The data and materials supporting the results and analyses of the paper "Health Security inequalities in Non-EU European Countries: A Cross-National Comparative Assessment Using an Integrated MCDM-Machine Learning Approach"

Mijahed Nasser Aljober [a]. Adel A. Nasser [b, c], Abed Saif Ahmed Alghawli[d*], and Amani A. K. Elsayed[e]

[a]Department of Artificial Intelligence, Modern Specialized University, Sana'a, Yemen; Email: mijahed@msu.edu.ye

[b]Department of Information Systems and Computer Science, Sa'adah University, Sa'adah, Yemen; Email: adel@saada-uni.edu.ye

[c]Department of Artificial Intelligence, Modern Specialized University, Sana'a, Yemen; Email: dr.adel@msu.edu.ye

[d]Department of Computer Science, College of Sciences and Humanities, Building No: 16 A 3, Prince Sattam Bin Abdulaziz University, Al-Kharj, Riyadh Province, Saudi Arabia, Postal code: 16700; Tel: +966-50-040-1831, Email: a.alghauly@psau.edu.sa

[e]Department of Computer Science, College of Sciences and Humanities, Building No: 16 A 3 Prince Sattam Bin Abdulaziz University, Al-Kharj, Riyadh Province, Saudi Arabia; Email: aa.elsayed@psau.edu.sa

[*]Corresponding Author

Summary: This document supplements the research paper titled *Health Security Inequities in Non-EU European Countries: A Cross-National Comparative Assessment Using an Integrated MCDM-Machine Learning Approach* by providing additional details and analyses. It includes all the data and materials supporting the results and analyses, organized into the following key elements**:**

1. **Health Security Framework:** A description of the health security standards employed, along with decision-making matrices for 2019 and 2021. It also outlines the initial research phase, which focused on defining the importance, ranking, and grouping of Non-EU European countries, as well as those in African and Eastern Mediterranean (EMR) regions**.**
2. **Entropy Weighting:** The results of entropy calculations are presented, which were used to assess the importance of various health security indicators for Non-EU European countries, African, and EMR countries in 2019, 2021, and the combined period of 2017–2021**.** This section includes the steps and values behind the results reported in section 3.1 of the paper.
3. **Ranking Results:** The document provides a detailed account of how the Entropy-CoCoSo model was used to rank the health security performance of Non-EU European countries throughout the study period, including score comparisons and trend analysis. This section includes the steps and values behind the results reported in section 3.2 of the paper.
4. **Cluster Analysis:** It explains the use of the K-means model to group Non-EU European countries into performance-based clusters, ranging from high to dangerous, based on their Entropy-CoCoSo health security scores. It also highlights the distribution of these clusters across different regions and three time periods. This section includes the steps and values behind the results reported in section 3.2 of the paper.
5. **Tabular and graphical visualization of results:** This section includes the values behind the measures reported in all analysis and discussion sections, as well as the values used to construct the figures.

   Overall, this supplementary material aims to improve the transparency and replicability of the study's findings, offering a more in-depth understanding of its methodological and empirical underpinnings.

1. Health security criteria and Initial decision matrixes for their evaluating

1.1. Health Security Index Criteria

Table 1. Health Security Index Criteria

C	HIS Criteria	Description
PR	Prevention	The effectiveness of countries in preventing and managing the occurrence or dissemination of pathogens.
DR	Detection and Reporting	The strength and effectiveness of systems responsible for identifying and reporting potential global outbreaks.
RR	Rapid Response	A country's ability to promptly and effectively respond to and manage the spread of an epidemic.
HS	Health System	The sufficiency and resilience of a country's healthcare sector in providing adequate treatment to patients.
CA	Commitments and Adherence	A country's commitment to improving its national capabilities and adhering to international norms in health security.
RE	Risk Environment	The overall risk environment and country vulnerability to biological threats.

1.2. Initial Decision Matrices for Assessing Health Security Performance in the Non-EU European countries

Table 2. Initial Decision Matrices for Assessing Health Security Performance in the Non-EU European Countries (Case -2019)

Country	PR	DR	RR	HS	CA	RE
Albania	42	45.4	43.5	37.8	55	53.7
Andorra	19	2.2	33.4	15.5	33	79.9
Armenia	75	67.9	72.6	55	58.7	50.3
Azerbaijan	32.6	21.7	33.4	21.7	37.8	57.8
Belarus	31.2	26.1	49.4	43.3	46.7	53.8
Bosnia and Herzegovina	34.6	13.3	36	39.3	45.3	49.9
Georgia	51.1	51.5	43.8	23.3	67.5	52
Iceland	33.2	32.2	44.8	47.5	46.9	80.7
Israel	41.6	43.3	52.6	52.8	43.4	70.4
Kazakhstan	55	22.4	39.7	32.3	58.7	60.5
Kyrgyz Republic	27.5	26.7	36.5	40.5	67	60.1
Liechtenstein	32.8	17.1	42.9	44.3	50	83.1
Moldova	37.3	34.2	40	46.8	38.9	47.5
Monaco	7.5	20.6	30.8	40.9	26.9	76
Montenegro	36.3	17.5	42.3	37	54	57.6
North Macedonia	39.9	30.8	40.2	28.8	43.2	57.6

Norway	**49.6**	**52.5**	**68.1**	**45.1**	**64.8**	**88.2**
Russia	**42.1**	**35.3**	**54.7**	**49.6**	**51.4**	**49.6**
San Marino	**17.4**	**17.2**	**28.8**	**28.6**	**26.6**	**74.5**
Serbia	**44**	**28.6**	**41.2**	**46.2**	**50.9**	**58.9**
Switzerland	**50.2**	**38.3**	**71.3**	**50.9**	**68.1**	**83.9**
Tajikistan	**30.8**	**5.8**	**34.5**	**24.9**	**39.4**	**43.5**
Turkey	**50.3**	**35.1**	**46.4**	**49.1**	**59.7**	**57.8**
Turkmenistan	**22**	**27.1**	**32.7**	**31.2**	**38**	**48.8**
Ukraine	**32.8**	**23.3**	**37.7**	**32.7**	**50.9**	**44**
United Kingdom	**63.3**	**62.5**	**68.1**	**66**	**75**	**75**
Uzbekistan	**36.2**	**20**	**35.7**	**24.4**	**57.3**	**52.7**

Table 3. Initial Decision Matrices for Assessing Health Security Performance in the Non-EU European Countries (Case -2021)

Country	**PR**	**DR**	**RR**	**HS**	**CA**	**RE**
Albania	**42**	**42.7**	**40.8**	**42.6**	**53.55**	**52.15**
Andorra	**23.05**	**2.2**	**36.45**	**15.45**	**38.1**	**80.2**
Armenia	**77.15**	**68.75**	**64.45**	**56.9**	**58.95**	**48.95**
Azerbaijan	**32.6**	**21.7**	**32.9**	**22.9**	**38.1**	**58.55**
Belarus	**32.6**	**30.25**	**45.8**	**44.5**	**51.15**	**52.7**
Bosnia and Herzegovina	**32.5**	**13.6**	**36.35**	**40.5**	**42.1**	**50.3**
Georgia	**53.15**	**58.3**	**44.95**	**28.5**	**65.7**	**51.8**
Iceland	**36.6**	**34.3**	**46.35**	**49.85**	**40.65**	**80.3**
Israel	**41.6**	**45**	**48.5**	**54**	**37.15**	**67.3**
Kazakhstan	**54.95**	**25.8**	**38.1**	**33.45**	**58.7**	**61.7**
Kyrgyz Republic	**27.65**	**26.7**	**34.65**	**40.45**	**66.55**	**60.25**
Liechtenstein	**37**	**17.1**	**40.3**	**45.45**	**50.7**	**83.75**
Moldova	**39.45**	**34.2**	**37.85**	**47.55**	**38.9**	**47.5**
Monaco	**7.5**	**20.6**	**33.2**	**40.9**	**23**	**76**
Montenegro	**35.05**	**24.8**	**41**	**39.35**	**56.6**	**57.75**
North Macedonia	**37.8**	**33.95**	**37.7**	**33.55**	**45.3**	**58.65**
Norway	**51.7**	**49.4**	**62.8**	**45.05**	**67.1**	**88.6**
Russia	**43.8**	**39.45**	**49.7**	**54.25**	**51.4**	**50.05**
San Marino	**17.4**	**19.3**	**32.7**	**28.6**	**22.7**	**74.6**
Serbia	**44**	**28.6**	**38.75**	**48.55**	**51.15**	**58.7**
Switzerland	**50.2**	**40.4**	**68.1**	**50.9**	**63.9**	**84.25**
Tajikistan	**26.45**	**8.2**	**31.9**	**24.85**	**40.25**	**45.75**
Turkey	**50.7**	**38.25**	**41.5**	**51.5**	**59.7**	**57.5**
Turkmenistan	**22.05**	**27.35**	**27.25**	**30.9**	**38**	**49.95**
Ukraine	**32.1**	**28.05**	**31.9**	**40.9**	**49.05**	**45.35**
United Kingdom	**63.4**	**66.65**	**66.45**	**67.15**	**68.75**	**74**
Uzbekistan	**38.4**	**19.25**	**32.15**	**27.35**	**60.05**	**53**

Table 4. Initial Decision Matrices for Assessing Health Security Performance in the Non-EU

European Countries (average 2019 and 2021 HSP scores)

Country	PR	DR	RR	HS	CA	RE
Albania	42	40	38.1	47.4	52.1	50.6
Andorra	27.1	2.2	39.5	15.4	43.2	80.5
Armenia	79.3	69.6	56.3	58.8	59.2	47.6
Azerbaijan	32.6	21.7	32.4	24.1	38.4	59.3
Belarus	34	34.4	42.2	45.7	55.6	51.6
Bosnia and Herzegovina	30.4	13.9	36.7	41.7	38.9	50.7
Georgia	55.2	65.1	46.1	33.7	63.9	51.6
Iceland	40	36.4	47.9	52.2	34.4	79.9
Israel	41.6	46.7	44.4	55.2	30.9	64.2
Kazakhstan	54.9	29.2	36.5	34.6	58.7	62.9
Kyrgyz Republic	27.8	26.7	32.8	40.4	66.1	60.4
Liechtenstein	41.2	17.1	37.7	46.6	51.4	84.4
Moldova	41.6	34.2	35.7	48.3	38.9	47.5
Monaco	7.5	20.6	35.6	40.9	19.1	76
Montenegro	33.8	32.1	39.7	41.7	59.2	57.9
North Macedonia	35.7	37.1	35.2	38.3	47.4	59.7
Norway	53.8	46.3	57.5	45	69.4	89
Russia	45.5	43.6	44.7	58.9	51.4	50.5
San Marino	17.4	21.4	36.6	28.6	18.8	74.7
Serbia	44	28.6	36.3	50.9	51.4	58.5
Switzerland	50.2	42.5	64.9	50.9	59.7	84.6
Tajikistan	22.1	10.6	29.3	24.8	41.1	48
Turkey	51.1	41.4	36.6	53.9	59.7	57.2
Turkmenistan	22.1	27.6	21.8	30.6	38	51.1
Ukraine	31.4	32.8	26.1	49.1	47.2	46.7
United Kingdom	63.5	70.8	64.8	68.3	62.5	73
Uzbekistan	40.6	18.5	28.6	30.3	62.8	53.3

1.3. Initial Decision Matrices for Assessing Health Security Performance in the EMR

Table 5. Initial decision matrix for evaluating health security performance in EMR (Case -2019)

Alternative	Country Group	PR	DR	RR	HS	CA	RE
Bahrain	GCC	31.9	33.5	44.8	38.9	29.2	55
Kuwait	GCC	34.7	17.9	52.4	42.5	30.6	62.8
Oman	GCC	35.4	33.5	45.9	26.2	39.6	64.7
Qatar	GCC	32.1	33.5	54.2	40	43.8	67
Saudi Arabia	GCC	33.4	50	39.4	38.4	49.3	59.7
United Arab Emirates	GCC	39	25.1	42.1	17.1	43.4	73.9
Afghanistan	Non-GCC	15.4	20	27.1	20.6	54.2	30.4
Djibouti	Non-GCC	12.7	10	26.9	14	33.2	46.6
Egypt	Non-GCC	19.1	18.3	32.7	16.5	34.2	61
Iran	Non-GCC	42.9	24.7	51.2	39.4	27.1	51.9

Iraq	**Non-GCC**	**17.3**	**15.8**	**26.7**	**15**	**29.5**	**35.4**
Jordan	**Non-GCC**	**30.3**	**27.2**	**45.2**	**40**	**48.1**	**56.5**
Lebanon	**Non-GCC**	**17**	**41**	**57**	**19.2**	**39.6**	**46.9**
Libya	**Non-GCC**	**15.5**	**22.1**	**21.5**	**13.1**	**29.2**	**38.5**
Morocco	**Non-GCC**	**29.4**	**27.9**	**36.1**	**30.9**	**32.6**	**57**
Pakistan	**Non-GCC**	**17**	**25**	**28.7**	**24.1**	**47.4**	**45.7**
Somalia	**Non-GCC**	**11.4**	**15.8**	**28.9**	**1.3**	**26**	**24.2**
Sudan	**Non-GCC**	**22.6**	**15.8**	**50.6**	**12.8**	**41.7**	**36.8**
Syria	**Non-GCC**	**9.7**	**8.3**	**24.6**	**13.4**	**24**	**32**
Tunisia	**Non-GCC**	**25.3**	**20.4**	**48.9**	**13.1**	**29.2**	**56**
Yemen	**Non-GCC**	**9.2**	**8.3**	**24.7**	**12**	**37.5**	**27.8**

Table 6. Initial decision matrix for evaluating health security performance in EMR (Case -2021)

