Title: A scalable and reusable R script for analysing pre and post activity
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1. Background

The first question will be: analyse pre and post activity *relative to what*? This 'index event' could arguably be anything – a GP attendance, an A+E visit, a 999 call, a particular point in time at which some intervention was made.

From experience, many managers and clinicians all around the system have the same question: what happens *before* patients get to me, and what happens *after*? These are valuable questions in order to understand the extent to which patients are using healthcare services as intended, and to identify any interventions that could be made.

For instance, if multiple interactions are detected before some 'index event' of interest, then analysis could reveal duplication and 'bouncing around'. Analysis of post-event activity could reveal opportunities to improve care at the event point, e.g. providing additional information to the patient to allay any concerns that may otherwise lead them to seeking more healthcare afterwards.

To date, we have received requests from clinicians to evaluate activity pre and post events for children's A+E attendance, adult A+E head injury attendance, and hospital admission for heart attacks. The purpose-built and reusable solution presented here can answer those questions, in a matter of minutes, with very little analyst input.

2. A scalable and reusable solution

Rather than conduct bespoke analysis each time we are asked question like these, there are benefits to having a scalable and reusable solution, that can provide the required analysis at the touch of the button. For the tool developed here, all the analyst will need to define is:

1. Sufficient information to isolate the cohort of interest, via specification of the index event (ultimately, a list of NHS numbers and index event times).
2. Coverage of the pre/post activity, in terms of the time range (how many hours to search before/after the index event) and the care settings of interest (e.g. GP attends, outpatient consultations, MSK community physio, 999 see/treat calls).

The analyst enters these inputs into an *R* script, which then automatically produces an MS Word document containing the main results. Full results are also available from a number of separate files also produced automatically by the script.

3. Example outputs

The MS Word output for a particular example is shown in the following pages.

What happens 96 hours before and after 999 see & treat calls within the first week of August 2022

Some One (some.one123@nhs.net)[1]

