Garda Síochána Analysis Service

Comparing breath tests recorded on Dräger devices to MAT/MIT checkpoints on PULSE

GSAS_V4_FINAL

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Contents

1. Introduction

As part of the MAT/MIT examination by An Garda Síochána, we analysed the Medical Bureau of Road Safety's (MBRS's) breath test data recorded on Dräger devices between 2006 and April 2017[1].

Members should send Dräger devices to MBRS for calibration every 6 months. However, this doesn't always happen, and some devices have much longer periods between calibrations. Likewise, sometimes there may be a shorter time interval between calibrations. During the calibration process, MBRS performs approximately 4-5 tests per device. These tests are included as part of the overall Dräger breath test count. Some additional tests (usually 1-2) are performed by the manufacturer, and again are included as part of the overall count.

Between 2006 and early 2016, MBRS recorded Dräger information in an Access database. In early 2016, Access was replaced by a Laboratory Information Management System (LIMS). For a while data were being recorded in both databases. Access was fully discontinued in mid-April 2016. Any device that was deemed lost or inactive in Access was not transferred to LIMS.

To ensure that we had the most up-to-date Dräger readings, we conducted a national audit of Drägers on the weekend of 8-9 April 2017 in addition to analysing the data supplied by MBRS. We asked the divisions to send us the readings for the devices in their possession over that weekend.

Finally, we compared the number of breath tests recorded on Drägers versus MAT/MIT checkpoints on PULSE.

[1] Dräger figures include breath tests conducted at MAT/MIT checkpoints as well as in other scenarios, including at the scenes of traffic collisions where someone has been injured, as a result of random patrols and people being pulled over by the Gardaí.

MAT (Mandatory Alcohol Testing) checkpoints started officially being recorded on PULSE from 7 June 2009. They were replaced with MIT (Mandatory Intoxication Testing) checkpoints on 4 December 2016 and now test for the consumption of drugs as well as alcohol.

To compare the number of breath tests recorded on Drägers versus MAT/MIT checkpoints on PULSE over the same time period, we excluded breath tests recorded on the Dräger devices before 7 June 2009 from the overall breath test count. Thus the comparison period was between 7 June 2009 and 10 April 2017[2].

The rest of the report outlines the steps taken to analyse the data and an overview of the results.

2. Data files received from MBRS

We received five data files from MBRS:

- A combined file containing Access and LIMS records. We did not use this file for analysis, as it only contained information related to the last four calibrations for each Dräger, and due to errors found during the data cleaning and checking stage. However, we included 38 Drägers from this file, which were not in the four raw data files (see below), into our combined analysis file.
- Access database extract, covering the period between 16 March 2006 and 15 April 2016;
- LIMS database extract 1, covering the period between 4 July 2011 and 2 March 2017[3];
- LIMS database extract 2, covering the period between 2 March 2017 and 11 April 2017; and

[2] While the Dräger audit took place on the weekend of 8-9 April 2017, the deadline for returns was 10 April, with some divisions responding on 12 April 2017 or shortly thereafter.

[3] Historical data for the Drägers in use were transferred from Access to LIMS during data migration. The information for the lost and inactive Drägers wasn't migrated.

- A file containing readings for the Dräger devices awaiting calibration at MBRS on 12 April 2017.

The latter four files were combined into one for the analysis purposes. As mentioned, the 38 devices which were not part of the four raw data files but were included in the combined Access/LIMS file were added to the combined analysis file.

Due to a different structure of the files provided by MBRS, file merging was a challenging and time-consuming process. Having combined the MBRS files, Dräger readings supplied by the divisions were added in. A detailed technical report outlining the steps undertaken to merge and clean MBRS/divisional return files is available (Garda Síochána Analysis Service (2017) *MBRS and Divisional Returns - Data Cleaning and Merging Steps: Technical Report*).

The final combined file contained readings for **1,586** devices. **Table 1** shows a breakdown of the number of Dräger devices in each data file.