Alternative	**Country Group**	**PR**	**DR**	**RR**	**HS**	**CA**	**RE**
Bahrain	**GCC**	**28.6**	**37.2**	**33.5**	**41.2**	**21.9**	**55.2**
Kuwait	**GCC**	**27.2**	**17.9**	**40.3**	**42.5**	**29.2**	**63.9**
Oman	**GCC**	**35.4**	**33.5**	**31.7**	**28.6**	**41.5**	**64.2**
Qatar	**GCC**	**36.4**	**39.7**	**55.2**	**42.4**	**46.7**	**71.7**
Saudi Arabia	**GCC**	**33.4**	**52.1**	**32.7**	**40.7**	**49.5**	**61.2**
United Arab Emirates	**GCC**	**39**	**22.6**	**37.5**	**19.5**	**43.9**	**74.7**
Afghanistan	**Non-GCC**	**12**	**20.6**	**24.5**	**23**	**60.9**	**31.6**
Djibouti	**Non-GCC**	**16.1**	**14.2**	**29.1**	**14**	**33.2**	**45**
Egypt	**Non-GCC**	**15.7**	**18.9**	**20.9**	**18.8**	**33.3**	**60.3**
Iran	**Non-GCC**	**42.9**	**28.9**	**36.4**	**39.4**	**27.1**	**44.4**
Iraq	**Non-GCC**	**15.4**	**24.2**	**21.3**	**20.2**	**32.8**	**30.1**
Jordan	**Non-GCC**	**30.3**	**32.5**	**41.8**	**47.1**	**48.1**	**57.1**
Lebanon	**Non-GCC**	**8.6**	**38.9**	**52**	**21.6**	**40.1**	**39**
Libya	**Non-GCC**	**11.1**	**28.3**	**31.1**	**13**	**31.3**	**36.7**
Morocco	**Non-GCC**	**29.3**	**27.9**	**28**	**30.8**	**33.2**	**52.5**
Pakistan	**Non-GCC**	**17.1**	**29.2**	**18.8**	**26.8**	**45.8**	**44.8**
Somalia	**Non-GCC**	**11.4**	**11.7**	**25.8**	**1.3**	**21.9**	**23.6**
Sudan	**Non-GCC**	**22.5**	**15.8**	**42.9**	**12.8**	**41.7**	**34.1**
Syria	**Non-GCC**	**12.9**	**4.2**	**18**	**13.4**	**24.5**	**27.4**
Tunisia	**Non-GCC**	**21.9**	**20.4**	**41.9**	**13**	**33.7**	**57.7**
Yemen	**Non-GCC**	**0.8**	**4.2**	**17.5**	**12**	**37.5**	**24.9**

Table 7. Initial decision matrix for evaluating health security performance in EMR (average 2019 and 2021 HSP scores)

Alternative	**Country Group**	**PR**	**DR**	**RR**	**HS**	**CA**	**RE**
Bahrain	**GCC**	**30.25**	**35.35**	**39.15**	**40.05**	**25.55**	**55.1**
Kuwait	**GCC**	**30.95**	**17.9**	**46.35**	**42.5**	**29.9**	**63.35**
Oman	**GCC**	**35.4**	**33.5**	**38.8**	**27.4**	**40.55**	**64.45**
Qatar	**GCC**	**34.25**	**36.6**	**54.7**	**41.2**	**45.25**	**69.35**
Saudi Arabia	**GCC**	**33.4**	**51.05**	**36.05**	**39.55**	**49.4**	**60.45**
United Arab Emirates	**GCC**	**39**	**23.85**	**39.8**	**18.3**	**43.65**	**74.3**
Afghanistan	**Non-GCC**	**13.7**	**20.3**	**25.8**	**21.8**	**57.55**	**31**
Djibouti	**Non-GCC**	**14.4**	**12.1**	**28**	**14**	**33.2**	**45.8**

Egypt	**Non-GCC**	**17.4**	**18.6**	**26.8**	**17.65**	**33.75**	**60.65**
Iran	**Non-GCC**	**42.9**	**26.8**	**43.8**	**39.4**	**27.1**	**48.15**
Iraq	**Non-GCC**	**16.35**	**20**	**24**	**17.6**	**31.15**	**32.75**
Jordan	**Non-GCC**	**30.3**	**29.85**	**43.5**	**43.55**	**48.1**	**56.8**
Lebanon	**Non-GCC**	**12.8**	**39.95**	**54.5**	**20.4**	**39.85**	**42.95**
Libya	**Non-GCC**	**13.3**	**25.2**	**26.3**	**13.05**	**30.25**	**37.6**
Morocco	**Non-GCC**	**29.35**	**27.9**	**32.05**	**30.85**	**32.9**	**54.75**
Pakistan	**Non-GCC**	**17.05**	**27.1**	**23.75**	**25.45**	**46.6**	**45.25**
Somalia	**Non-GCC**	**11.4**	**13.75**	**27.35**	**1.3**	**23.95**	**23.9**
Sudan	**Non-GCC**	**22.55**	**15.8**	**46.75**	**12.8**	**41.7**	**35.45**
Syria	**Non-GCC**	**11.3**	**6.25**	**21.3**	**13.4**	**24.25**	**29.7**
Tunisia	**Non-GCC**	**23.6**	**20.4**	**45.4**	**13.05**	**31.45**	**56.85**
Yemen	**Non-GCC**	**5**	**6.25**	**21.1**	**12**	**37.5**	**26.35**

1.4. Initial Decision Matrices for Assessing Health Security Performance in Africa

Table 8. Initial Decision Matrices for Assessing Health Security Performance in Africa (Case -2019)

Country	PR	DR	RR	HS	CA	RE
Algeria	**19.4**	**8.5**	**31.1**	**12.6**	**37.3**	**52**
Angola	**13.4**	**13.3**	**20.9**	**16.8**	**43.1**	**43.7**
Benin	**9.2**	**18.3**	**31.6**	**7.6**	**50**	**44.9**
Botswana	**14.7**	**18.9**	**30.3**	**18.5**	**41.7**	**62.4**
Burkina Faso	**9.7**	**37.6**	**47.7**	**11.3**	**51.9**	**48.4**
Burundi	**10.3**	**14.2**	**30**	**9.1**	**33.3**	**39**
Cabot Verde	**20.1**	**10.6**	**37.4**	**21.5**	**39.4**	**66.5**
Cameroon	**15.2**	**31.4**	**33.8**	**17.9**	**56.3**	**38.8**
Central African Republic	**13.8**	**12.5**	**27.8**	**8.3**	**31.8**	**29.9**
Chad	**18.1**	**18.3**	**29.6**	**10.2**	**41.7**	**29.2**
Comoros	**8.4**	**15.8**	**31.4**	**11.6**	**47.9**	**36.3**
Congo (Brazzaville)	**9.5**	**4.2**	**28**	**8.2**	**54.2**	**39.2**
Congo (Democratic Republic)	**12.4**	**29.2**	**29.8**	**16.2**	**42.2**	**26.4**
Côte d'Ivoire	**15.7**	**33.8**	**38.8**	**14.7**	**50**	**44.3**
Equatorial Guinea	**0.001**	**0.001**	**24.9**	**8.3**	**29.2**	**45.4**
Eritrea	**16**	**10.4**	**23.6**	**8.6**	**37.5**	**38.8**
satiny	**23.8**	**21.1**	**30.1**	**9.4**	**48.4**	**51.3**
Ethiopia	**22.5**	**23.5**	**42**	**28.2**	**64.9**	**43.2**
Gabon	**3.2**	**3.3**	**27.9**	**9.3**	**35.4**	**40.5**
Gambia	**10.8**	**20.8**	**37.3**	**17.9**	**40.1**	**50.2**
Ghana	**27**	**22.6**	**34.2**	**15.6**	**33.9**	**56.4**
Guinea	**18**	**28.3**	**33.7**	**18**	**36.8**	**36**
Guinea-Bissau	**8.4**	**12.5**	**24.8**	**7.2**	**34.7**	**28.3**
Kenya	**34.4**	**51.5**	**38.4**	**23.9**	**66.5**	**43.8**
Lesotho	**21.6**	**8.5**	**46.9**	**27.2**	**43.6**	**48.1**
Liberia	**7.6**	**23.8**	**34.7**	**29.2**	**67.4**	**44.7**
Madagascar	**17.5**	**27.5**	**35.9**	**15.8**	**52.6**	**36.1**

Malawi	**17.3**	**14.7**	**23.5**	**19.9**	**47.9**	**43.2**
Mali	**13.9**	**24.6**	**33.1**	**14.5**	**58.2**	**39.1**
Mauritania	**1.9**	**24.6**	**31**	**21**	**33.2**	**40.8**
Mauritius	**27.3**	**35.8**	**29.9**	**20.7**	**51.2**	**65**
Mozambique	**15.1**	**24.2**	**30.2**	**24**	**41**	**43.1**
Namibia	**12.5**	**35.4**	**27.4**	**14.4**	**41.5**	**53.9**
Niger	**22.3**	**28.3**	**25**	**24**	**41.7**	**37.1**
Nigeria	**23.5**	**35.8**	**41.8**	**23.4**	**54.7**	**42.6**
Rwanda	**29.7**	**24.6**	**28.5**	**20.9**	**33.9**	**49.2**
São Tomé and Príncipe	**0.001**	**5.8**	**29.4**	**10.9**	**34.7**	**44.7**
Senegal	**14.3**	**28.3**	**49.5**	**14.3**	**56.8**	**51.9**
Seychelles	**8.3**	**22.9**	**37.4**	**15.8**	**45.1**	**69.8**
Sierra Leone	**17.4**	**31.4**	**39.1**	**30.6**	**48.6**	**37.7**
South Africa	**35.5**	**52.1**	**61.3**	**29.3**	**47.2**	**59.4**
South Sudan	**15.4**	**16.7**	**21.3**	**17.1**	**31.3**	**27.8**
Tanzania	**18.8**	**29.7**	**29.9**	**11**	**53.1**	**50.8**
Togo	**13.6**	**27.1**	**30.3**	**11.5**	**33.3**	**40.9**
Uganda	**22.9**	**35**	**45.1**	**20.4**	**67.2**	**43.4**
Zambia	**14**	**18.8**	**33**	**20.8**	**35.2**	**46.4**
Zimbabwe	**21.4**	**40.4**	**36.9**	**14.4**	**42.2**	**44.9**

Table 9. Initial decision matrix for evaluating health security performance in Africa (2021)

Country	**PR**	**DR**	**RR**	**HS**	**CA**	**RE**
Algeria	**15.3**	**12.6**	**25.6**	**15**	**38.9**	**49.7**
Angola	**14.7**	**13.3**	**31.6**	**23.1**	**47.7**	**43.9**
Benin	**9.3**	**14.2**	**29.3**	**7.7**	**46.9**	**45**
Botswana	**14.7**	**29.3**	**25.3**	**20.9**	**48.3**	**63.3**
Burkina Faso	**9.7**	**33.9**	**32.4**	**13.7**	**51.9**	**37.4**
Burundi	**14.2**	**14.2**	**21.5**	**9.1**	**34.4**	**39.4**
Cabot Verde	**22.3**	**14.7**	**38.5**	**23.1**	**43.6**	**62.5**
Cameroon	**6.5**	**30.8**	**29.5**	**20.3**	**51**	**33.8**
Central African Republic	**10.5**	**12.5**	**20.6**	**8.3**	**33.9**	**26.2**
Chad	**18.1**	**18.3**	**25.7**	**10.2**	**46.4**	**25**
Comoros	**8.4**	**17.9**	**22.4**	**14**	**47.9**	**38.8**
Congo (Brazzaville)	**1.1**	**9.6**	**36.2**	**8.2**	**63**	**40**
Congo (Democratic Republic)	**12.4**	**29.2**	**26.2**	**16.2**	**42.7**	**29.9**
Côte d'Ivoire	**12.4**	**29.6**	**35.3**	**17.1**	**47.7**	**45.2**
Equatorial Guinea	**0.001**	**0.001**	**21.2**	**8.3**	**29.2**	**46**
Eritrea	**12.5**	**10.4**	**19.9**	**8.6**	**37.5**	**39.3**
eSwatini	**24**	**21.7**	**25.9**	**11.8**	**40.1**	**52.1**
Ethiopia	**22.5**	**29.7**	**45.9**	**28.2**	**59.4**	**41.2**
Gabon	**4.6**	**7.5**	**28.4**	**11.7**	**37.5**	**41.2**
Gambia	**10.8**	**22.9**	**30.9**	**15.5**	**40.6**	**51.4**
Ghana	**27**	**33.1**	**31.4**	**22.7**	**34.4**	**57.2**

Guinea	**14.6**	**28.3**	**25.4**	**20.3**	**37.3**	**35.1**
Guinea-Bissau	**8.4**	**16.7**	**25.3**	**7.2**	**41.7**	**29.1**
Kenya	**31**	**55.7**	**19.3**	**21.5**	**62.3**	**43.1**
Lesotho	**12.5**	**8.5**	**45.8**	**27.2**	**42.7**	**48.8**
Liberia	**7.6**	**24.6**	**32.6**	**36.4**	**66.5**	**46.6**
Madagascar	**17.5**	**31.7**	**28.5**	**15.8**	**52.6**	**36.6**
Malawi	**17.3**	**10.6**	**24.9**	**22.3**	**51.9**	**44.2**
Mali	**10.5**	**25.1**	**32.2**	**17.3**	**56.1**	**32.7**
Mauritania	**1.9**	**26.7**	**28.5**	**21**	**37.8**	**41.3**
Mauritius	**27.3**	**32.2**	**35**	**23.1**	**54.5**	**65.8**
Mozambique	**19.2**	**28.3**	**26.9**	**24**	**43.6**	**40.5**
Namibia	**9.2**	**31.8**	**31.1**	**16.8**	**40.6**	**52.2**
Niger	**18.9**	**24.2**	**26.7**	**24**	**46.4**	**31.9**
Nigeria	**20.1**	**37.9**	**43.2**	**23.4**	**62.8**	**40.7**
Rwanda	**25.4**	**34.6**	**30.5**	**18.5**	**39.4**	**50.1**
São Tomé and Príncipe	**14.4**	**7.9**	**32.1**	**25.2**	**33.9**	**46**
Senegal	**11**	**28.3**	**41.3**	**14.6**	**54**	**47.8**
Seychelles	**8.6**	**18.8**	**32.5**	**18.2**	**45.7**	**67.3**
Sierra Leone	**9**	**31.4**	**37.3**	**31**	**47.2**	**40.3**
South Africa	**32.1**	**50**	**62**	**29.2**	**43.1**	**58.5**
South Sudan	**12.1**	**14.6**	**25.4**	**19.5**	**31.3**	**25.1**
Tanzania	**15.4**	**25.6**	**26.4**	**11**	**58.9**	**50.5**
Togo	**10.2**	**34.6**	**27**	**13.8**	**38.5**	**42.6**
Uganda	**19.5**	**35.6**	**33.8**	**20.4**	**67.2**	**42.4**
Zambia	**5.6**	**19.3**	**34.9**	**21.1**	**34.4**	**43.5**
Zimbabwe	**18.1**	**40.4**	**31.4**	**16.8**	**42.7**	**44.9**

