



COVID-19 Rapid Mortality Surveillance

CRMS v1 User Guide

1. Introduction

This document describes a simple software tool designed by the InterVA team for use in conjunction with the COVID-19 Rapid Mortality Surveillance (CRMS) technical package, developed by Vital Strategies and the World Health Organization with other collaborators in May 2020. The concept involves a minimal interview with household or family members following a death, with the intention of determining the probability of the death having involved COVID-19. The CRMS Technical Package is available from the <https://preventepidemics.org> website

In the context of COVID-19 epidemics, when social distancing and other restrictions are likely to be in place, opportunities to carry out a full verbal autopsy may be limited, given that at least 15 minutes is required for the interview and the personal nature of some of the questions. CRMS is a much simpler process involving capturing age, sex and 10 questions with yes/no answers relating to the two-week period before the death occurred. The interview can therefore readily be carried out by telephone, possibly from a call centre, to minimise any risks associated with process.

The CRMS software fulfils two major functions: firstly to guide the rapid survey process and capture the responses (or capture data for manually surveyed cases), and secondly to calculate the probability that the death involved COVID-19. The methodology underlying the CRMS tool is a simplified version of the probabilistic modelling methods used in the well-established InterVA models for handling full verbal autopsies (available at www.interva.net).

Disclaimer

It is a condition of downloading and using the CRMS software that users take complete responsibility for its use and for any consequences arising. In particular, it should be emphasised that the model is designed for rapidly ascertaining COVID-19 mortality in a community, and it should not be regarded as providing a legally valid individual cause of death, nor as a COVID-19 symptom checker for living patients.

The CRMS software is released under the terms of the GPL version 3 open source licence, including the source code.

2. Download and installation

The CRMS model is available as a zipped file of approximately 3 MB. It is designed to run on PCs under Windows. It is known to work satisfactorily under Windows XP, Vista, 7 and 10.

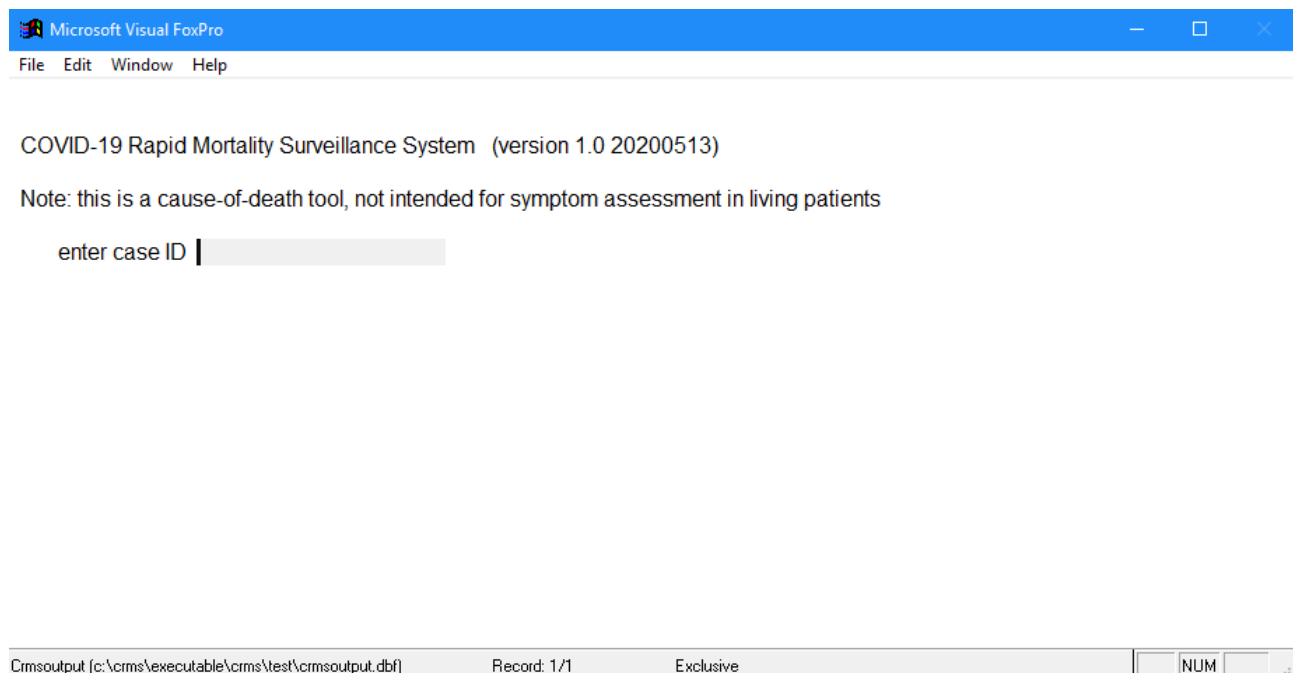
After downloading the zipped file from www.interva.net/crms, the files should be unpacked into a convenient folder on your hard disk. There is no additional installation procedure required and no files are placed in other folders. It is probably a good idea to create a folder specifically for this application, for example C:\CRMS