Table 1: Dräger breakdown by data file

Data file	No. of Drägers
Total	**1,586***
Access database extract	1,522, of which 337 had not been transferred to LIMS during migration
LIMS database extract 1	1,207
LIMS database extract 2	213, of which 209 were in LIMS extract 1 and four were new
Awaiting calibration on 12 April 2017	47 – all in the previous two LIMS extracts
Combined Access and LIMS file	38 additional Drägers not in the above four data files
Divisional return	1,310 – all in one of the above MBRS files

The total number of devices is calculated as follows: **337 devices not transferred from Access to LIMS + **1,207** devices in the LIMS extract 1 + **4** devices in the LIMS extract 2 + **38** devices from the combined Access and LIMS file = **1,586**.*

3. Device status/ recency of the reading analysis

Table 2 shows a breakdown of Drägers by their status/recency of the reading.

Of the **1,586** devices, **959** (60%) had a reading from April 2017 – **950** readings were supplied by the divisions; a further **9** by MBRS (for the devices that were awaiting calibration). A further **100** (6%) devices had a reading from earlier in 2017. Therefore **1,059** (67%) devices had an up-to-date reading.

The remaining **527** (33%) devices had not had a calibration in 2017. Of these, **346** (66%) were lost or missing. They were last calibrated between 2006 and end of 2016. A further **111** (21%) of the remaining devices were broken/beyond economic repair, with the last calibration date for them ranging between 2006 and end of 2016; **9** (2%) were coded as inactive/stock/never issued to a station. The status for the remaining **61** (12%) of these devices was unclear. The divisions did not supply a reading for these Drägers, with some stating that the devices were not in their possession, and some providing no explanation. The majority of the devices in this category (**44** or 72%) were last calibrated in 2016; **6** in 2015; **2** in 2014; **2** in 2013; **4** in 2012 and **3** in 2011.

Table 2: Dräger devices by status/recency of the reading

Status	No. of devices	% of total	% cumulative
Drägers for which the divisions supplied a reading in April 2017	950	60%	60%
Drägers awaiting calibration at MBRS on 12 April 2017, for which the divisions did not supply a reading	9	1%	60%
Drägers for which the divisions did not supply a reading but which were calibrated by MBRS in 2017	100	6%	67%
Lost/missing	346	22%	89%
Broken/beyond economic repair	111	7%	96%
Inactive/never issued to a station/stock	9	1%	96%
Other (not currently at the station, not accessible, reading was not returned by the division but no reason stated)	61	4%	100%
Total	**1,586**	**100%**	**100%**

4. Breath tests based on Dräger readings

Despite the efforts to obtain the most up-to-date readings for the Drägers in use, the number of breath tests based on the Dräger data is still inaccurate. This is due to a number of factors. Firstly, the divisions did not supply readings for all the devices as outlined above. Where this was the case, the last available MBRS reading was taken, which in some cases was quite out-of-date.

We also queried readings for 76 devices, as the figures supplied for them by the divisions were somewhat questionable. Unfortunately, we could not confirm the readings for several of these devices and thus substituted them with the latest MBRS reading.

Thus, the number of breath tests quoted in this report is somewhat lower than the actual number of breath tests recorded on the Drägers.

In addition, 100 devices were excluded from the calculations for the following reasons:

- 49 devices were used for training purposes (the total number of breath tests on these Drägers was 24,304);
- 4 devices were used internally by MBRS / had not been issued to a station (208 breath tests);
- 47 devices had a breath test count between 0 and 5. These were stock or missing devices, and breath tests on them would have been recorded solely during the calibration/mechanical testing (22 breath tests).

The total number of breath tests recorded on the 100 excluded devices was **24,534**.

Finally, breath tests due to calibration were also excluded from the total. It was difficult to accurately calculate the number of calibrations for each device. This is due to the fact that LIMS data extracts did not include all calibration records from the Access file. To get an accurate number of calibrations would have been a very slow and error prone process. Thus the missing calibrations were estimated instead. A total of 65 devices calibrated in different years were checked at random. For them, the average number of missing calibrations since the migration to LIMS was calculated, separately for each year. This estimate was then added to the calibration total (based on the Access file) of each remaining Dräger. On average, 2 calibrations were added for Drägers calibrated in 2017; 1 for Drägers calibrated in 2016 and zero for Drägers calibrated in 2015 or earlier.