Table 10. Initial decision matrix for evaluating health security performance in Africa (average 2019 and 2021 HSP scores)

Country	**PR**	**DR**	**RR**	**HS**	**CA**	**RE**
Algeria	**17.35**	**10.55**	**28.35**	**13.8**	**38.1**	**50.85**
Angola	**14.05**	**13.3**	**26.25**	**19.95**	**45.4**	**43.8**
Benin	**9.25**	**16.25**	**30.45**	**7.65**	**48.45**	**44.95**
Botswana	**14.7**	**24.1**	**27.8**	**19.7**	**45**	**62.85**
Burkina Faso	**9.7**	**35.75**	**40.05**	**12.5**	**51.9**	**42.9**
Burundi	**12.25**	**14.2**	**25.75**	**9.1**	**33.85**	**39.2**
Cabo Verde	**21.2**	**12.65**	**37.95**	**22.3**	**41.5**	**64.5**
Cameroon	**10.85**	**31.1**	**31.65**	**19.1**	**53.65**	**36.3**
Central African Republic	**12.15**	**12.5**	**24.2**	**8.3**	**32.85**	**28.05**
Chad	**18.1**	**18.3**	**27.65**	**10.2**	**44.05**	**27.1**
Comoros	**8.4**	**16.85**	**26.9**	**12.8**	**47.9**	**37.55**
Congo (Brazzaville)	**5.3**	**6.9**	**32.1**	**8.2**	**58.6**	**39.6**
Congo (Democratic Republic)	**12.4**	**29.2**	**28**	**16.2**	**42.45**	**28.15**
Côte d'Ivoire	**14.05**	**31.7**	**37.05**	**15.9**	**48.85**	**44.75**

Equatorial Guinea	**0.001**	**0.001**	**23.05**	**8.3**	**29.2**	**45.7**
Eritrea	**14.25**	**10.4**	**21.75**	**8.6**	**37.5**	**39.05**
eSwatini	**23.9**	**21.4**	**28**	**10.6**	**44.25**	**51.7**
Ethiopia	**22.5**	**26.6**	**43.95**	**28.2**	**62.15**	**42.2**
Gabon	**3.9**	**5.4**	**28.15**	**10.5**	**36.45**	**40.85**
Gambia	**10.8**	**21.85**	**34.1**	**16.7**	**40.35**	**50.8**
Ghana	**27**	**27.85**	**32.8**	**19.15**	**34.15**	**56.8**
Guinea	**16.3**	**28.3**	**29.55**	**19.15**	**37.05**	**35.55**
Guinea-Bissau	**8.4**	**14.6**	**25.05**	**7.2**	**38.2**	**28.7**
Kenya	**32.7**	**53.6**	**28.85**	**22.7**	**64.4**	**43.45**
Lesotho	**17.05**	**8.5**	**46.35**	**27.2**	**43.15**	**48.45**
Liberia	**7.6**	**24.2**	**33.65**	**32.8**	**66.95**	**45.65**
Madagascar	**17.5**	**29.6**	**32.2**	**15.8**	**52.6**	**36.35**
Malawi	**17.3**	**12.65**	**24.2**	**21.1**	**49.9**	**43.7**
Mali	**12.2**	**24.85**	**32.65**	**15.9**	**57.15**	**35.9**
Mauritania	**1.9**	**25.65**	**29.75**	**21**	**35.5**	**41.05**
Mauritius	**27.3**	**34**	**32.45**	**21.9**	**52.85**	**65.4**
Mozambique	**17.15**	**26.25**	**28.55**	**24**	**42.3**	**41.8**
Namibia	**10.85**	**33.6**	**29.25**	**15.6**	**41.05**	**53.05**
Niger	**20.6**	**26.25**	**25.85**	**24**	**44.05**	**34.5**
Nigeria	**21.8**	**36.85**	**42.5**	**23.4**	**58.75**	**41.65**
Rwanda	**27.55**	**29.6**	**29.5**	**19.7**	**36.65**	**49.65**
São Tomé and Príncipe	**7.2005**	**6.85**	**30.75**	**18.05**	**34.3**	**45.35**
Senegal	**12.65**	**28.3**	**45.4**	**14.45**	**55.4**	**49.85**
Seychelles	**8.45**	**20.85**	**34.95**	**17**	**45.4**	**68.55**
Sierra Leone	**13.2**	**31.4**	**38.2**	**30.8**	**47.9**	**39**
South Africa	**33.8**	**51.05**	**61.65**	**29.25**	**45.15**	**58.95**
South Sudan	**13.75**	**15.65**	**23.35**	**18.3**	**31.3**	**26.45**
Tanzania	**17.1**	**27.65**	**28.15**	**11**	**56**	**50.65**
Togo	**11.9**	**30.85**	**28.65**	**12.65**	**35.9**	**41.75**
Uganda	**21.2**	**35.3**	**39.45**	**20.4**	**67.2**	**42.9**
Zambia	**9.8**	**19.05**	**33.95**	**20.95**	**34.8**	**44.95**
Zimbabwe	**19.75**	**40.4**	**34.15**	**15.6**	**42.45**	**44.9**

2. Estimating the relative importance of health security indicators countries using the entropy method.

2.1. Determining the relative importance of health security indicators (Non-EU European Countries based on 2019 data)

Table 11. Determining the relative importance of health security indicators (Non-EU European countries based on 2019 data)

1. Construction of decision matrix							
	Country	**PR**	**DR**	**RR**	**HS**	**CA**	**RE**

1	**Albania**	**42**	**45.4**	**43.5**	**37.8**	**55**	**53.7**
2	**Andorra**	**19**	**2.2**	**33.4**	**15.5**	**33**	**79.9**
3	**Armenia**	**75**	**67.9**	**72.6**	**55**	**58.7**	**50.3**
4	**Azerbaijan**	**32.6**	**21.7**	**33.4**	**21.7**	**37.8**	**57.8**
5	**Belarus**	**31.2**	**26.1**	**49.4**	**43.3**	**46.7**	**53.8**
6	**Bosnia and Herzegovina**	**34.6**	**13.3**	**36**	**39.3**	**45.3**	**49.9**
7	**Georgia**	**51.1**	**51.5**	**43.8**	**23.3**	**67.5**	**52**
8	**Iceland**	**33.2**	**32.2**	**44.8**	**47.5**	**46.9**	**80.7**
9	**Israel**	**41.6**	**43.3**	**52.6**	**52.8**	**43.4**	**70.4**
10	**Kazakhstan**	**55**	**22.4**	**39.7**	**32.3**	**58.7**	**60.5**
11	**Kyrgyz Republic**	**27.5**	**26.7**	**36.5**	**40.5**	**67**	**60.1**
12	**Liechtenstein**	**32.8**	**17.1**	**42.9**	**44.3**	**50**	**83.1**
13	**Moldova**	**37.3**	**34.2**	**40**	**46.8**	**38.9**	**47.5**
14	**Monaco**	**7.5**	**20.6**	**30.8**	**40.9**	**26.9**	**76**
15	**Montenegro**	**36.3**	**17.5**	**42.3**	**37**	**54**	**57.6**
16	**North Macedonia**	**39.9**	**30.8**	**40.2**	**28.8**	**43.2**	**57.6**
17	**Norway**	**49.6**	**52.5**	**68.1**	**45.1**	**64.8**	**88.2**
18	**Russia**	**42.1**	**35.3**	**54.7**	**49.6**	**51.4**	**49.6**
19	**San Marino**	**17.4**	**17.2**	**28.8**	**28.6**	**26.6**	**74.5**
20	**Serbia**	**44**	**28.6**	**41.2**	**46.2**	**50.9**	**58.9**
21	**Switzerland**	**50.2**	**38.3**	**71.3**	**50.9**	**68.1**	**83.9**
22	**Tajikistan**	**30.8**	**5.8**	**34.5**	**24.9**	**39.4**	**43.5**
23	**Turkey**	**50.3**	**35.1**	**46.4**	**49.1**	**59.7**	**57.8**
24	**Turkmenistan**	**22**	**27.1**	**32.7**	**31.2**	**38**	**48.8**
25	**Ukraine**	**32.8**	**23.3**	**37.7**	**32.7**	**50.9**	**44**
26	**United Kingdom**	**63.3**	**62.5**	**68.1**	**66**	**75**	**75**
27	**Uzbekistan**	**36.2**	**20**	**35.7**	**24.4**	**57.3**	**52.7**
2. Calculating the normalized values of alternatives using (2)							
	Country	**PR**	**DR**	**RR**	**HS**	**CA**	**RE**
1	**Albania**	**0.041**	**0.055**	**0.036**	**0.036**	**0.041**	**0.032**
2	**Andorra**	**0.018**	**0.003**	**0.028**	**0.015**	**0.024**	**0.048**
3	**Armenia**	**0.072**	**0.083**	**0.060**	**0.052**	**0.043**	**0.030**
4	**Azerbaijan**	**0.031**	**0.027**	**0.028**	**0.021**	**0.028**	**0.035**
5	**Belarus**	**0.030**	**0.032**	**0.041**	**0.041**	**0.034**	**0.032**
6	**Bosnia and Herzegovina**	**0.033**	**0.016**	**0.030**	**0.037**	**0.033**	**0.030**
7	**Georgia**	**0.049**	**0.063**	**0.036**	**0.022**	**0.050**	**0.031**
8	**Iceland**	**0.032**	**0.039**	**0.037**	**0.045**	**0.035**	**0.048**
9	**Israel**	**0.040**	**0.053**	**0.044**	**0.050**	**0.032**	**0.042**
10	**Kazakhstan**	**0.053**	**0.027**	**0.033**	**0.031**	**0.043**	**0.036**
11	**Kyrgyz Republic**	**0.027**	**0.033**	**0.030**	**0.038**	**0.049**	**0.036**
12	**Liechtenstein**	**0.032**	**0.021**	**0.036**	**0.042**	**0.037**	**0.050**
13	**Moldova**	**0.036**	**0.042**	**0.033**	**0.044**	**0.029**	**0.028**
14	**Monaco**	**0.007**	**0.025**	**0.026**	**0.039**	**0.020**	**0.046**
15	**Montenegro**	**0.035**	**0.021**	**0.035**	**0.035**	**0.040**	**0.035**
16	**North Macedonia**	**0.039**	**0.038**	**0.033**	**0.027**	**0.032**	**0.035**

17	**Norway**	**0.048**	**0.064**	**0.057**	**0.043**	**0.048**	**0.053**
18	**Russia**	**0.041**	**0.043**	**0.046**	**0.047**	**0.038**	**0.030**
19	**San Marino**	**0.017**	**0.021**	**0.024**	**0.027**	**0.020**	**0.045**
20	**Serbia**	**0.042**	**0.035**	**0.034**	**0.044**	**0.038**	**0.035**
21	**Switzerland**	**0.048**	**0.047**	**0.059**	**0.048**	**0.050**	**0.050**
22	**Tajikistan**	**0.030**	**0.007**	**0.029**	**0.024**	**0.029**	**0.026**
23	**Turkey**	**0.049**	**0.043**	**0.039**	**0.047**	**0.044**	**0.035**
24	**Turkmenistan**	**0.021**	**0.033**	**0.027**	**0.030**	**0.028**	**0.029**
25	**Ukraine**	**0.032**	**0.028**	**0.031**	**0.031**	**0.038**	**0.026**
26	**United Kingdom**	**0.061**	**0.076**	**0.057**	**0.063**	**0.055**	**0.045**
27	**Uzbekistan**	**0.035**	**0.024**	**0.030**	**0.023**	**0.042**	**0.032**
Sum		**1.00000**	**1.00000**	**1.00000**	**1.00000**	**1.00000**	**1.00000**
3. Computing the entropy measure E_j							
	Country	**PR**	**DR**	**RR**	**HS**	**CA**	**RE**
1	**Albania**	**-0.130**	**-0.160**	**-0.120**	**-0.119**	**-0.130**	**-0.111**
2	**Andorra**	**-0.073**	**-0.016**	**-0.100**	**-0.062**	**-0.090**	**-0.146**
3	**Armenia**	**-0.190**	**-0.207**	**-0.170**	**-0.154**	**-0.136**	**-0.106**
4	**Azerbaijan**	**-0.109**	**-0.096**	**-0.100**	**-0.080**	**-0.100**	**-0.117**
5	**Belarus**	**-0.106**	**-0.110**	**-0.131**	**-0.131**	**-0.116**	**-0.111**
6	**Bosnia and Herzegovina**	**-0.114**	**-0.067**	**-0.105**	**-0.123**	**-0.114**	**-0.105**
7	**Georgia**	**-0.149**	**-0.174**	**-0.121**	**-0.084**	**-0.149**	**-0.108**
8	**Iceland**	**-0.110**	**-0.127**	**-0.123**	**-0.140**	**-0.116**	**-0.147**
9	**Israel**	**-0.129**	**-0.155**	**-0.137**	**-0.150**	**-0.110**	**-0.134**
10	**Kazakhstan**	**-0.156**	**-0.098**	**-0.113**	**-0.107**	**-0.136**	**-0.120**
11	**Kyrgyz Republic**	**-0.096**	**-0.112**	**-0.106**	**-0.125**	**-0.149**	**-0.120**
12	**Liechtenstein**	**-0.109**	**-0.081**	**-0.119**	**-0.133**	**-0.122**	**-0.149**
13	**Moldova**	**-0.120**	**-0.133**	**-0.113**	**-0.138**	**-0.102**	**-0.101**
14	**Monaco**	**-0.036**	**-0.093**	**-0.094**	**-0.126**	**-0.078**	**-0.141**
15	**Montenegro**	**-0.117**	**-0.082**	**-0.118**	**-0.117**	**-0.128**	**-0.116**
16	**North Macedonia**	**-0.125**	**-0.123**	**-0.114**	**-0.098**	**-0.110**	**-0.116**
17	**Norway**	**-0.146**	**-0.176**	**-0.163**	**-0.135**	**-0.145**	**-0.155**
18	**Russia**	**-0.130**	**-0.136**	**-0.141**	**-0.144**	**-0.124**	**-0.105**
19	**San Marino**	**-0.069**	**-0.081**	**-0.089**	**-0.098**	**-0.077**	**-0.139**
20	**Serbia**	**-0.134**	**-0.117**	**-0.116**	**-0.137**	**-0.123**	**-0.118**
21	**Switzerland**	**-0.147**	**-0.143**	**-0.168**	**-0.146**	**-0.150**	**-0.150**
22	**Tajikistan**	**-0.105**	**-0.035**	**-0.102**	**-0.088**	**-0.103**	**-0.095**
23	**Turkey**	**-0.147**	**-0.135**	**-0.126**	**-0.143**	**-0.138**	**-0.117**
24	**Turkmenistan**	**-0.082**	**-0.113**	**-0.098**	**-0.104**	**-0.100**	**-0.103**
25	**Ukraine**	**-0.109**	**-0.101**	**-0.109**	**-0.108**	**-0.123**	**-0.096**
26	**United Kingdom**	**-0.171**	**-0.196**	**-0.163**	**-0.173**	**-0.160**	**-0.139**
27	**Uzbekistan**	**-0.117**	**-0.091**	**-0.105**	**-0.087**	**-0.134**	**-0.109**
Sum		**-3.22587**	**-3.15916**	**-3.26032**	**-3.24946**	**-3.26453**	**-3.27328**
Entropy		**0.97877**	**0.95853**	**0.98922**	**0.98593**	**0.99050**	**0.99315**
4. Computing the entropy measure E_j		**PR**	**DR**	**RR**	**HS**	**CA**	**RE**

1-Entropy	0.021	0.041	0.011	0.014	0.009	0.007
Weight	0.204	0.399	0.104	0.135	0.091	0.066

These steps were repeated to calculate the relative importance of various health security indicators based on 2019, 2021 data and the aggregated data scores for Non-EU European Countries, AFRICA, and EMR case studies (Sec. 2.2).