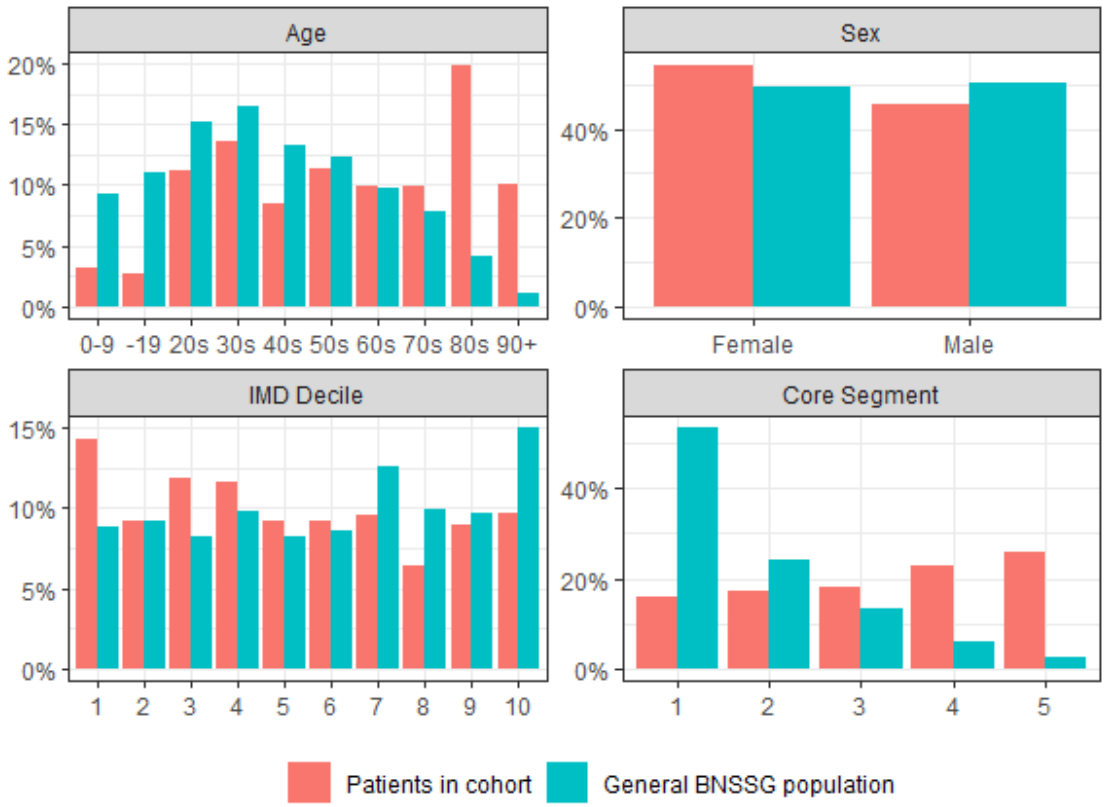
11 November 2022

1. Descriptive overview of the identified cohort

The cohort contains 668 instances for which an index event is recorded. Among these, there are 619 unique patients, meaning an average of 1.1 index events per patient.

The below figure contains attributes for the 639 instances (593 unique patients) that have relevant attribute data (taken from the closest month to the index event).

For context, the attributes of the general BNSSG population is also included, from the most recent month's data.



2. Activity volumes before and after the index event

The tables below summarise the volumes of activity occurring before and after the index event, for the 668 instances in the cohort.

[1] *Created using an R script developed by ICB Modelling and Analytics. Suggestions, comments and bug reports to richard.wood16@nhs.net.*

Summary of activity volumes BEFORE the index event

Activity	Mean activity per instance	Instances with >0 activity	Mean activity per instance with >0 activity
111	0.34	28.3%	1.22
999 (all types)	0.29	13%	2.21
A+E	0.09	7.8%	1.17
GP	0.65	36.1%	1.81

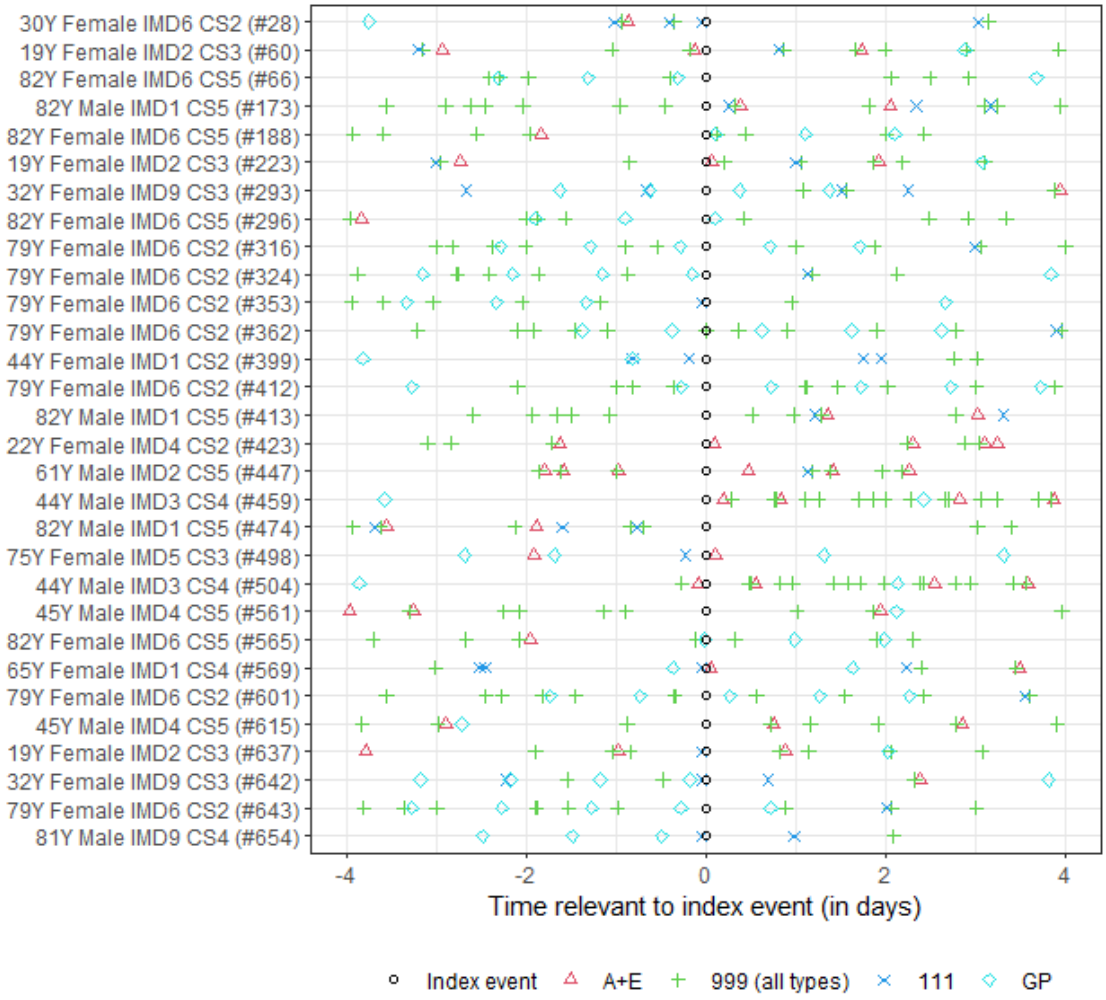
Summary of activity volumes AFTER the index event