There were approximately **15,270** calibrations performed between 2006 and April 2017[4], resulting in the exclusion of **76,345** breath tests[5].

Therefore, a total of **100,879** breath tests were excluded from the total number of breath tests recorded on the Dräger devices.

Table 3 shows the number of breath tests recorded on Drägers. It indicates that by conducting the national Dräger audit we obtained a more recent and thus more accurate overall Dräger breath test figure (143,162 additional breath tests). However, this figure is still likely to be lower than the actual number of breath tests recorded for the reasons outlined at the start of this section.

Table 3: Breath tests based on Dräger readings, 16 March 2006 – 10 April 2017*

	No. of breath tests, MBRS only	No. of breath tests, combined MBRS / divisional return	No. of breath tests, MBRS / divisional return, excluding breath tests due to calibration
Total**	3,160,305	3,303,467	3,227,122

**A small number of Dräger devices were returned on 12 April 2017 or shortly thereafter and thus may contain readings from a slightly later date in April.*

***Breath tests for the 100 excluded devices are not included in the total.*

5. Breath tests: Drägers compared to PULSE

The next step was to compare the number of breath tests recorded on Drägers versus PULSE.

[4] Only includes calibrations with non-zero values in the Dräger reading column.

[5] The figure is not 76,350 because there were 3 devices that had 8 calibrations between them and only 35 breath tests recorded instead of the expected 40. As noted previously, 5 breath tests per device per calibration was an average figure that was excluded. However some devices had fewer than 5 breath tests recorded during calibration; some had more.

For the purposes of this comparison we only included breath tests recorded as part of the MAT/MIT checkpoints on PULSE. While the majority of breath tests are conducted at MAT/MIT checkpoints, some are also conducted in a number of other scenarios, such as at the scenes of traffic collisions where someone has been injured, as a result of random patrols and people being pulled over by the Gardaí. The breath tests conducted in these scenarios may or may not be recorded on PULSE. As there is no single record source for these, they are not included as part of the PULSE examination.

As already noted, MAT checkpoints started being officially recorded on PULSE from 7 June 2009. Thus our Dräger versus PULSE comparison period was 7 June 2009 to 10 April 2017. The starting point for the Dräger data was 2006; therefore, we had to exclude breath tests recorded on the Drägers before 7 June 2009 in order to be able to compare Dräger and PULSE figures over the same time period.

a. Breath tests recorded on the Dräger devices

There was no easy way to exclude Dräger data collected before 7 June 2009. This is because individual Drägers are brought in for calibration at different points in time, with each having different periods between calibrations. To calculate the overall Dräger reading at a particular point in time from the MBRS data requires estimation, which ultimately leads to data inaccuracies.

Our approach was to take two calibrations closest to 7 June 2009 (either side of this date) and split the number of breath tests between the two dates proportionally, relative to how far each calibration was from 7 June 2009. For example, if the device was calibrated on 4 February 2008 and then on 17 February 2010, and the number of breath tests recorded over that period was 1000, 660 breath tests were allocated to the period before 7 June 2009 (66% of the time period between calibrations occurred before 7 June 2009) and 340 to the period on/after 7 June 2009 (34% of the time period between

calibrations occurred on/after 7 June 2009). While this approach was not entirely accurate, as it assumed that the device was used equally throughout the period, it was the most practical way to split the breath tests. In addition, this approach took into account only a small number of devices which were issued, for the first time, before 7 June 2009 and were first calibrated on/after 7 June 2009 and later that year[6]. For example, if a Dräger was first issued on 1 April 2009, and came in for calibration on 29 July 2009, the entire breath test count for that Dräger was allocated to the post-7-June-2009 period.

Therefore, the Dräger breath test figure for the on/after-7-June-2009 period quoted in this report should be treated with some caution, acknowledging the challenges with and limitations of the calculation process outlined above.