2.2. Determining the relative importance of health security indicators for other cases

Table 12. Regional prioritization of HeS dimensions: Non-EU vs. EMR vs. African Region

Data	Region	Weights Values					
		PR	DR	RR	HS	CA	RE
2019	Non-EU European countries	0.204	0.399	0.104	0.135	0.091	0.066
2021		0.218	0.372	0.098	0.126	0.123	0.064
Aggregated		0.214	0.388	0.097	0.130	0.104	0.067
2019	African Region	0.330	0.326	0.060	0.172	0.057	0.055
2021		0.352	0.294	0.072	0.169	0.051	0.063
Aggregated		0.325	0.322	0.061	0.175	0.056	0.061
2019	Eastern Mediterranean	0.209	0.217	0.098	0.322	0.060	0.095
2021		0.259	0.221	0.096	0.261	0.063	0.099
Aggregated		0.228	0.220	0.092	0.298	0.063	0.099

3. Application of Entropy-CoCoSo-model for Evaluating and Ranking of Non-EU Countries

3.1. Application of Entropy-CoCoSo-model for Evaluating and Ranking of Non-EU European Countries (Case 2019)

Table 13.Entropy-CoCoSo HeS Scores (C_i), and Rankings (R_i), for Non-EU European Countries (Case 2019)

1. Construct the decision matrix (X)							
	Country	PR	DR	RR	HS	CA	RE
1	Albania	42	45.4	43.5	37.8	55	53.7
2	Andorra	19	2.2	33.4	15.5	33	79.9
3	Armenia	75	67.9	72.6	55	58.7	50.3
4	Azerbaijan	32.6	21.7	33.4	21.7	37.8	57.8
5	Belarus	31.2	26.1	49.4	43.3	46.7	53.8
6	Bosnia and Herzegovina	34.6	13.3	36	39.3	45.3	49.9
7	Georgia	51.1	51.5	43.8	23.3	67.5	52
8	Iceland	33.2	32.2	44.8	47.5	46.9	80.7
9	Israel	41.6	43.3	52.6	52.8	43.4	70.4
10	Kazakhstan	55	22.4	39.7	32.3	58.7	60.5
11	Kyrgyz Republic	27.5	26.7	36.5	40.5	67	60.1
12	Liechtenstein	32.8	17.1	42.9	44.3	50	83.1
13	Moldova	37.3	34.2	40	46.8	38.9	47.5
14	Monaco	7.5	20.6	30.8	40.9	26.9	76

15	Montenegro	36.3	17.5	42.3	37	54	57.6
16	North Macedonia	39.9	30.8	40.2	28.8	43.2	57.6
17	Norway	49.6	52.5	68.1	45.1	64.8	88.2
18	Russia	42.1	35.3	54.7	49.6	51.4	49.6
19	San Marino	17.4	17.2	28.8	28.6	26.6	74.5
20	Serbia	44	28.6	41.2	46.2	50.9	58.9
21	Switzerland	50.2	38.3	71.3	50.9	68.1	83.9
22	Tajikistan	30.8	5.8	34.5	24.9	39.4	43.5
23	Turkey	50.3	35.1	46.4	49.1	59.7	57.8
24	Turkmenistan	22	27.1	32.7	31.2	38	48.8
25	Ukraine	32.8	23.3	37.7	32.7	50.9	44
26	United Kingdom	63.3	62.5	68.1	66	75	75
27	Uzbekistan	36.2	20	35.7	24.4	57.3	52.7

2. Calculate the normalized values of alternatives (N).

	Country	PR	DR	RR	HS	CA	RE
1	Albania	0.51111	0.65753	0.33562	0.44158	0.58678	0.22819
2	Andorra	0.17037	0.00000	0.10502	0.00000	0.13223	0.81432
3	Armenia	1.00000	1.00000	1.00000	0.78218	0.66322	0.15213
4	Azerbaijan	0.37185	0.29680	0.10502	0.12277	0.23140	0.31991
5	Belarus	0.35111	0.36377	0.47032	0.55050	0.41529	0.23043
6	Bosnia and Herzegovina	0.40148	0.16895	0.16438	0.47129	0.38636	0.14318
7	Georgia	0.64593	0.75038	0.34247	0.15446	0.84504	0.19016
8	Iceland	0.38074	0.45662	0.36530	0.63366	0.41942	0.83221
9	Israel	0.50519	0.62557	0.54338	0.73861	0.34711	0.60179
10	Kazakhstan	0.70370	0.30746	0.24886	0.33267	0.66322	0.38031
11	Kyrgyz Republic	0.29630	0.37291	0.17580	0.49505	0.83471	0.37136
12	Liechtenstein	0.37481	0.22679	0.32192	0.57030	0.48347	0.88591
13	Moldova	0.44148	0.48706	0.25571	0.61980	0.25413	0.08949
14	Monaco	0.00000	0.28006	0.04566	0.50297	0.00620	0.72707
15	Montenegro	0.42667	0.23288	0.30822	0.42574	0.56612	0.31544
16	North Macedonia	0.48000	0.43531	0.26027	0.26337	0.34298	0.31544
17	Norway	0.62370	0.76560	0.89726	0.58614	0.78926	1.00000
18	Russia	0.51259	0.50381	0.59132	0.67525	0.51240	0.13647
19	San Marino	0.14667	0.22831	0.00000	0.25941	0.00000	0.69351
20	Serbia	0.54074	0.40183	0.28311	0.60792	0.50207	0.34452
21	Switzerland	0.63259	0.54947	0.97032	0.70099	0.85744	0.90380
22	Tajikistan	0.34519	0.05479	0.13014	0.18614	0.26446	0.00000
23	Turkey	0.63407	0.50076	0.40183	0.66535	0.68388	0.31991
24	Turkmenistan	0.21481	0.37900	0.08904	0.31089	0.23554	0.11857
25	Ukraine	0.37481	0.32116	0.20320	0.34059	0.50207	0.01119
26	United Kingdom	0.82667	0.91781	0.89726	1.00000	1.00000	0.70470
27	Uzbekistan	0.42519	0.27093	0.15753	0.17624	0.63430	0.20582
Wj		0.20435	0.39917	0.10373	0.13545	0.09142	0.06589

3. Calculate the sum the weighted comparability sequence (Si)

	Country	PR	DR	RR	HS	CA	RE	Si
1	Albania	0.104	0.262	0.035	0.060	0.054	0.015	0.530
2	Andorra	0.035	0.000	0.011	0.000	0.012	0.054	0.111

3	Armenia	0.204	0.399	0.104	0.106	0.061	0.010	0.884
4	Azerbaijan	0.076	0.118	0.011	0.017	0.021	0.021	0.264
5	Belarus	0.072	0.145	0.049	0.075	0.038	0.015	0.393
6	Bosnia and Herzegovina	0.082	0.067	0.017	0.064	0.035	0.009	0.275
7	Georgia	0.132	0.300	0.036	0.021	0.077	0.013	0.578
8	Iceland	0.078	0.182	0.038	0.086	0.038	0.055	0.477
9	Israel	0.103	0.250	0.056	0.100	0.032	0.040	0.581
10	Kazakhstan	0.144	0.123	0.026	0.045	0.061	0.025	0.423
11	Kyrgyz Republic	0.061	0.149	0.018	0.067	0.076	0.024	0.395
12	Liechtenstein	0.077	0.091	0.033	0.077	0.044	0.058	0.380
13	Moldova	0.090	0.194	0.027	0.084	0.023	0.006	0.424
14	Monaco	0.000	0.112	0.005	0.068	0.001	0.048	0.233
15	Montenegro	0.087	0.093	0.032	0.058	0.052	0.021	0.342
16	North Macedonia	0.098	0.174	0.027	0.036	0.031	0.021	0.387
17	Norway	0.127	0.306	0.093	0.079	0.072	0.066	0.744
18	Russia	0.105	0.201	0.061	0.091	0.047	0.009	0.514
19	San Marino	0.030	0.091	0.000	0.035	0.000	0.046	0.202
20	Serbia	0.110	0.160	0.029	0.082	0.046	0.023	0.451
21	Switzerland	0.129	0.219	0.101	0.095	0.078	0.060	0.682
22	Tajikistan	0.071	0.022	0.013	0.025	0.024	0.000	0.155
23	Turkey	0.130	0.200	0.042	0.090	0.063	0.021	0.545
24	Turkmenistan	0.044	0.151	0.009	0.042	0.022	0.008	0.276
25	Ukraine	0.077	0.128	0.021	0.046	0.046	0.001	0.319
26	United Kingdom	0.169	0.366	0.093	0.135	0.091	0.046	0.902
27	Uzbekistan	0.087	0.108	0.016	0.024	0.058	0.014	0.307
2. Computing the squared weighted comparability sequence for each alternative (Pi)								
	Country	PR	DR	RR	HS	CA	RE	Pi
1	Albania	0.872	0.846	0.893	0.895	0.952	0.907	5.366
2	Andorra	0.697	0.000	0.792	0.000	0.831	0.987	3.306
3	Armenia	1.000	1.000	1.000	0.967	0.963	0.883	5.814
4	Azerbaijan	0.817	0.616	0.792	0.753	0.875	0.928	4.779
5	Belarus	0.807	0.668	0.925	0.922	0.923	0.908	5.153
6	Bosnia and Herzegovina	0.830	0.492	0.829	0.903	0.917	0.880	4.850
7	Georgia	0.915	0.892	0.895	0.776	0.985	0.896	5.359
8	Iceland	0.821	0.731	0.901	0.940	0.924	0.988	5.305
9	Israel	0.870	0.829	0.939	0.960	0.908	0.967	5.472
10	Kazakhstan	0.931	0.625	0.866	0.862	0.963	0.938	5.184
11	Kyrgyz Republic	0.780	0.675	0.835	0.909	0.984	0.937	5.119
12	Liechtenstein	0.818	0.553	0.889	0.927	0.936	0.992	5.115
13	Moldova	0.846	0.750	0.868	0.937	0.882	0.853	5.137
14	Monaco	0.000	0.602	0.726	0.911	0.628	0.979	3.846
15	Montenegro	0.840	0.559	0.885	0.891	0.949	0.927	5.051
16	North Macedonia	0.861	0.717	0.870	0.835	0.907	0.927	5.116
17	Norway	0.908	0.899	0.989	0.930	0.979	1.000	5.705
18	Russia	0.872	0.761	0.947	0.948	0.941	0.877	5.346
19	San Marino	0.676	0.555	0.000	0.833	0.000	0.976	3.039
20	Serbia	0.882	0.695	0.877	0.935	0.939	0.932	5.260
21	Switzerland	0.911	0.787	0.997	0.953	0.986	0.993	5.627
22	Tajikistan	0.805	0.314	0.809	0.796	0.886	0.000	3.610

23	Turkey	0.911	0.759	0.910	0.946	0.966	0.928	5.419
24	Turkmenistan	0.730	0.679	0.778	0.854	0.876	0.869	4.786
25	Ukraine	0.818	0.635	0.848	0.864	0.939	0.744	4.848
26	United Kingdom	0.962	0.966	0.989	1.000	1.000	0.977	5.894
27	Uzbekistan	0.840	0.594	0.826	0.790	0.959	0.901	4.910
Sum of PI		134.417	Sum of SI		11.775	λ		0.5
MAX		5.8942	MAX		0.902			
MIN		3.0392	MIN		0.111			
5. Calculate the relative importance of the alternatives								
	Country	SI	PI	Ka	Kb	Kc	K	Final Ranking
1	Albania	0.530	5.366	0.040	6.523	0.868	3.088	8
2	Andorra	0.111	3.306	0.023	2.088	0.503	1.162	27
3	Armenia	0.884	5.814	0.046	9.843	0.986	4.388	2
4	Azerbaijan	0.264	4.779	0.035	3.943	0.742	2.039	23
5	Belarus	0.393	5.153	0.038	5.226	0.816	2.572	14
6	Bosnia and Herzegovina	0.275	4.850	0.035	4.065	0.754	2.093	21
7	Georgia	0.578	5.359	0.041	6.947	0.874	3.247	6
8	Iceland	0.477	5.305	0.040	6.025	0.851	2.893	10
9	Israel	0.581	5.472	0.041	7.011	0.891	3.285	5
10	Kazakhstan	0.423	5.184	0.038	5.502	0.825	2.680	12
11	Kyrgyz Republic	0.395	5.119	0.038	5.233	0.811	2.570	15
12	Liechtenstein	0.380	5.115	0.038	5.095	0.809	2.518	17
13	Moldova	0.424	5.137	0.038	5.497	0.818	2.673	13
14	Monaco	0.233	3.846	0.028	3.357	0.600	1.712	24
15	Montenegro	0.342	5.051	0.037	4.733	0.794	2.372	18
16	North Macedonia	0.387	5.116	0.038	5.153	0.810	2.540	16
17	Norway	0.744	5.705	0.044	8.549	0.949	3.890	3
18	Russia	0.514	5.346	0.040	6.375	0.862	3.030	9
19	San Marino	0.202	3.039	0.022	2.812	0.477	1.413	25
20	Serbia	0.451	5.260	0.039	5.779	0.840	2.794	11
21	Switzerland	0.682	5.627	0.043	7.972	0.928	3.665	4
22	Tajikistan	0.155	3.610	0.026	2.581	0.554	1.386	26
23	Turkey	0.545	5.419	0.041	6.672	0.878	3.151	7
24	Turkmenistan	0.276	4.786	0.035	4.050	0.745	2.081	22
25	Ukraine	0.319	4.848	0.035	4.454	0.760	2.243	19
26	United Kingdom	0.902	5.894	0.046	10.030	1.000	4.467	1
27	Uzbekistan	0.307	4.910	0.036	4.368	0.768	2.217	20