Activity	Mean activity per instance	Instances with >0 activity	Mean activity per instance with >0 activity
111	0.09	7.5%	1.16
999 (all types)	0.36	17.5%	2.04
A+E	0.27	22.5%	1.21
GP	0.65	35.9%	1.81

3. Activity theographs for a sample of the cohort

The below figure contains examples of theographs. Here, each row contains activity for a certain patient centred around the index event (including the unique *#instance_id*).

Only the top 30 instances, by highest total volume of activity within the considered window, are included here (see the associated *theographs_full.pdf* file for the full results).



4. Tallies of distinct activity profiles around the index event

Considered here are the various combinations of activity volume profiles around the index event, in terms of a tally of the number of instances which match the distinct activity volume profile. The particular order or timing of the activities is not a consideration.

Only the top 10 distinct activity profiles, by frequency, are included here (see the associated *tallies_full.xlsx* file for the full results).

Tally of distinct activity volume profiles BEFORE the index event

A+E	999 (all types)	111	GP	Freq	Percent
0	0	0	0	280	42%
0	0	0	1	83	12%
0	0	1	0	82	12%
0	0	0	2	29	4%
0	0	1	1	29	4%
0	0	1	2	16	2%
0	1	0	0	10	1%
0	0	0	3	9	1%
0	0	0	4	8	1%

A+E	999 (all types)	111	GP	Freq	Percent
0	0	2	0	7	1%

Tally of distinct activity volume profiles AFTER the index event

A+E	999 (all types)	111	GP	Freq	Percent
0	0	0	0	294	44%
0	0	0	1	97	15%
1	0	0	0	52	8%
0	0	0	2	37	6%
1	1	0	0	20	3%
0	0	0	3	17	3%
0	1	0	0	16	2%
1	0	0	1	12	2%
1	0	0	2	7	1%
1	1	1	0	7	1%

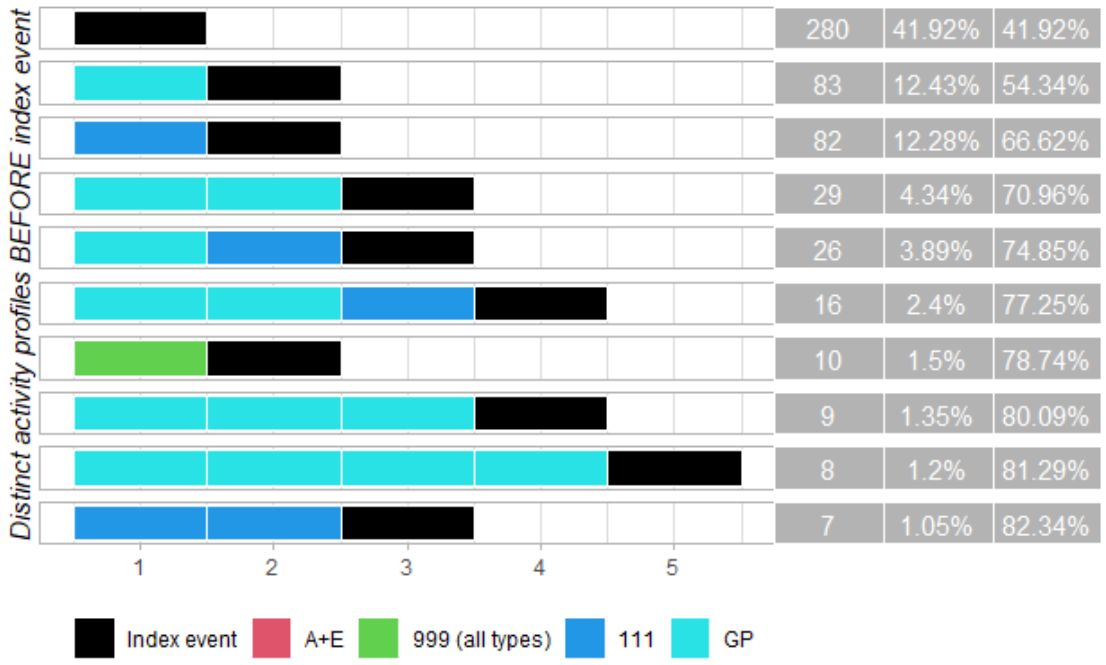
Tally of distinct activity volume profiles both BEFORE (B) and AFTER (A) the index event