Table 4 shows the number of breath tests recorded on Drägers before and on/after 7 June 2009. It indicates that approximately 1.19 million breath tests were recorded in the first 3-and-a-quarter years compared to 2 million in nearly 8 years after that. This translates into approximately 368,000 breath tests per year before and 263,000 breath tests per year on/after 7 June 2009 – a 29% drop.

Table 4: Dräger readings before and on/after 7 June 2009

	No. of breath tests, combined MBRS / divisional return	No. of breath tests, combined MBRS / divisional return excluding breath tests due to calibration
Total	3,303,467	3,227,122
Before 7 June 2009	1,199,850 (36%)	1,186,955 (37%)*
On/after 7 June 2009	**2,103,617 (64%)**	**2,040,179 (63%)***

**The figures do not add up to 3,227,122 due to calculations to exclude breath tests due to calibration.*

[6] There were up to 99 Drägers affected with approximately 25,000 breath tests on them. Therefore, at least a proportion of these breath tests could have been allocated to the pre-7-June-2009 period.

b. Breath tests on PULSE

We do not have PULSE breath test figures prior to 7 June 2009; however, **Table 5** shows that the number of breath tests at MAT/MIT checkpoints recorded on PULSE has been declining since the start of their recording in June 2009. In 2010, the first full year of data, the number of breath tests recorded was nearly twice as high as in 2015 (568,573 versus 332,080), when the lowest annual figure over that period was recorded. The number of breath tests in 2016 increased slightly to 338,539. However this figure was 40% lower compared to 2010.

Table 5: MAT/MIT checkpoints, negative and positive breath tests and checkpoint duration, 7 June 2009 – 10 April 2017

Year	No. of checkpoints[2]	Sum of negative and positive breath tests	Average No. of breath tests per checkpoint	Average checkpoint duration (min)[3]	Personnel of Garda rank[4]
2009[1]	21,805	286,507	13	32	10,543
2010	54,320	568,573	10	31	10,346
2011	67,090	543,347	8	30	10,072
2012	67,851	472,170	7	29	9,815
2013	73,826	446,379	6	28	9,546
2014	72,486	404,632	6	27	9,164
2015	70,834	332,080	5	26	9,175
2016	72,629	338,539	5	26	9,101
2017[1]	22,357	106,173	5	26	N/A
Total	**523,198**	**3,498,400**	**7[5]**	**28[5]**	**9,720[5]**

[1]Does not include full year. MAT/MIT checkpoints started officially being recorded on PULSE from 7 June 2009. 2017 includes MAT/MIT checkpoints up to 10 April.
[2]Does not include checkpoints where the number of vehicles through a checkpoint, the number of vehicles stopped and controlled and the sum of negative, positive and failed/refused breath tests were equal to zero. These checkpoints are most likely invalid and just hadn't been invalidated on PULSE (n=27,011).
[3]Excludes checkpoints where the duration is 2 hours or longer (n=3,886).
[4] Excludes DMR Office and Headquarters staff.
[5] Average across the years.

While the number of breath tests in 2016 reduced by 40% compared with 2010, the number of MAT/MIT checkpoints conducted, on the other hand, increased by 34% over the same time period, from 54,320 to 72,629. We could not calculate, from the data provided, how the number of Garda members at individual checkpoints changed between 2010 and 2016; however, there was a 12% reduction, overall, in the personnel of Garda rank (that is, members most likely to conduct the checkpoints) over that period. Thus an increase in the checkpoints might seem surprising, especially considering a drop in the breath test figures.

There are multiple factors that could explain lower breath test figures with more checkpoints being conducted, including shorter checkpoints with fewer members at them, fewer vehicles on the road, checkpoints being conducted at different times of the day or at quieter locations, recording errors, etc. For the purposes of this analysis, we only examined checkpoint duration, which indeed became shorter between 2010 and 2016. In 2010, the average length of the checkpoint was 31 minutes versus 26 minutes in 2016[7]. Analysis of other factors was outside of the scope of this examination.

c. Dräger versus PULSE breath tests

The comparison of breath tests recorded on Drägers versus MAT/MIT checkpoints on PULSE between 7 June 2009 and 10 April 2017, revealed a difference of about 1.46 million breath tests – see **Table 6**.