3.2. Application of Entropy-CoCoSo-model for Evaluating and Ranking of Non-EU European Countries (Case 2019)

Table 14.Entropy-CoCoSo HeS Scores (C_i), and Rankings (R_i), for Non-EU European Countries (Case 2021)

1. Construct the decision matrix (X)							
	Country	PR	DR	RR	HS	CA	RE
1	Albania	42	40	38.1	47.4	52.1	50.6
2	Andorra	27.1	2.2	39.5	15.4	43.2	80.5
3	Armenia	79.3	69.6	56.3	58.8	59.2	47.6
4	Azerbaijan	32.6	21.7	32.4	24.1	38.4	59.3
5	Belarus	34	34.4	42.2	45.7	55.6	51.6
6	Bosnia and Herzegovina	30.4	13.9	36.7	41.7	38.9	50.7
7	Georgia	55.2	65.1	46.1	33.7	63.9	51.6
8	Iceland	40	36.4	47.9	52.2	34.4	79.9
9	Israel	41.6	46.7	44.4	55.2	30.9	64.2
10	Kazakhstan	54.9	29.2	36.5	34.6	58.7	62.9
11	Kyrgyz Republic	27.8	26.7	32.8	40.4	66.1	60.4
12	Liechtenstein	41.2	17.1	37.7	46.6	51.4	84.4
13	Moldova	41.6	34.2	35.7	48.3	38.9	47.5
14	Monaco	7.5	20.6	35.6	40.9	19.1	76
15	Montenegro	33.8	32.1	39.7	41.7	59.2	57.9
16	North Macedonia	35.7	37.1	35.2	38.3	47.4	59.7
17	Norway	53.8	46.3	57.5	45	69.4	89
18	Russia	45.5	43.6	44.7	58.9	51.4	50.5
19	San Marino	17.4	21.4	36.6	28.6	18.8	74.7
20	Serbia	44	28.6	36.3	50.9	51.4	58.5
21	Switzerland	50.2	42.5	64.9	50.9	59.7	84.6
22	Tajikistan	22.1	10.6	29.3	24.8	41.1	48
23	Turkey	51.1	41.4	36.6	53.9	59.7	57.2
24	Turkmenistan	22.1	27.6	21.8	30.6	38	51.1
25	Ukraine	31.4	32.8	26.1	49.1	47.2	46.7
26	United Kingdom	63.5	70.8	64.8	68.3	62.5	73
27	Uzbekistan	40.6	18.5	28.6	30.3	62.8	53.3
2. Calculate the normalized values of alternatives (N).							
	Country	PR	DR	RR	HS	CA	RE
1	Albania	0.48050	0.55102	0.37819	0.60491	0.65810	0.09220
2	Andorra	0.27298	0.00000	0.41067	0.00000	0.48221	0.79905
3	Armenia	1.00000	0.98251	0.80046	0.82042	0.79842	0.02128
4	Azerbaijan	0.34958	0.28426	0.24594	0.16446	0.38735	0.29787
5	Belarus	0.36908	0.46939	0.47332	0.57278	0.72727	0.11584
6	Bosnia and Herzegovina	0.31894	0.17055	0.34571	0.49716	0.39723	0.09456
7	Georgia	0.66435	0.91691	0.56381	0.34594	0.89130	0.11584
8	Iceland	0.45265	0.49854	0.60557	0.69565	0.30830	0.78487
9	Israel	0.47493	0.64869	0.52436	0.75236	0.23913	0.41371
10	Kazakhstan	0.66017	0.39359	0.34107	0.36295	0.78854	0.38298
11	Kyrgyz Republic	0.28273	0.35714	0.25522	0.47259	0.93478	0.32388
12	Liechtenstein	0.46936	0.21720	0.36891	0.58979	0.64427	0.89125
13	Moldova	0.47493	0.46647	0.32251	0.62193	0.39723	0.01891
14	Monaco	0.00000	0.26822	0.32019	0.48204	0.00593	0.69267
15	Montenegro	0.36630	0.43586	0.41531	0.49716	0.79842	0.26478

16	North Macedonia	0.39276	0.50875	0.31090	0.43289	0.56522	0.30733
17	Norway	0.64485	0.64286	0.82831	0.55955	1.00000	1.00000
18	Russia	0.52925	0.60350	0.53132	0.82231	0.64427	0.08983
19	San Marino	0.13788	0.27988	0.34339	0.24953	0.00000	0.66194
20	Serbia	0.50836	0.38484	0.33643	0.67108	0.64427	0.27896
21	Switzerland	0.59471	0.58746	1.00000	0.67108	0.80830	0.89598
22	Tajikistan	0.20334	0.12245	0.17401	0.17769	0.44071	0.03073
23	Turkey	0.60724	0.57143	0.34339	0.72779	0.80830	0.24823
24	Turkmenistan	0.20334	0.37026	0.00000	0.28733	0.37945	0.10402
25	Ukraine	0.33287	0.44606	0.09977	0.63705	0.56126	0.00000
26	United Kingdom	0.77994	1.00000	0.99768	1.00000	0.86364	0.62175
27	Uzbekistan	0.46100	0.23761	0.15777	0.28166	0.86957	0.15603
Wj		0.21797	0.37171	0.09754	0.12553	0.12284	0.06442

3. Calculate the sum the weighted comparability sequence (Si)								
	Country	PR	DR	RR	HS	CA	RE	Si
1	Albania	0.105	0.205	0.037	0.076	0.081	0.006	0.509
2	Andorra	0.060	0.000	0.040	0.000	0.059	0.051	0.210
3	Armenia	0.218	0.365	0.078	0.103	0.098	0.001	0.864
4	Azerbaijan	0.076	0.106	0.024	0.021	0.048	0.019	0.293
5	Belarus	0.080	0.174	0.046	0.072	0.089	0.007	0.470
6	Bosnia and Herzegovina	0.070	0.063	0.034	0.062	0.049	0.006	0.284
7	Georgia	0.145	0.341	0.055	0.043	0.109	0.007	0.701
8	Iceland	0.099	0.185	0.059	0.087	0.038	0.051	0.519
9	Israel	0.104	0.241	0.051	0.094	0.029	0.027	0.546
10	Kazakhstan	0.144	0.146	0.033	0.046	0.097	0.025	0.491
11	Kyrgyz Republic	0.062	0.133	0.025	0.059	0.115	0.021	0.414
12	Liechtenstein	0.102	0.081	0.036	0.074	0.079	0.057	0.430
13	Moldova	0.104	0.173	0.031	0.078	0.049	0.001	0.436
14	Monaco	0.000	0.100	0.031	0.061	0.001	0.045	0.237
15	Montenegro	0.080	0.162	0.041	0.062	0.098	0.017	0.460
16	North Macedonia	0.086	0.189	0.030	0.054	0.069	0.020	0.449
17	Norway	0.141	0.239	0.081	0.070	0.123	0.064	0.718
18	Russia	0.115	0.224	0.052	0.103	0.079	0.006	0.580
19	San Marino	0.030	0.104	0.033	0.031	0.000	0.043	0.242
20	Serbia	0.111	0.143	0.033	0.084	0.079	0.018	0.468
21	Switzerland	0.130	0.218	0.098	0.084	0.099	0.058	0.687
22	Tajikistan	0.044	0.046	0.017	0.022	0.054	0.002	0.185
23	Turkey	0.132	0.212	0.033	0.091	0.099	0.016	0.585
24	Turkmenistan	0.044	0.138	0.000	0.036	0.047	0.007	0.271
25	Ukraine	0.073	0.166	0.010	0.080	0.069	0.000	0.397
26	United Kingdom	0.170	0.372	0.097	0.126	0.106	0.040	0.911
27	Uzbekistan	0.100	0.088	0.015	0.035	0.107	0.010	0.356
2. Computing the squared weighted comparability sequence for each alternative (Pi)								
	Country	PR	DR	RR	HS	CA	RE	Pi
1	Albania	0.852	0.801	0.910	0.939	0.950	0.858	5.310
2	Andorra	0.754	0.000	0.917	0.000	0.914	0.986	3.570

3	Armenia	1.000	0.993	0.979	0.975	0.973	0.780	5.701
4	Azerbaijan	0.795	0.627	0.872	0.797	0.890	0.925	4.906
5	Belarus	0.805	0.755	0.930	0.932	0.962	0.870	5.254
6	Bosnia and Herzegovina	0.780	0.518	0.902	0.916	0.893	0.859	4.867
7	Georgia	0.915	0.968	0.946	0.875	0.986	0.870	5.560
8	Iceland	0.841	0.772	0.952	0.955	0.865	0.985	5.371
9	Israel	0.850	0.851	0.939	0.965	0.839	0.945	5.389
10	Kazakhstan	0.913	0.707	0.900	0.881	0.971	0.940	5.313
11	Kyrgyz Republic	0.759	0.682	0.875	0.910	0.992	0.930	5.149
12	Liechtenstein	0.848	0.567	0.907	0.936	0.947	0.993	5.198
13	Moldova	0.850	0.753	0.895	0.942	0.893	0.774	5.108
14	Monaco	0.000	0.613	0.895	0.912	0.533	0.977	3.930
15	Montenegro	0.803	0.734	0.918	0.916	0.973	0.918	5.262
16	North Macedonia	0.816	0.778	0.892	0.900	0.932	0.927	5.245
17	Norway	0.909	0.849	0.982	0.930	1.000	1.000	5.669
18	Russia	0.870	0.829	0.940	0.976	0.947	0.856	5.419
19	San Marino	0.649	0.623	0.901	0.840	0.000	0.974	3.987
20	Serbia	0.863	0.701	0.899	0.951	0.947	0.921	5.283
21	Switzerland	0.893	0.821	1.000	0.951	0.974	0.993	5.632
22	Tajikistan	0.707	0.458	0.843	0.805	0.904	0.799	4.516
23	Turkey	0.897	0.812	0.901	0.961	0.974	0.914	5.459
24	Turkmenistan	0.707	0.691	0.000	0.855	0.888	0.864	4.005
25	Ukraine	0.787	0.741	0.799	0.945	0.932	0.000	4.203
26	United Kingdom	0.947	1.000	1.000	1.000	0.982	0.970	5.899
27	Uzbekistan	0.845	0.586	0.835	0.853	0.983	0.887	4.989
Sum of PI		136.194	Sum of SI		12.712	λ		0.5
MAX		5.8990	MAX		0.911			
MIN		3.5703	MIN		0.185			
5. Calculate the relative importance of the alternatives								
	Country	SI	PI	Ka	Kb	Kc	K	Final Ranking
1	Albania	0.509	5.310	0.039	4.236	0.854	2.231	10
2	Andorra	0.210	3.570	0.025	2.135	0.555	1.216	27
3	Armenia	0.864	5.701	0.044	6.259	0.964	3.066	2
4	Azerbaijan	0.293	4.906	0.035	2.957	0.764	1.681	21
5	Belarus	0.470	5.254	0.038	4.008	0.840	2.135	13
6	Bosnia and Hercegovina	0.284	4.867	0.035	2.896	0.756	1.652	22
7	Georgia	0.701	5.560	0.042	5.342	0.919	2.692	4
8	Iceland	0.519	5.371	0.040	4.305	0.865	2.265	9
9	Israel	0.546	5.389	0.040	4.458	0.872	2.327	8
10	Kazakhstan	0.491	5.313	0.039	4.136	0.852	2.192	11
11	Kyrgyz Republic	0.414	5.149	0.037	3.679	0.817	1.993	18
12	Liechtenstein	0.430	5.198	0.038	3.775	0.826	2.037	16
13	Moldova	0.436	5.108	0.037	3.787	0.814	2.032	17
14	Monaco	0.237	3.930	0.028	2.379	0.612	1.350	26
15	Montenegro	0.460	5.262	0.038	3.957	0.840	2.116	14

16	North Macedonia	0.449	5.245	0.038	3.891	0.836	2.088	15
17	Norway	0.718	5.669	0.043	5.463	0.938	2.751	3
18	Russia	0.580	5.419	0.040	4.647	0.881	2.404	7
19	San Marino	0.242	3.987	0.028	2.421	0.621	1.373	24
20	Serbia	0.468	5.283	0.039	4.006	0.845	2.137	12
21	Switzerland	0.687	5.632	0.042	5.285	0.928	2.678	5
22	Tajikistan	0.185	4.516	0.032	2.265	0.690	1.363	25
23	Turkey	0.585	5.459	0.041	4.687	0.888	2.424	6
24	Turkmenistan	0.271	4.005	0.029	2.587	0.628	1.441	23
25	Ukraine	0.397	4.203	0.031	3.320	0.675	1.753	20
26	United Kingdom	0.911	5.899	0.046	6.569	1.000	3.208	1
27	Uzbekistan	0.356	4.989	0.036	3.322	0.785	1.835	19

3.3. Application of Entropy-CoCoSo-model for Evaluating and Ranking of Non-EU European Countries (The whole period (2017-2021))

Table 15.Entropy-CoCoSo HeS Scores (C_i), and Rankings (R_i), for Non-EU European Countries (The whole period (2017-2021))