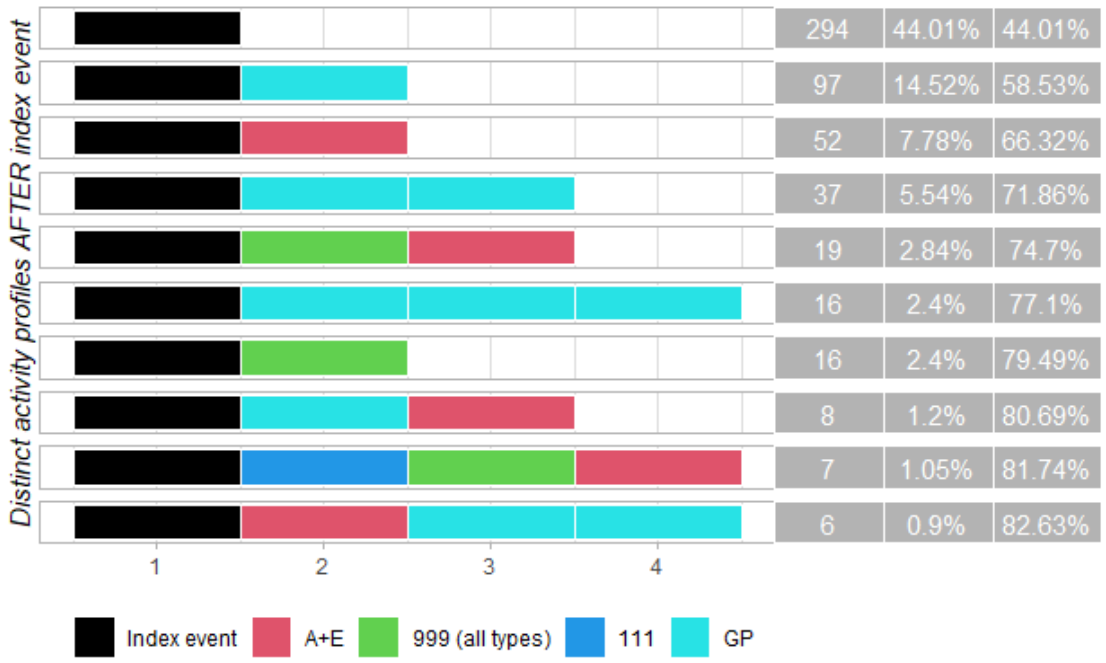
B:111	B:999 (all types)	B:A+E	B:GP	A:111	A:999 (all types)	A:A+E	A:GP	Freq	Percent
0	0	0	0	0	0	0	0	151	23%
0	0	0	0	0	0	0	1	38	6%
1	0	0	0	0	0	0	0	38	6%
0	0	0	1	0	0	0	0	37	6%
0	0	0	0	0	0	1	0	23	3%
0	0	0	1	0	0	0	1	13	2%
0	0	0	2	0	0	0	0	12	2%
1	0	0	1	0	0	0	0	12	2%
0	0	0	0	0	0	0	2	11	2%
1	0	0	0	0	0	0	1	11	2%

