338	ixa_2
3	0.302	HLTRI_1		0.295	IBM_3		0.327	IBM_1
4	0.294	IBM_3		0.294	IBM_1		0.327	IBM_2
5	0.294	IBM_1		0.293	IBM_2		0.325	IBM_3
6	0.293	IBM_2		0.293	HLTRI_1		0.306	ixa_1
7	0.276	ixa_1		0.277	ixa_1		0.3	vigicovid_2
8	0.266	vigicovid_2		0.267	vigicovid_2		0.297	vigicovid_3
9	0.263	vigicovid_3		0.265	vigicovid_3		0.289	HLTRI_1
10	0.226	UPC_USMBA_1		0.218	UPC_USMBA_1		0.215	vigicovid_1
11	0.204	UPC_USMBA_2		0.198	UPC_USMBA_2		0.212	UPC_USMBA_1
12	0.191	vigicovid_1		0.192	vigicovid_1		0.192	UPC_USMBA_2
13	0.149	covidbert_2		0.149	Dindadiel_1		0.165	Dindadiel_1
14	0.148	Dindadiel_1		0.144	covidbert_1		0.158	covidbert_1
15	0.143	covidbert_1		0.142	covidbert_2		0.131	nlm_lhc_qa_2
16	0.134	nlm_lhc_qa_2		0.132	nlm_lhc_qa_2		0.131	covidbert_2
17	0.113	nlm_lhc_qa_1		0.111	nlm_lhc_qa_1		0.109	nlm_lhc_qa_1

Preliminary Round Results: Task B

	NDNS-Partial		NDNS-Relaxed		NDNS-Exact	
1	**0.488**	**HLTRI_1**	**0.482**	**HLTRI_1**	**0.475**	**HLTRI_1**
2	0.398	IBM_1	0.396	IBM_1	0.413	IBM_1
3	0.394	IBM_3	0.394	IBM_3	0.409	IBM_3
4	0.374	IBM_2	0.372	IBM_2	0.39	IBM_2
5	0.364	covidbert_1	0.364	covidbert_1	0.389	covidbert_1
6	0.315	UPC_USMBA_1	0.307	UPC_USMBA_1	0.302	UPC_USMBA_1
7	0.307	UPC_USMBA_2	0.299	UPC_USMBA_2	0.286	UPC_USMBA_2
8	0.281	covidbert_2	0.276	nlm_lhc_qa_1	0.257	nlm_lhc_qa_1
9	0.278	nlm_lhc_qa_1	0.272	covidbert_2	0.253	covidbert_2
10	0.059	CORONAWHY_1	0.059	CORONAWHY_1	0.043	CORONAWHY_1

Primary Round: Data

Documents
- CORD-19 from October 8, 2020
- NIH, WHO, CDC documents + /r/AskScience + CCNC

Questions
- 30 questions
- No document-level relevance judgments
- Access to sentence-level annotations from preliminary round

Primary Round Results: Task A

	NDNS-Partial			NDNS-Relaxed			NDNS-Exact		
1	**0.421**	**HLTRI_3**		**0.37**	**HLTRI_3**		**0.371**	**HLTRI_3**	
2	0.413	HLTRI_2		0.363	HLTRI_2		0.364	HLTRI_2	
3	0.41	Yastil_R_1		0.361	Yastil_R_1		0.362	Yastil_R_1	
4	0.408	HLTRI_1		0.359	HLTRI_1		0.36	HLTRI_1	
5	0.391	vigicovid_3		0.345	IBM_2		0.344	vigicovid_3	
6	0.39	h2oloo_2		0.344	vigicovid_3		0.344	IBM_2	
7	0.388	h2oloo_1		0.34	h2oloo_2		0.341	h2oloo_2	
8	0.385	Yastil_R_2		0.338	h2oloo_1		0.339	h2oloo_1	
9	0.376	h2oloo_3		0.337	Yastil_R_2		0.338	Yastil_R_2	
10	0.374	vigicovid_2		0.336	IBM_3		0.334	IBM_3	
11	0.367	IBM_2		0.331	IBM_1		0.329	vigicovid_2	
12	0.359	vigicovid_1		0.329	vigicovid_2		0.329	h2oloo_3	
13	0.354	IBM_3		0.328	h2oloo_3		0.327	IBM_1	
14	0.353	IBM_1		0.315	vigicovid_1		0.315	vigicovid_1	
15	0.209	nlm_lhc_qa_1		0.223	nlm_lhc_qa_1		0.219	nlm_lhc_qa_1	
16	0.148	UPC_USMBA_1		0.126	UPC_USMBA_1		0.127	UPC_USMBA_1	

Primary Round Results: Task B

	NDNS-Partial		NDNS-Relaxed		NDNS-Exact	
1	**0.414**	**h2oloo_2**	**0.366**	**h2oloo_2**	**0.368**	**h2oloo_2**
2	0.407	h2oloo_1	0.359	h2oloo_1	0.361	h2oloo_1
3	0.382	h2oloo_3	0.338	h2oloo_3	0.339	h2oloo_3
4	0.363	HLTRI_3	0.316	HLTRI_3	0.317	HLTRI_3
5	0.353	HLTRI_2	0.312	HLTRI_2	0.313	HLTRI_2
6	0.346	HLTRI_1	0.304	HLTRI_1	0.305	HLTRI_1
7	0.282	IBM_2	0.268	IBM_3	0.264	IBM_2
8	0.278	IBM_3	0.268	IBM_2	0.263	IBM_3
9	0.267	IBM_1	0.249	IBM_1	0.245	IBM_1
10	0.183	nlm_lhc_qa_1	0.186	nlm_lhc_qa_1	0.184	nlm_lhc_qa_1
11	0.175	UPC_USMBA_3	0.176	UPC_USMBA_3	0.172	UPC_USMBA_3
12	0.033	UPC_USMBA_1	0.03	UPC_USMBA_1	0.03	UPC_USMBA_1

Conclusions

- Goals:
  - Explore extractive question answering for COVID-19
  - Explore the role of user expertise on answer satisfaction
  - Encourage diverse answers
- Substantial difference between nuggets selected for expert and consumer questions
- Substantial differences in passages selected by expert and consumer questions
- Challenging task, but very promising results!

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- o Kyle Lo, Lucy Lu Wang, Sam Skjonsberg, Mark Neumann

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