The following files should be found after extracting all the files from the zipped download of CRMS:

CLICK HERE TO RUN.bat
crms.exe
crms_v1.prg
crms_v1_UG.pdf (*this document*)
crmsoutput.dbf
GNU general public license v3.txt
knowbase.xls (*version 1.0 20200513*)
msvcr71.dll
vfp9r.dll
vfp9enu.dll

All the files needed to run the software are included in the download. Although the software is compiled under FoxPro, it is not necessary to have FoxPro software installed on your computer in order to run CRMS. The CRMS program code, should you wish to see it, is included in the file crms_v1.prg, but this file is not required to run the software. The file knowbase.xls contains conditional probability estimates used to calculate outputs, based on emerging literature and expert input¹. This release of CRMS is hereby made on a fully open-source basis.

The program should run by double-clicking on CLICK HERE TO RUN.bat, giving an opening screen as shown below. It is possible when running CRMS for the first time, that, depending on your system's security settings, you may get warning messages at this stage. You may need to accept running CRMS as an unrecognised application or otherwise satisfy your security software that you do indeed wish to use the CRMS software.



3. Using CRMS

- a) A case ID has to be entered for each death, which might be a number, or a name, or whatever is locally defined
- b) The age at death in years has to be entered - if it is not known exactly, an estimate to the nearest decade should be sufficient. For a child under 1 year old, enter 0.
- c) The sex of the deceased has to be entered - M or m for male, F or f for female, D or d for don't know
- d) A series of 10 questions follows about specific issues relating to the deceased in the two weeks before death. All of these should be answered Y or y for Yes, N or n for No, D or d for don't know
- e) After the last question, the output is shown on the screen (ID, date and time, % probability of death due to COVID-19 and % probability of death due to other causes
- f) A question "another case?" allows the user to move on to another case or close the software

A screenshot example of a test case is shown on the next page.

All the responses entered, as well as the outputs, are automatically stored in a comma-separated text file called *CRMSoutput.csv* which can be copied from the *CRMS* folder, archived, opened with statistical or spreadsheet software, etc. as desired.

Microsoft Visual FoxPro

File Edit Window Help

COVID-19 Rapid Mortality Surveillance System (version 1.0 20200513)

Note: this is a cause-of-death tool, not intended for symptom assessment in living patients

enter case ID test case 1

How old was the deceased in years? (enter 0 for <1 yr) 58

Was the deceased male or female? M/F/D f

During 2 wks before death, did (s)he live in an area with distancing or stay-at-home in force? Y/N/D n

During 2 wks before death, did (s)he have an injury or accident that led to death? Y/N/D n

During 2 wks before death, was (s)he tested for COVID-19 by a health professional, with a positive result? Y/N/D n

During 2 wks before death, did (s)he have a high fever for at least 3 days? Y/N/D y