[7] The median duration was 30 minutes in 2010 and 29 minutes in 2016.

Table 6: Dräger versus PULSE breath tests, 7 June 2009 – 10 April 2017*

	No. of breath tests on Dräger devices (excluding breath tests due to calibration)	No. of breath tests on PULSE MAT/MIT checkpoints	Difference
Total	2,040,179	3,498,400	1,458,221

** A small number of Dräger devices were returned on 12 April 2017 or shortly thereafter and thus may contain readings from a slightly later date in April.*

6. Divisional comparisons

We compared the number of breath tests recorded on the Dräger devices versus MAT/MIT checkpoints on PULSE across the 28 Garda divisions. Similarly to the overall breath test figure, divisional Dräger figures should be treated with some caution, acknowledging the challenges encountered when calculating them.

In addition to the difficulty in separating breath tests into pre- and on/after-7-June-2009 periods, there was an added complexity with allocating breath tests to the divisions because of Dräger movement across the divisions over time. While most of the movement occurred in the earlier years (between 2006 and early 2009), there were 14 devices that changed divisions over the period of our examination. Unfortunately, Dräger movement information was only available in the MBRS files until mid-April 2016[8]. Thus any later Dräger re-allocations between the divisions had not been taken into consideration.

Breath tests for the 14 devices that had moved after 7 June 2009 were split between the associated divisions proportionally, based on the time the Dräger had spent in the particular division. However, it was not always possible to apportion breath tests accurately. For example, in some instances the device

[8] This information was only included in the Access file, and was not available in LIMS extracts.

had been issued to one division and returned from another. As it was not possible to determine at which point the device had moved, all breath tests were allocated to the division to which the Dräger had been issued.

Table 7 compares breath tests recorded on Drägers versus MAT/MIT checkpoints on PULSE for each division. It also shows the number of MAT/MIT checkpoints recorded on PULSE between 7 June 2009 and 10 April 2017 and their average length as well as the average number of personnel of Garda rank between 2009 and 2016.
Table 7 indicates that, divisionally, the biggest difference between the Dräger and PULSE breath test figures was observed in Tipperary (385%), followed by DMR West (373%) and Meath (315%). Regionally, the biggest difference could be seen in the South East (142%), with three out of four divisions in the region having gaps of more than 100% between Dräger and PULSE figures.

The rest of this chapter takes a closer look at the ten divisions where the difference between the Dräger and PULSE breath test figures was more than 100%.

Table 7: Members of Garda rank, MAT/MIT checkpoints, checkpoint duration and breath tests recorded on Drägers versus MAT/MIT checkpoints on PULSE by division, 7 June 2009 – 10 April 2017