1. Construct the decision matrix (X)							
	Country	PR	DR	RR	HS	CA	RE
1	Albania	42	42.7	40.8	42.6	53.55	52.15
2	Andorra	23.05	2.2	36.45	15.45	38.1	80.2
3	Armenia	77.15	68.75	64.45	56.9	58.95	48.95
4	Azerbaijan	32.6	21.7	32.9	22.9	38.1	58.55
5	Belarus	32.6	30.25	45.8	44.5	51.15	52.7
6	Bosnia and Herzegovina	32.5	13.6	36.35	40.5	42.1	50.3
7	Georgia	53.15	58.3	44.95	28.5	65.7	51.8
8	Iceland	36.6	34.3	46.35	49.85	40.65	80.3
9	Israel	41.6	45	48.5	54	37.15	67.3
10	Kazakhstan	54.95	25.8	38.1	33.45	58.7	61.7
11	Kyrgyz Republic	27.65	26.7	34.65	40.45	66.55	60.25
12	Liechtenstein	37	17.1	40.3	45.45	50.7	83.75
13	Moldova	39.45	34.2	37.85	47.55	38.9	47.5
14	Monaco	7.5	20.6	33.2	40.9	23	76
15	Montenegro	35.05	24.8	41	39.35	56.6	57.75
16	North Macedonia	37.8	33.95	37.7	33.55	45.3	58.65
17	Norway	51.7	49.4	62.8	45.05	67.1	88.6
18	Russia	43.8	39.45	49.7	54.25	51.4	50.05
19	San Marino	17.4	19.3	32.7	28.6	22.7	74.6
20	Serbia	44	28.6	38.75	48.55	51.15	58.7
21	Switzerland	50.2	40.4	68.1	50.9	63.9	84.25
22	Tajikistan	26.45	8.2	31.9	24.85	40.25	45.75
23	Turkey	50.7	38.25	41.5	51.5	59.7	57.5
24	Turkmenistan	22.05	27.35	27.25	30.9	38	49.95
25	Ukraine	32.1	28.05	31.9	40.9	49.05	45.35
26	United Kingdom	63.4	66.65	66.45	67.15	68.75	74
27	Uzbekistan	38.4	19.25	32.15	27.35	60.05	53

2. Calculate the normalized values of alternatives (N).

	Country	PR	DR	RR	HS	CA	RE
1	Albania	0.49533	0.60856	0.33170	0.52515	0.66992	0.15723
2	Andorra	0.22326	0.00000	0.22521	0.00000	0.33442	0.80578
3	Armenia	1.00000	1.00000	0.91065	0.80174	0.78719	0.08324
4	Azerbaijan	0.36037	0.29301	0.13831	0.14410	0.33442	0.30520
5	Belarus	0.36037	0.42149	0.45410	0.56190	0.61781	0.16994
6	Bosnia and Herzegovina	0.35894	0.17130	0.22277	0.48453	0.42128	0.11445
7	Georgia	0.65542	0.84298	0.43329	0.25242	0.93377	0.14913
8	Iceland	0.41780	0.48234	0.46756	0.66538	0.38979	0.80809
9	Israel	0.48959	0.64313	0.52020	0.74565	0.31379	0.50751
10	Kazakhstan	0.68126	0.35462	0.26561	0.34816	0.78176	0.37803
11	Kyrgyz Republic	0.28930	0.36814	0.18115	0.48356	0.95223	0.34451
12	Liechtenstein	0.42355	0.22389	0.31946	0.58027	0.60803	0.88786
13	Moldova	0.45872	0.48084	0.25949	0.62089	0.35179	0.04971
14	Monaco	0.00000	0.27648	0.14565	0.49226	0.00651	0.70867
15	Montenegro	0.39555	0.33959	0.33660	0.46228	0.73616	0.28671
16	North Macedonia	0.43503	0.47708	0.25581	0.35010	0.49077	0.30751
17	Norway	0.63460	0.70924	0.87026	0.57253	0.96417	1.00000
18	Russia	0.52118	0.55973	0.54957	0.75048	0.62324	0.10867
19	San Marino	0.14214	0.25695	0.13341	0.25435	0.00000	0.67630
20	Serbia	0.52405	0.39669	0.28152	0.64023	0.61781	0.30867
21	Switzerland	0.61307	0.57400	1.00000	0.68569	0.89468	0.89942
22	Tajikistan	0.27207	0.09016	0.11383	0.18182	0.38111	0.00925
23	Turkey	0.62024	0.54170	0.34884	0.69729	0.80347	0.28092
24	Turkmenistan	0.20890	0.37791	0.00000	0.29884	0.33225	0.10636
25	Ukraine	0.35319	0.38843	0.11383	0.49226	0.57220	0.00000
26	United Kingdom	0.80258	0.96844	0.95961	1.00000	1.00000	0.66243
27	Uzbekistan	0.44365	0.25620	0.11995	0.23017	0.81107	0.17688
Wj		0.21387	0.38806	0.09737	0.13034	0.10352	0.06684

3. Calculate the sum the weighted comparability sequence (Si)

	Country	PR	DR	RR	HS	CA	RE	Si
1	Albania	0.106	0.236	0.032	0.068	0.069	0.011	0.523
2	Andorra	0.048	0.000	0.022	0.000	0.035	0.054	0.158
3	Armenia	0.214	0.388	0.089	0.105	0.081	0.006	0.882
4	Azerbaijan	0.077	0.114	0.013	0.019	0.035	0.020	0.278
5	Belarus	0.077	0.164	0.044	0.073	0.064	0.011	0.433
6	Bosnia and Herzegovina	0.077	0.066	0.022	0.063	0.044	0.008	0.279
7	Georgia	0.140	0.327	0.042	0.033	0.097	0.010	0.649
8	Iceland	0.089	0.187	0.046	0.087	0.040	0.054	0.503
9	Israel	0.105	0.250	0.051	0.097	0.032	0.034	0.569
10	Kazakhstan	0.146	0.138	0.026	0.045	0.081	0.025	0.461
11	Kyrgyz Republic	0.062	0.143	0.018	0.063	0.099	0.023	0.407
12	Liechtenstein	0.091	0.087	0.031	0.076	0.063	0.059	0.406
13	Moldova	0.098	0.187	0.025	0.081	0.036	0.003	0.431
14	Monaco	0.000	0.107	0.014	0.064	0.001	0.047	0.234
15	Montenegro	0.085	0.132	0.033	0.060	0.076	0.019	0.405

16	North Macedonia	0.093	0.185	0.025	0.046	0.051	0.021	0.420
17	Norway	0.136	0.275	0.085	0.075	0.100	0.067	0.737
18	Russia	0.111	0.217	0.054	0.098	0.065	0.007	0.552
19	San Marino	0.030	0.100	0.013	0.033	0.000	0.045	0.221
20	Serbia	0.112	0.154	0.027	0.083	0.064	0.021	0.461
21	Switzerland	0.131	0.223	0.097	0.089	0.093	0.060	0.693
22	Tajikistan	0.058	0.035	0.011	0.024	0.039	0.001	0.168
23	Turkey	0.133	0.210	0.034	0.091	0.083	0.019	0.570
24	Turkmenistan	0.045	0.147	0.000	0.039	0.034	0.007	0.272
25	Ukraine	0.076	0.151	0.011	0.064	0.059	0.000	0.361
26	United Kingdom	0.172	0.376	0.093	0.130	0.104	0.044	0.919
27	Uzbekistan	0.095	0.099	0.012	0.030	0.084	0.012	0.332
2. Computing the squared weighted comparability sequence for each alternative (Pi)								
	Country	PR	DR	RR	HS	CA	RE	Pi
1	Albania	0.860	0.825	0.898	0.919	0.959	0.884	5.346
2	Andorra	0.726	0.000	0.865	0.000	0.893	0.986	3.469
3	Armenia	1.000	1.000	0.991	0.972	0.976	0.847	5.785
4	Azerbaijan	0.804	0.621	0.825	0.777	0.893	0.924	4.843
5	Belarus	0.804	0.715	0.926	0.928	0.951	0.888	5.212
6	Bosnia and Herzegovina	0.803	0.504	0.864	0.910	0.914	0.865	4.861
7	Georgia	0.914	0.936	0.922	0.836	0.993	0.881	5.480
8	Iceland	0.830	0.754	0.929	0.948	0.907	0.986	5.353
9	Israel	0.858	0.843	0.938	0.962	0.887	0.956	5.444
10	Kazakhstan	0.921	0.669	0.879	0.872	0.975	0.937	5.252
11	Kyrgyz Republic	0.767	0.679	0.847	0.910	0.995	0.931	5.128
12	Liechtenstein	0.832	0.559	0.895	0.932	0.950	0.992	5.160
13	Moldova	0.846	0.753	0.877	0.940	0.897	0.818	5.132
14	Monaco	0.000	0.607	0.829	0.912	0.594	0.977	3.919
15	Montenegro	0.820	0.658	0.899	0.904	0.969	0.920	5.170
16	North Macedonia	0.837	0.750	0.876	0.872	0.929	0.924	5.188
17	Norway	0.907	0.875	0.987	0.930	0.996	1.000	5.695
18	Russia	0.870	0.798	0.943	0.963	0.952	0.862	5.389
19	San Marino	0.659	0.590	0.822	0.837	0.000	0.974	3.882
20	Serbia	0.871	0.699	0.884	0.944	0.951	0.924	5.273
21	Switzerland	0.901	0.806	1.000	0.952	0.989	0.993	5.640
22	Tajikistan	0.757	0.393	0.809	0.801	0.905	0.731	4.396
23	Turkey	0.903	0.788	0.903	0.954	0.978	0.919	5.444
24	Turkmenistan	0.715	0.685	0.000	0.854	0.892	0.861	4.008
25	Ukraine	0.800	0.693	0.809	0.912	0.944	0.000	4.158
26	United Kingdom	0.954	0.988	0.996	1.000	1.000	0.973	5.911
27	Uzbekistan	0.840	0.590	0.813	0.826	0.979	0.891	4.938
Sum of PI		135.478	Sum of SI		12.324	λ		0.5
MAX		5.9105	MAX		0.919			
MIN		3.4690	MIN		0.158			
5. Calculate the relative importance of the alternatives								

	Country	SI	PI	Ka	Kb	Kc	K	Final Ranking
1	Albania	0.523	5.346	0.040	4.846	0.859	2.464	9
2	Andorra	0.158	3.469	0.025	2.000	0.531	1.148	27
3	Armenia	0.882	5.785	0.045	7.245	0.976	3.439	2
4	Azerbaijan	0.278	4.843	0.035	3.154	0.750	1.747	22
5	Belarus	0.433	5.212	0.038	4.243	0.827	2.214	13
6	Bosnia and Herzegovina	0.279	4.861	0.035	3.167	0.753	1.754	21
7	Georgia	0.649	5.480	0.041	5.683	0.897	2.803	5
8	Iceland	0.503	5.353	0.040	4.724	0.857	2.417	10
9	Israel	0.569	5.444	0.041	5.164	0.880	2.598	7
10	Kazakhstan	0.461	5.252	0.039	4.427	0.837	2.291	12
11	Kyrgyz Republic	0.407	5.128	0.037	4.052	0.810	2.130	18
12	Liechtenstein	0.406	5.160	0.038	4.058	0.815	2.136	16
13	Moldova	0.431	5.132	0.038	4.202	0.814	2.190	14
14	Monaco	0.234	3.919	0.028	2.607	0.608	1.436	24
15	Montenegro	0.405	5.170	0.038	4.050	0.816	2.134	17
16	North Macedonia	0.420	5.188	0.038	4.152	0.821	2.176	15
17	Norway	0.737	5.695	0.044	6.301	0.942	3.066	3
18	Russia	0.552	5.389	0.040	5.042	0.870	2.545	8
19	San Marino	0.221	3.882	0.028	2.519	0.601	1.397	25
20	Serbia	0.461	5.273	0.039	4.438	0.840	2.297	11
21	Switzerland	0.693	5.640	0.043	6.010	0.927	2.947	4
22	Tajikistan	0.168	4.396	0.031	2.330	0.668	1.373	26
23	Turkey	0.570	5.444	0.041	5.171	0.881	2.601	6
24	Turkmenistan	0.272	4.008	0.029	2.874	0.627	1.550	23
25	Ukraine	0.361	4.158	0.031	3.480	0.662	1.804	20
26	United Kingdom	0.919	5.911	0.046	7.515	1.000	3.557	1
27	Uzbekistan	0.332	4.938	0.036	3.521	0.772	1.902	19

4. K-Means Clustering of Non-EU European Countries by Entropy-CoCoSo Health Security Performance Scores

4.1. Health security performance clustering results- Output for FIVE Clusters/Segments (Case - 2019)

Table 16. Health security performance clustering results- Output for FIVE Clusters/Segments (Case - 2019)

Output for FIVE Clusters/Segments				
Mean/Centroid	*Ci*			
Segment 1	3.19			
Segment 2	1.32			
Segment 3	4.25			
Segment 4	2.06			
Segment 5	2.59			
AVERAGE	2.67			
Respondents	Number	%	SSE/Segment	

Segment 1	7	25.9%	0.4	
Segment 2	3	11.1%	0.0	SSE Total 0.9
Segment 3	3	11.1%	0.2	
Segment 4	6	22.2%	0.2	
Segment 5	8	29.6%	0.1	
TOTAL	27	100.0%		

2.Ranking clusters

	Segment	Ci	Number	%	SSE/Segment
3	1	3.194012403	7	25.9%	0.4
1	2	1.320553508	3	11.1%	0.0
2	3	4.24861582	3	11.1%	0.2
4	4	2.064025768	6	22.2%	0.2
5	5	2.589809946	8	29.6%	0.1

Level	Grade ID	Ci	Number	%	
Grade 1	1	4.24861582	3	11.1%	0.2
Grade 2	2	3.194012403	7	25.9%	0.4
Grade 3	3	2.589809946	8	29.6%	0.1
Grade 4	4	2.064025768	6	22.2%	0.2
Grade 5	5	1.320553508	3	11.1%	0.0

	Country	Segment	Grade
1	Albania	1	2
2	Andorra	2	5
3	Armenia	3	1
4	Azerbaijan	4	4
5	Belarus	5	3
6	Bosnia and Herzegovina	4	4
7	Georgia	1	2
8	Iceland	1	2
9	Israel	1	2
10	Kazakhstan	5	3
11	Kyrgyz Republic	5	3
12	Liechtenstein	5	3
13	Moldova	5	3
14	Monaco	4	4
15	Montenegro	5	3
16	North Macedonia	5	3
17	Norway	3	1
18	Russia	1	2
19	San Marino	2	5
20	Serbia	5	3
21	Switzerland	1	2
22	Tajikistan	2	5
23	Turkey	1	2
24	Turkmenistan	4	4
25	Ukraine	4	4

26	**United Kingdom**	**3**	**1**
27	**Uzbekistan**	**4**	**4**

4.2. Health security performance clustering results- Output for FIVE Clusters/Segments (Case - 2021)

Table 17. Health security performance clustering results- Output for FIVE Clusters/Segments (Case - 2021)