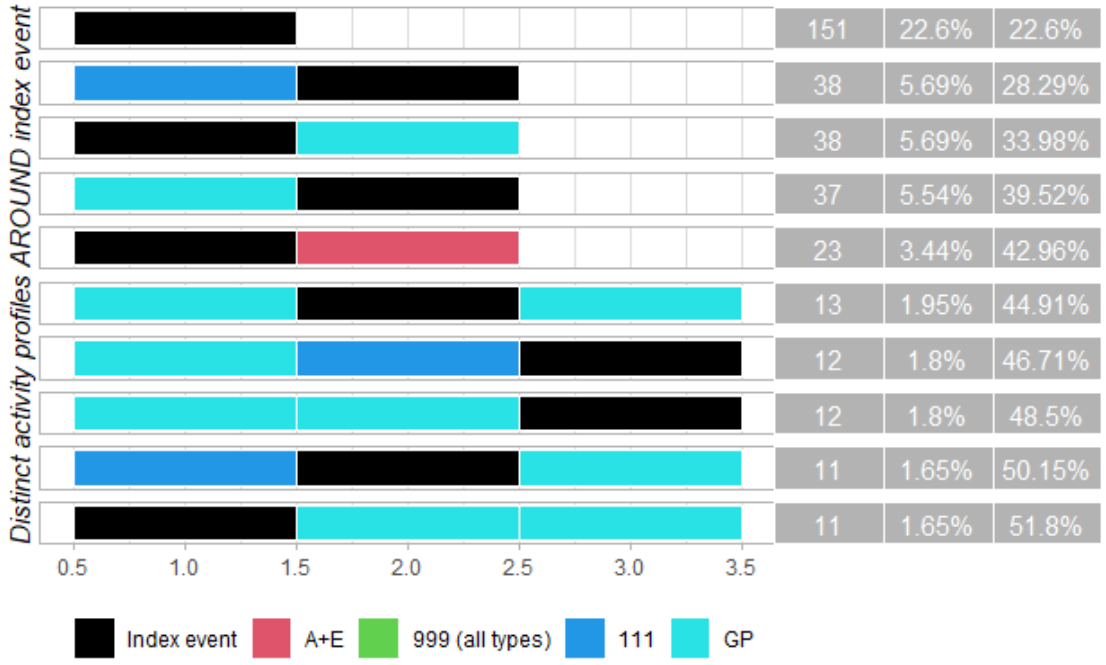
5. Trace-plots displaying activity order around the index event

Building on the tallies, trace-plots can be used to illustrate the particular order of activities. The three columns show the frequency and percentage (which should equate to the tallies in the previous section) and the cumulative percentage

Only the top 10 distinct activity profiles are included here (see the associated *trace_before_full.pdf*, *trace_after_full.pdf* and *trace_both_full.pdf* files for the full results).


Distinct activity profiles BEFORE index event
280 41.92% 41.92%
83 12.43% 54.34%
82 12.28% 66.62%
29 4.34% 70.96%
26 3.89% 74.85%
16 2.4% 77.25%
10 1.5% 78.74%
9 1.35% 80.09%
8 1.2% 81.29%
7 1.05% 82.34%
1
2
3
4
5
Index event
A+E
999 (all types)
111
GP


Distinct activity profiles AFTER index event
294 44.01% 44.01%
97 14.52% 58.53%
52 7.78% 66.32%
37 5.54% 71.86%
19 2.84% 74.7%
16 2.4% 77.1%
16 2.4% 79.49%
8 1.2% 80.69%
7 1.05% 81.74%
6 0.9% 82.63%
1
2
3
4
Index event
A+E
999 (all types)
111
GP


Distinct activity profiles AROUND index event
151 22.6% 22.6%
38 5.69% 28.29%
38 5.69% 33.98%
37 5.54% 39.52%
23 3.44% 42.96%
13 1.95% 44.91%
12 1.8% 46.71%
12 1.8% 48.5%
11 1.65% 50.15%
11 1.65% 51.8%
0.5
1.0
1.5
2.0
2.5
3.0
3.5
Index event
A+E
999 (all types)
111
GP