Region/Division	Av. No. of Garda rank[1]	No. of MAT/MIT chk. on PULSE[2]	Av. chk. duration (min)[3]	Av. No. of chk. per person[4]	Av. No. of breath tests (PULSE) per chk.[5]	No. of breath tests - Dräger	No. of breath tests MAT/MIT chk. - PULSE	Diff. between breath tests: Dräger vs. PULSE[6]	% of the total difference between Dräger & PULSE[7]
Dublin Region	**3,343***	**37,376**	**38**	**11**	**19**	**493,645**	**727,787**	**47%**	**16%**
D.M.R. Eastern	356	3,400	49	10	27	54,330	92,705	71%	3%
D.M.R. North Central	539	4,262	34	8	18	36,752	74,596	103%	3%
D.M.R. Northern	623	7,192	34	12	15	54,692	110,187	101%	4%
D.M.R. South Central	594	4,170	41	7	36	112,055	150,133	34%	3%
D.M.R. Southern	490	4,973	45	10	26	108,431	127,339	17%	1%
D.M.R. Western	625	13,379	36	21	13	36,527	172,827	373%	9%
D.M.R. Traffic[8]	117					90,853			
Garda Mounted Unit[8]						5			
Eastern Region	**1,228***	**56,646**	**29**	**46**	**10**	**266,526**	**542,551**	**104%**	**19%**
Kildare Div	263	12,703	29	48	13	75,059	168,851	125%	6%
Laois/Offaly	243	11,200	26	46	9	63,292	100,752	59%	3%
Meath Div	242	12,553	29	52	8	23,577	97,830	315%	5%
Westmeath Div	205	10,313	26	50	8	42,619	79,904	87%	3%
Wicklow	276	9,877	34	36	10	61,979	95,214	54%	2%
Northern Region	**1,119**	**55,140**	**25**	**49**	**6**	**199,280**	**347,082**	**74%**	**10%**
Cavan/Monaghan	277	17,083	27	62	5	58,555	86,844	48%	2%
Donegal	354	19,643	24	55	7	79,899	128,666	61%	3%
Louth Div	240	8,308	24	35	7	17,913	56,077	213%	3%
Sligo/Leitrim	248	10,106	23	41	7	42,913	75,495	76%	2%
South Eastern Region	**1,006***	**108,374**	**26**	**108**	**6**	**248,894**	**601,962**	**142%**	**24%**
Kilkenny/Carlow	247	22,080	27	89	7	60,824	157,211	158%	7%
Tipperary	307	58,180	25	190	4	47,943	232,639	385%	13%
Waterford Div	237	13,256	29	56	8	53,828	110,503	105%	4%
Wexford Div	216	14,858	24	69	7	86,299	101,609	18%	1%
Southern Region	**1,804***	**182,377**	**29**	**101**	**4**	**546,419**	**797,047**	**46%**	**17%**
Cork City	555	34,895	27	63	6	105,357	199,754	90%	6%
Cork North	247	55,233	27	224	3	131,196	189,974	45%	4%
Cork West	242	47,665	31	197	4	123,238	173,687	41%	3%
Kerry	256	16,300	30	64	6	87,567	95,759	9%	1%
Limerick	505	28,284	29	56	5	99,061	137,873	39%	3%
Western Region	**1,221**	**83,285**	**28**	**68**	**6**	**285,415**	**481,971**	**69%**	**13%**
Clare	257	28,076	28	109	5	66,689	136,944	105%	5%
Galway Div	482	30,458	26	63	6	126,642	193,504	53%	5%
Mayo	249	14,208	30	57	6	48,903	85,562	75%	3%
Roscommon/ Longford Div	233	10,543	27	45	6	43,181	65,961	53%	2%
Total	**9,720***	**523,198**	**28**	**54**	**7**	**2,040,179**	**3,498,400**	**71%**	**100%***

**Does not add up due to rounding.*

[1]Garda personnel only include Garda rank; excludes DMR Office and Headquarters staff; the numbers are averaged over the 2009-2016 period.

[2]Checkpoints where the number of vehicles through a checkpoint, the number of vehicles stopped and controlled and negative, positive and failed/refused breath tests are equal to zero were excluded from the calculations, as these checkpoints are most likely invalid and just hadn't been invalidated on PULSE (n=27,011).

[3] Excludes checkpoints where the duration is 2 hours or longer (n=3,886).

[4]Divisions where the number of checkpoints per person is more than twice the national average are highlighted in red.

[5]Divisions where the number of breath tests per checkpoint is about half the national average are highlighted in red.

[6]Divisions with the difference between PULSE and Dräger of more than 100% are highlighted in red.

[7]Base = 1,458,221.Top five divisions are highlighted in red.