Output for FIVE Clusters/Segments					
Mean/Centroid	***Ci***				
Segment 1	**2.31**				
Segment 2	**1.35**				
Segment 3	**2.88**				
Segment 4	**1.73**				
Segment 5	**2.08**				
AVERAGE	**2.09**				
Respondents	**Number**	**%**	**SSE/Segment**		
Segment 1	**6**	**22.2%**	**0.0**		
Segment 2	**5**	**18.5%**	**0.0**	**SSE Total**	**0.3**
Segment 3	**5**	**18.5%**	**0.2**		
Segment 4	**4**	**14.8%**	**0.0**		
Segment 5	**7**	**25.9%**	**0.0**		
TOTAL	**27**	**100.0%**			
	2.Ranking clusters				
	Segment	**Ci**	**Number**	**%**	**SSE/Segment**
2	**1**	**2.30719215**	**6**	**22.2%**	**0.0**
5	**2**	**1.348619316**	**5**	**18.5%**	**0.0**
1	**3**	**2.878930808**	**5**	**18.5%**	**0.2**
4	**4**	**1.730189396**	**4**	**14.8%**	**0.0**
3	**5**	**2.076802905**	**7**	**25.9%**	**0.0**
	Grade ID	**Ci**	**Number**	**%**	**SSE/Segment**
Grade 1	**1**	**2.878930808**	**5**	**18.5%**	**0.2**
Grade 2	**2**	**2.30719215**	**6**	**22.2%**	**0.0**
Grade 3	**3**	**2.076802905**	**7**	**25.9%**	**0.0**
Grade 4	**4**	**1.730189396**	**4**	**14.8%**	**0.0**
Grade 5	**5**	**1.348619316**	**5**	**18.5%**	**0.0**

	Country	**Segment**	**Grade**
1	**Albania**	**1**	**2**
2	**Andorra**	**2**	**5**
3	**Armenia**	**3**	**1**
4	**Azerbaijan**	**4**	**4**
5	**Belarus**	**5**	**3**
6	**Bosnia and Herzegovina**	**4**	**4**

7	**Georgia**	**3**	**1**
8	**Iceland**	**1**	**2**
9	**Israel**	**1**	**2**
10	**Kazakhstan**	**1**	**2**
11	**Kyrgyz Republic**	**5**	**3**
12	**Liechtenstein**	**5**	**3**
13	**Moldova**	**5**	**3**
14	**Monaco**	**2**	**5**
15	**Montenegro**	**5**	**3**
16	**North Macedonia**	**5**	**3**
17	**Norway**	**3**	**1**
18	**Russia**	**1**	**2**
19	**San Marino**	**2**	**5**
20	**Serbia**	**5**	**3**
21	**Switzerland**	**3**	**1**
22	**Tajikistan**	**2**	**5**
23	**Turkey**	**1**	**2**
24	**Turkmenistan**	**2**	**5**
25	**Ukraine**	**4**	**4**
26	**United Kingdom**	**3**	**1**
27	**Uzbekistan**	**4**	**4**

4.3. Health security performance clustering results- Output for FIVE Clusters/Segments (Case - 2021)

Table 18. Health security performance clustering results- Output for FIVE Clusters/Segments (The whole period (2017-2021))

Output for FIVE Clusters/Segments					
Mean/Centroid	***Ci***				
Segment 1	**2.63**				
Segment 2	**1.34**				
Segment 3	**3.35**				
Segment 4	**1.75**				
Segment 5	**2.20**				
AVERAGE	**2.23**				
Respondents	**Number**	**%**	**SSE/Segment**		
Segment 1	**7**	**25.9%**	**0.2**		
Segment 2	**4**	**14.8%**	**0.1**	**SSE Total**	**0.5**
Segment 3	**3**	**11.1%**	**0.1**		
Segment 4	**5**	**18.5%**	**0.1**		
Segment 5	**8**	**29.6%**	**0.0**		
TOTAL	**27**	**100.0%**			
	2.Ranking clusters				
	Segment	**Ci**	**Number**	**%**	**SSE/Segment**

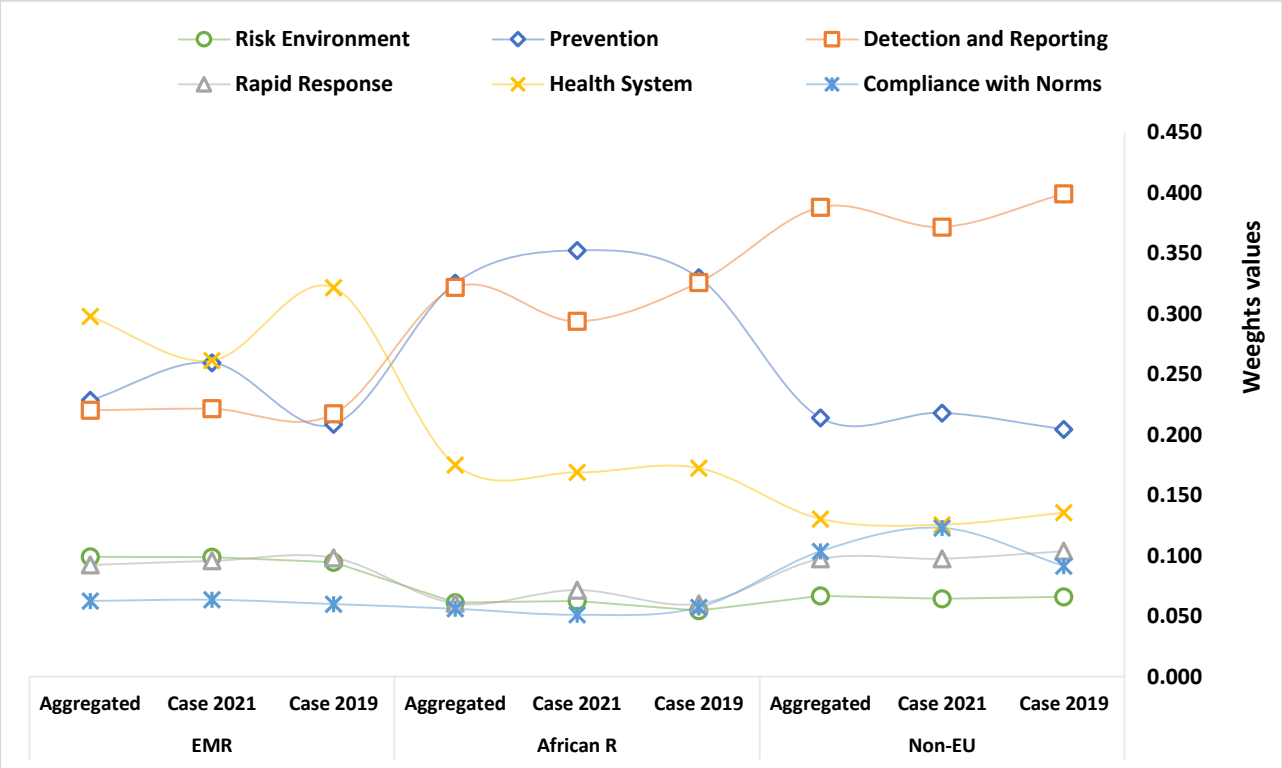
2	1	2.625085889	7	25.9%	0.2
5	2	1.338547039	4	14.8%	0.1
1	3	3.353703783	3	11.1%	0.1
4	4	1.751484039	5	18.5%	0.1
3	5	2.196035071	8	29.6%	0.0
	Grade ID	Ci	Number	%	SSE/Segment
Grade 1	1	3.353703783	3	11.1%	0.1
Grade 2	2	2.625085889	7	25.9%	0.2
Grade 3	3	2.196035071	8	29.6%	0.0
Grade 4	4	1.751484039	5	18.5%	0.1
Grade 5	5	1.338547039	4	14.8%	0.1

	Country	Segment	Grade
1	Albania	1	2
2	Andorra	2	5
3	Armenia	3	1
4	Azerbaijan	4	4
5	Belarus	5	3
6	Bosnia and Herzegovina	4	4
7	Georgia	1	2
8	Iceland	1	2
9	Israel	1	2
10	Kazakhstan	5	3
11	Kyrgyz Republic	5	3
12	Liechtenstein	5	3
13	Moldova	5	3
14	Monaco	2	5
15	Montenegro	5	3
16	North Macedonia	5	3
17	Norway	3	1
18	Russia	1	2
19	San Marino	2	5
20	Serbia	5	3
21	Switzerland	1	2
22	Tajikistan	2	5
23	Turkey	1	2
24	Turkmenistan	4	4
25	Ukraine	4	4
26	United Kingdom	3	1
27	Uzbekistan	4	4

5. Tabular and graphical visualization of results

5.1. Entropy weights of health system indicators for non-EU countries, EMR and African region.

Table 19. Entropy-weighted prioritization of health security dimensions across non-EU countries, EMR, and African Region, 2017–2021



Group	Data	Prevention	Detection and Reporting	Rapid Response	Health System	Compliance with Norms	Risk Environment
Non-EU	**Case 2019**	**0.204**	**0.399**	**0.104**	**0.135**	**0.091**	**0.066**
	Case 2021	**0.218**	**0.372**	**0.098**	**0.126**	**0.123**	**0.064**
	Aggregated	**0.214**	**0.388**	**0.097**	**0.130**	**0.104**	**0.067**
African R	**Case 2019**	**0.330**	**0.326**	**0.060**	**0.172**	**0.057**	**0.055**
	Case 2021	**0.352**	**0.294**	**0.072**	**0.169**	**0.051**	**0.063**
	Aggregated	**0.325**	**0.322**	**0.061**	**0.175**	**0.056**	**0.061**
EMR	**Case 2019**	**0.209**	**0.217**	**0.098**	**0.322**	**0.060**	**0.095**
	Case 2021	**0.259**	**0.221**	**0.096**	**0.261**	**0.063**	**0.099**
	Aggregated	**0.228**	**0.220**	**0.092**	**0.298**	**0.063**	**0.099**

Figure 1. .Entropy-weighted prioritization of health security dimensions across non-EU countries, EMR, and African Region, 2017–2021 (Source: Authors)

Dynamic prioritization of indicators (change in weights 2019-2021)

Group	PR	DR	RR	HS	CA	RE
Non-EU	0.014	-0.027	-0.006	-0.010	0.031	-0.001
African R	0.023	-0.032	0.011	-0.004	-0.006	0.008

EMR	0.051	0.004	-0.003	-0.060	0.004	0.004

5.2. Health security performance clustering results- Output for FIVE Clusters/Segments (Case - 2021)

Table 20. Entropy-CoCoSo HeS Scores (C_i), Rankings (R_i), and Cluster Assignments (S_i) for Non-EU European Countries

		Case 1-2019			Case 2- 2021			Case 3-The whole period (2017-2021)			Shifts	
	Country	**Ci**	**Ri**	**Si**	**Ci**	**Ri**	**Si**	**Ci**	**Ri**	**Si**	**Ri**	**Si**
1	**Albania**	**3.088**	**8**	**2**	**2.231**	**10**	**2**	**2.464**	**9**	**2**	**2**	**0**
2	**Andorra**	**1.162**	**27**	**5**	**1.216**	**27**	**5**	**1.148**	**27**	**5**	**0**	**0**
3	**Armenia**	**4.388**	**2**	**1**	**3.066**	**2**	**1**	**3.439**	**2**	**1**	**0**	**0**
4	**Azerbaijan**	**2.039**	**23**	**4**	**1.681**	**21**	**4**	**1.747**	**22**	**4**	**-2**	**0**
5	**Belarus**	**2.572**	**14**	**3**	**2.135**	**13**	**3**	**2.214**	**13**	**3**	**-1**	**0**
6	**Bosnia & Herzegovina**	**2.093**	**21**	**4**	**1.652**	**22**	**4**	**1.754**	**21**	**4**	**1**	**0**
7	**Georgia**	**3.247**	**6**	**2**	**2.692**	**4**	**1**	**2.803**	**5**	**2**	**-2**	**-1**
8	**Iceland**	**2.893**	**10**	**2**	**2.265**	**9**	**2**	**2.417**	**10**	**2**	**-1**	**0**
9	**Israel**	**3.285**	**5**	**2**	**2.327**	**8**	**2**	**2.598**	**7**	**2**	**3**	**0**
10	**Kazakhstan**	**2.680**	**12**	**3**	**2.192**	**11**	**2**	**2.291**	**12**	**3**	**-1**	**-1**
11	**Kyrgyz Republic**	**2.570**	**15**	**3**	**1.993**	**18**	**3**	**2.130**	**18**	**3**	**3**	**0**
12	**Liechtenstein**	**2.518**	**17**	**3**	**2.037**	**16**	**3**	**2.136**	**16**	**3**	**-1**	**0**
13	**Moldova**	**2.673**	**13**	**3**	**2.032**	**17**	**3**	**2.190**	**14**	**3**	**4**	**0**
14	**Monaco**	**1.712**	**24**	**4**	**1.350**	**26**	**5**	**1.436**	**24**	**5**	**2**	**1**
15	**Montenegro**	**2.372**	**18**	**3**	**2.116**	**14**	**3**	**2.134**	**17**	**3**	**-4**	**0**
16	**North Macedonia**	**2.540**	**16**	**3**	**2.088**	**15**	**3**	**2.176**	**15**	**3**	**-1**	**0**
17	**Norway**	**3.890**	**3**	**1**	**2.751**	**3**	**1**	**3.066**	**3**	**1**	**0**	**0**
18	**Russia**	**3.030**	**9**	**2**	**2.404**	**7**	**2**	**2.545**	**8**	**2**	**-2**	**0**
19	**San Marino**	**1.413**	**25**	**5**	**1.373**	**24**	**5**	**1.397**	**25**	**5**	**-1**	**0**
20	**Serbia**	**2.794**	**11**	**3**	**2.137**	**12**	**3**	**2.297**	**11**	**3**	**1**	**0**
21	**Switzerland**	**3.665**	**4**	**2**	**2.678**	**5**	**1**	**2.947**	**4**	**2**	**1**	**-1**
22	**Tajikistan**	**1.386**	**26**	**5**	**1.363**	**25**	**5**	**1.373**	**26**	**5**	**-1**	**0**
23	**Turkey**	**3.151**	**7**	**2**	**2.424**	**6**	**2**	**2.601**	**6**	**2**	**-1**	**0**
24	**Turkmenistan**	**2.081**	**22**	**4**	**1.441**	**23**	**5**	**1.550**	**23**	**4**	**1**	**1**
25	**Ukraine**	**2.243**	**19**	**4**	**1.753**	**20**	**4**	**1.804**	**20**	**4**	**1**	**0**
26	**United Kingdom**	**4.467**	**1**	**1**	**3.208**	**1**	**1**	**3.557**	**1**	**1**	**0**	**0**
27	**Uzbekistan**	**2.217**	**20**	**4**	**1.835**	**19**	**4**	**1.902**	**19**	**4**	**-1**	**0**