During 2 wks before death, did (s)he have extreme fatigue? Y/N/D n

During 2 wks before death, did (s)he have a cough? Y/N/D y

During 2 wks before death, did (s)he report lost or reduced sense of smell or taste? Y/N/D y

During 2 wks before death, did (s)he have difficulty breathing? Y/N/D y

During 2 wks before death, did (s)he live with/visit/care for someone with these symptoms or a positive COVID test? Y/N/D n

During 2 wks before death, did (s)he travel to an area where COVID-19 was present? Y/N/D n

test case 1 2020.05.14 10:24:48 AM Probability of death due to COVID-19: 93%; other causes: 7%

another case? ☐

Crmsoutput (c:\crms\crmsoutput.dbf) Record: EOF/6 Exclusive NUM

6. Managing and interpreting CRMS output

If the output file CRMSoutput.csv is opened in Excel, the contents relating to the example above appear like this:

CRMSoutput.csv																			
File	Home	Insert	Page Layout	Formulas	Data	Review	View	Help	Inquire	ACROBAT	Share	Comments							
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R		
1	id	start	version	ageyrs	sexmf	stay_home	injury_acc	pos_test	fev_3dys	loss_smell	cont_cough	diff_breat	ext_fatig	cont_case	trav_exp	prob_covid	prob_other		
2	test case 1	2020.05.14 10:24:48	vers CRMS1.0, KB1.0	58	F	N	N	N	Y	Y	Y	Y	N	N	N	93	7		
3																			
4																			

All the cases processed on a particular computer are stored in that file on that computer and will be added to each time new cases are processed.

The interpretation of the % probabilities for deaths from COVID-19 or other causes is a matter for users to decide locally. One approach is to take a cutoff, saying for example that any death with a COVID-19 probability greater than a certain value, e.g. 70%, will be considered to be a death due to COVID-19. Another approach is simply to total the prob_covid and prob_other columns over all deaths in a particular community and/or time/age/sex window, divide both totals by 100, and you get estimates of the overall numbers of COVID-19 and other deaths.

The world's understanding of COVID-19 is constantly developing, and so it may become necessary to update aspects of the CRMS model in the future. For this

reason, the output file also automatically captures, for each case, the version of the CRMS software used (currently version 1.0) and the version of the knowledge base used, which is contained in the file knowbase.xls (currently version 1.0).

If it is desired to present the questions on-screen in other languages, it is possible to carefully edit the knowbase.xls file using Excel, and substitute translations of the question texts found in column B. It is crucial to not disturb other parts of the knowbase.xls file, however, which is critical to the proper running of the software. Thus any language editing should first be carried out on a copy of the file for safety. Once a translation is finalised, that file must be saved as knowbase.xls (Excel 5.0/95 format).

7. Acknowledgements and support

The development of this CRMS software package has been undertaken by the InterVA team from Umeå University, Umeå, Sweden, in collaboration with Vital Strategies, the World Health Organization and other partners involved in developing the COVID-19 Rapid Mortality Surveillance Technical Package. Further details and website links are available at the www.interva.net website.

We would be grateful if anyone making use of the CRMS model would make clear in any publication or other communication that "*the InterVA CRMS model (version 1.0) was used for handling COVID-19 Rapid Mortality Surveillance data*".

Although we have limited resources for technical support, we will be pleased to hear about both good and frustrating experiences of using this CRMS model, and give advice if possible. Please contact us via global.health@epiph.umu.se

Please also follow us @InterVA on Twitter for latest news and updates.

i Sources:

WHO. COVID-19 coding in ICD-10. www.who.int/classifications/icd/covid19/en/

Rossman et al. Nature Medicine 2020; 26:634-638

Bagheri et al. MedRxiv preprint 2020; <https://doi.org/10.1101/2020.03.23.20041889>

Klopfenstein et al. Med Mal Infect 2020; <https://doi.org/10.1016/j.medmal.2020.04.006>

Menni et al. Nature Medicine 2020; <https://doi.org/10.1038/s41591-020-0916-2>