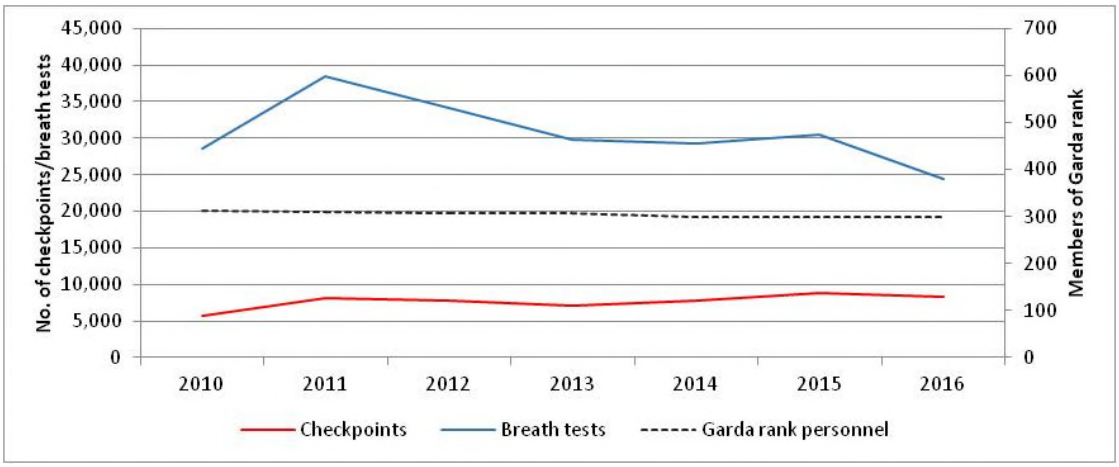
[8]DMR Traffic and Garda Mounted Unit are not reported as separate divisions on PULSE. Dräger readings for the DMR Traffic and Garda Mounted Unit should be subdivided among the six DMR divisions. However, due to difficulties in accurately apportioning the breath tests of the former two among the remaining six divisions, DMR Traffic and Garda Mounted Unit are reported separately in this analysis.

a. South Eastern Region

As already noted, three out of four divisions in the South Eastern Region had differences of more than 100% between the breath tests recorded on the Dräger devices versus PULSE. The biggest difference could be observed in Tipperary (385%), followed by Kilkenny/Carlow (158%) and Waterford (105%).

While we do not have yearly Dräger breath test figures, we can look at PULSE and personnel data to get a better understanding of the trends in the checkpoint/breath test recording over the examination period in each division. Looking at the years with full year of data, we can see that the number of MAT/MIT checkpoints in Tipperary increased by 46% between 2010 and 2016, from 5,754 to 8,376, while the number of members of Garda rank decreased by 4% over the same time period, from 312 to 299. The number of positive/negative breath tests also decreased by 14% (28,572 in 2010 versus 24,477 in 2016) (**Chart 1**).

Chart 1: Members of Garda rank, MAT/MIT checkpoints and breath tests at MAT/MIT checkpoints recorded on PULSE, Tipperary, 2010-2016



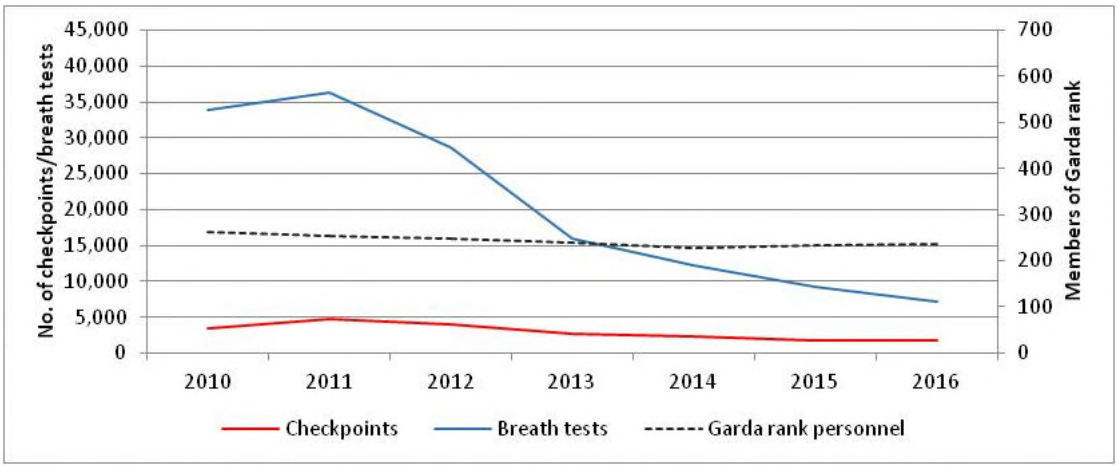
It might appear counter-intuitive to see the number of breath tests fall when the number of checkpoints increases. However, as already mentioned there could be a number of explanations for this, such as a smaller number of cars

on the road, checkpoints being conducted at places with fewer cars passing through, shorter checkpoints, etc. The average checkpoint duration in Tipperary, indeed, went down slightly, from about 26 minutes in 2010 to around 25 minutes in 2016.