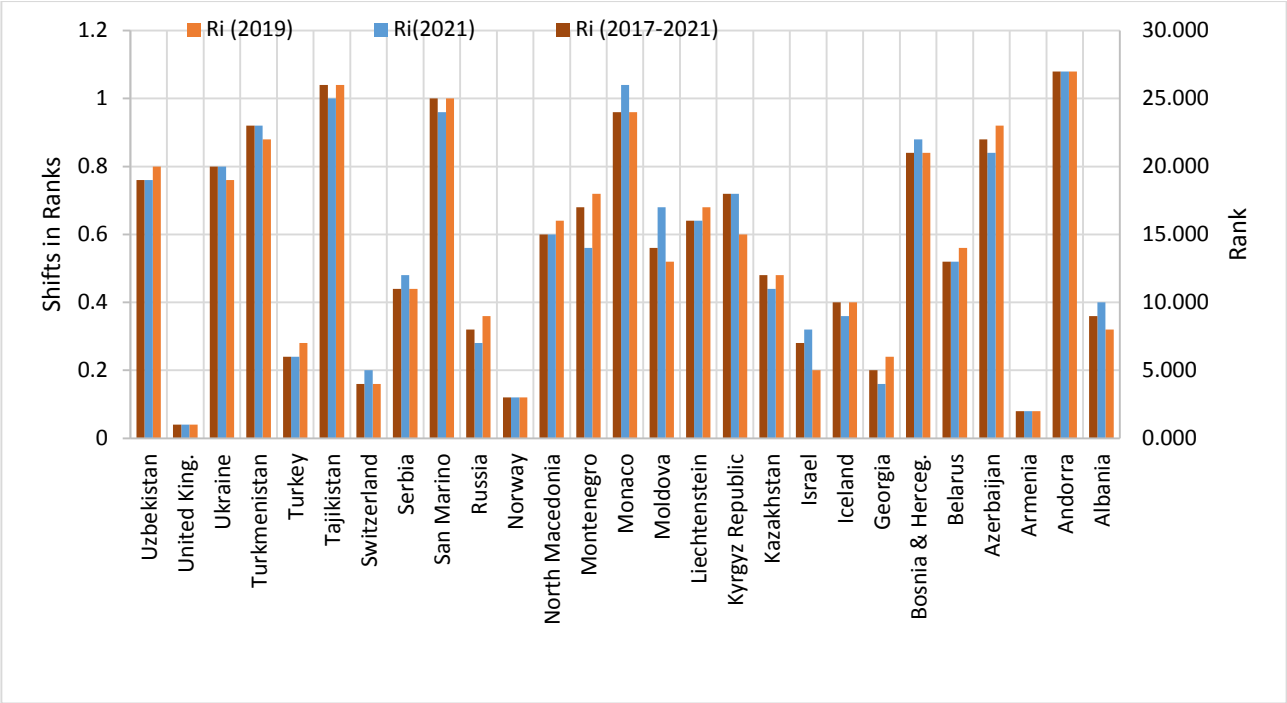


Figure 2. Health Security Preparedness Rankings of Non-EU countries (Source: Authors)

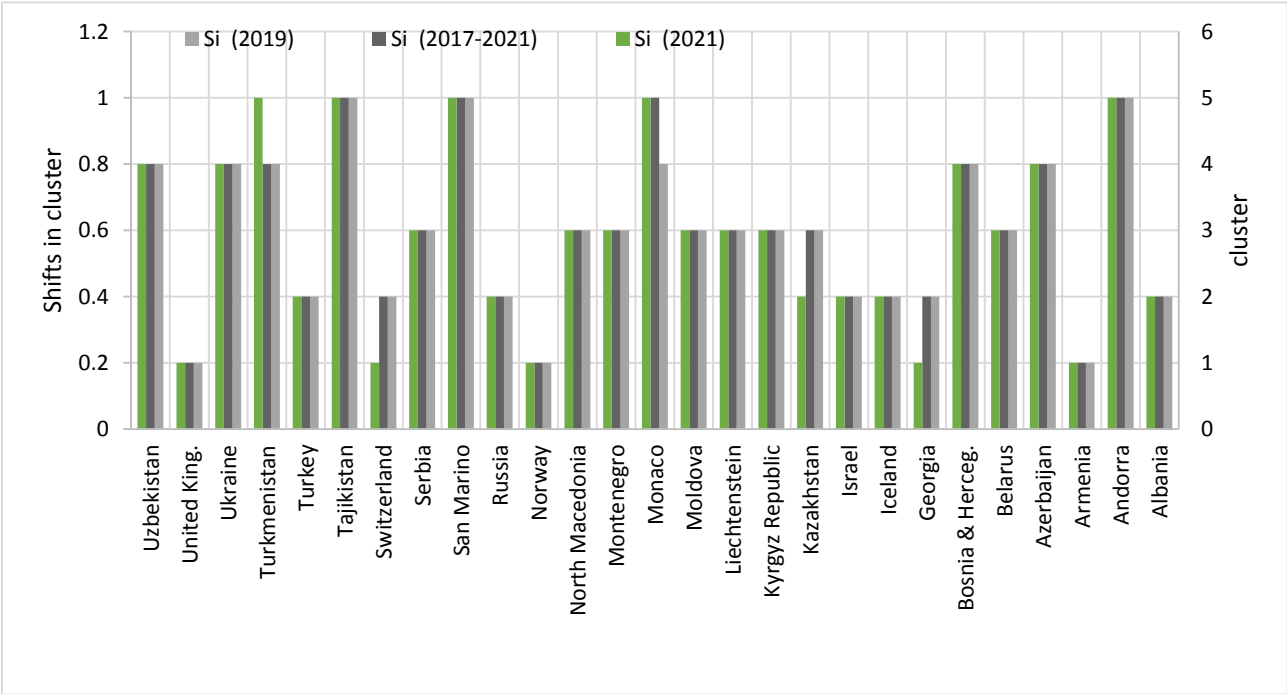


Figure 3. Health security performance clustering results of Non-EU countries (Source: Authors)

5.3. Health Security Performance: Insights and Patterns across Five Clusters

Table 21. Average health security performance scores across the five clusters of non-EU countries (Source: Authors)

Indicator	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
1.1) Antimicrobial resistance (AMR)	**87.483**	**59.507**	**56.244**	**32.490**	**22.925**

1.2) Zoonotic disease	**46.283**	**37.443**	**36.081**	**23.900**	**14.525**
1.3) Biosecurity	**63.100**	**31.043**	**32.838**	**20.270**	**21.000**
1.4) Biosafety	**66.667**	**53.571**	**28.125**	**25.000**	**0.000**
1.5) Dual-use research and culture of responsible science	**33.333**	**0.000**	**0.000**	**0.000**	**0.000**
1.6) Immunization	**87.500**	**91.071**	**78.125**	**87.500**	**53.125**
2.1) Laboratory systems strength and quality	**64.583**	**70.536**	**42.188**	**37.500**	**3.125**
2.2) Laboratory supply chains	**50.000**	**17.857**	**6.250**	**10.000**	**25.000**
2.3) Real-time surveillance and reporting	**66.667**	**25.000**	**26.563**	**17.500**	**6.250**
2.4) Surveillance data accessibility and transparency	**88.333**	**50.471**	**40.219**	**25.660**	**25.388**
2.5) Case-based investigation	**33.333**	**38.393**	**19.531**	**1.250**	**3.125**
2.6) Epidemiology workforce	**66.667**	**53.571**	**31.250**	**40.000**	**12.500**
3.1) Emergency preparedness and response planning	**52.800**	**42.857**	**44.275**	**14.170**	**18.750**
3.2) Exercising response plans	**22.917**	**12.500**	**14.063**	**13.750**	**9.375**
3.3) Emergency response operation	**55.567**	**26.171**	**24.975**	**26.640**	**8.325**
3.4) Linking public health and security authorities	**100.000**	**42.857**	**0.000**	**0.000**	**0.000**
3.5) Risk communication	**79.167**	**75.293**	**51.306**	**47.100**	**39.588**
3.6) Access to communications infrastructure	**83.350**	**79.471**	**77.694**	**68.070**	**68.450**
3.7) Trade and travel restrictions	**58.333**	**60.714**	**62.500**	**55.000**	**90.625**
4.1) Health capacity in clinics, hospitals and community care centers	**53.083**	**41.771**	**33.819**	**22.120**	**28.638**
4.2) Supply chain for health system and healthcare workers	**64.817**	**46.421**	**42.344**	**30.550**	**27.750**
4.3) Medical countermeasures and personnel deployment	**33.333**	**35.714**	**12.500**	**0.000**	**0.000**
4.4) Healthcare access	**51.783**	**57.764**	**61.969**	**67.450**	**54.313**
4.5) Communications with healthcare workers during a public health emergency	**16.667**	**21.429**	**3.125**	**0.000**	**0.000**
4.6) Infection control practices	**100.000**	**71.429**	**75.000**	**50.000**	**50.000**
4.7) Capacity to test and approve new medical countermeasures	**75.000**	**57.143**	**62.500**	**57.500**	**31.250**
5.1) IHR reporting compliance and disaster risk reduction	**100.000**	**60.714**	**78.125**	**55.000**	**37.500**
5.2) Cross-border agreements on public health and animal health emergency response	**58.333**	**64.286**	**68.750**	**50.000**	**25.000**
5.3) International commitments	**81.267**	**77.250**	**51.775**	**62.830**	**34.000**
5.4) JEE and PVS	**12.500**	**17.857**	**21.875**	**7.500**	**6.250**
5.5) Financing	**59.733**	**32.157**	**27.100**	**30.840**	**16.663**
5.6) Commitment to sharing of genetic & biological data & specimens	**77.800**	**66.700**	**66.700**	**66.700**	**66.700**
6.1) Political and security risk	**72.600**	**58.314**	**54.469**	**37.500**	**79.975**
6.2) Socio-economic resilience	**84.500**	**76.271**	**72.813**	**62.790**	**69.625**
6.3) Infrastructure adequacy	**63.900**	**65.471**	**54.181**	**40.020**	**77.100**
6.4) Environmental risks	**54.833**	**52.186**	**64.313**	**58.240**	**56.538**
6.5) Public health vulnerabilities	**76.667**	**64.479**	**54.794**	**58.580**	**62.538**

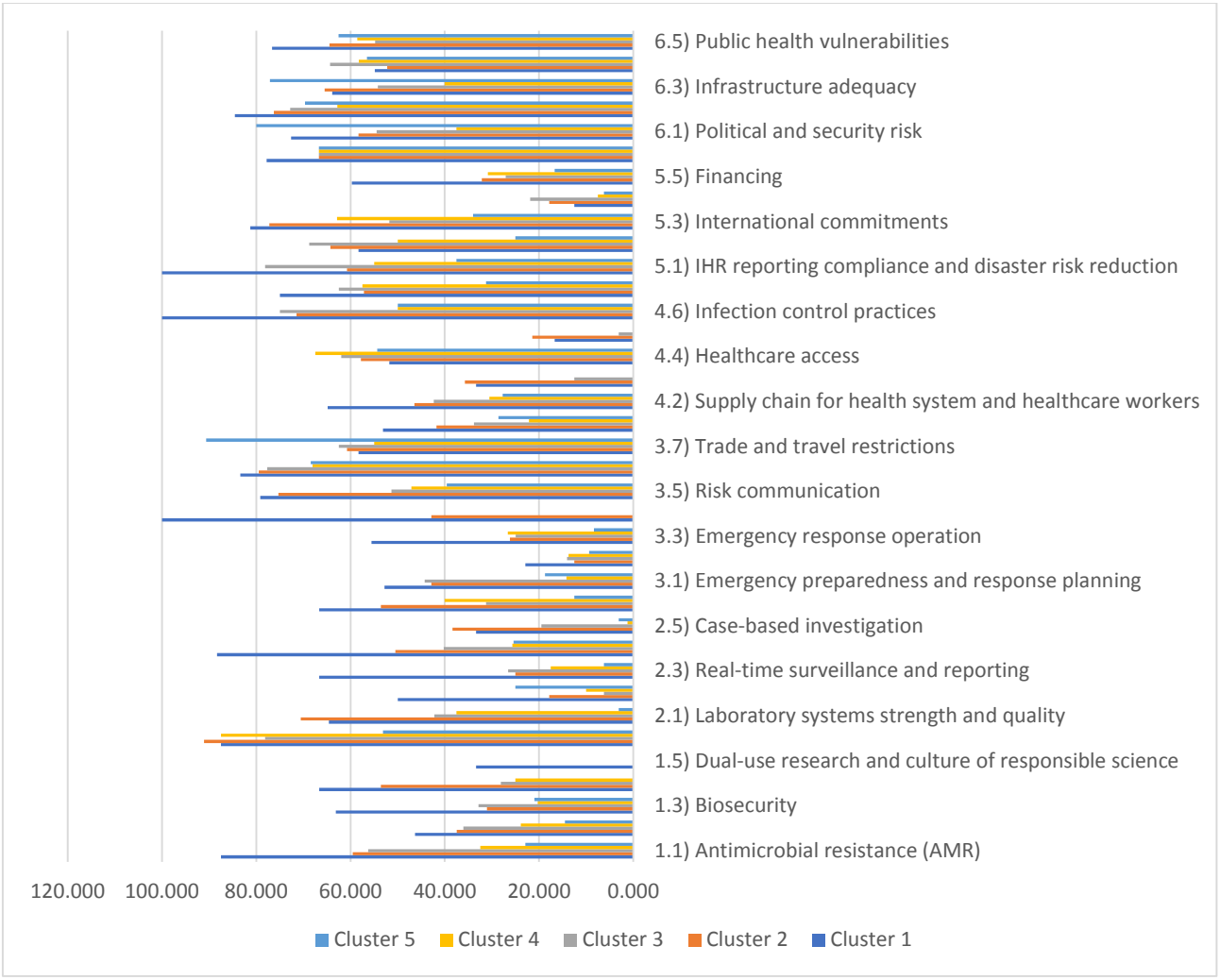


Figure 4. Average health security performance scores across the five clusters of non-EU countries (Source: Authors)