It is important to highlight that between 7 June 2009 and 10 April 2017 Tipperary recorded more MAT/MIT checkpoints on PULSE than breath tests on their Dräger devices (58,180 versus 47,943), the only division in the country to have done that. We examined the number of MAT/MIT checkpoints that had zero breath tests recorded in the roadside breath test fields on PULSE, as such checkpoints might indicate MAT/MIT checkpoints being used as substitute records for different types of checkpoints, for example, burglary. There were 947 such checkpoints recorded in Tipperary between 7 June 2009 and 10 April 2017 (2% of the Tipperary's total checkpoints). There were 6,561 such checkpoints recorded over the same time period on PULSE overall. This means that 14% of all checkpoints with zero breath tests (the highest proportion) were recorded in Tipperary.

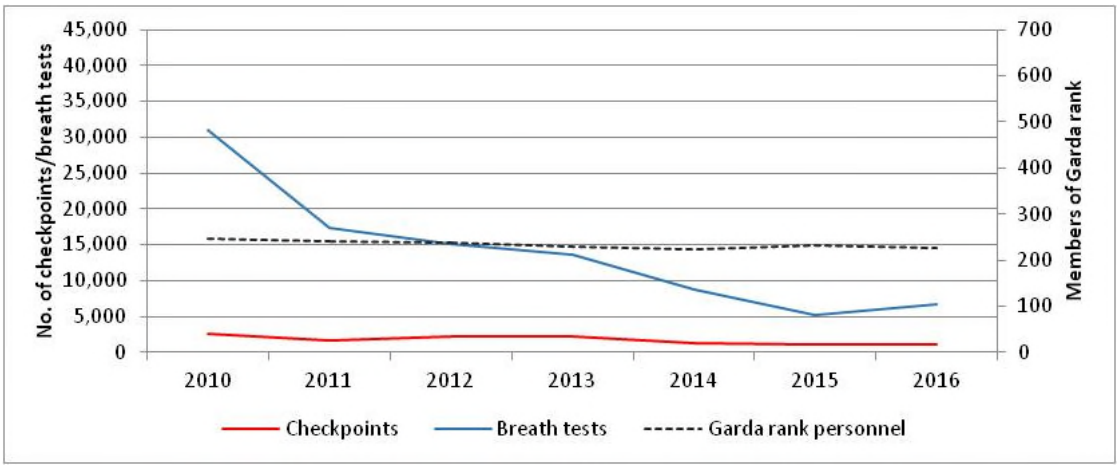
In Kilkenny/Carlow, the number of checkpoints dropped by 51% between 2010 and 2016, while the number of breath tests decreased by 79% (from 3,461 to 1,680 and from 33,875 to 7,108 respectively) (**Chart 2**). There was an 11% drop in the members of Garda rank over the same period (from 264 to 236). The average checkpoint duration also decreased from around 30 minutes in 2010 to just over 22 minutes in 2016.

Chart 2: Members of Garda rank, MAT/MIT checkpoints and breath tests at MAT/MIT checkpoints recorded on PULSE, Kilkenny/Carlow, 2010-2016



In Waterford, similarly, the number of checkpoints conducted reduced by 54% (from 2,556 in 2010 to 1,174 in 2016) while the number of breath tests reduced by 78% (from 31,073 to 6,723) over the same period (**Chart 3**). There was an 8% reduction in the personnel of Garda rank (from 248 to 227), while the average length of the checkpoints decreased from around 33 minutes to around 27 minutes.

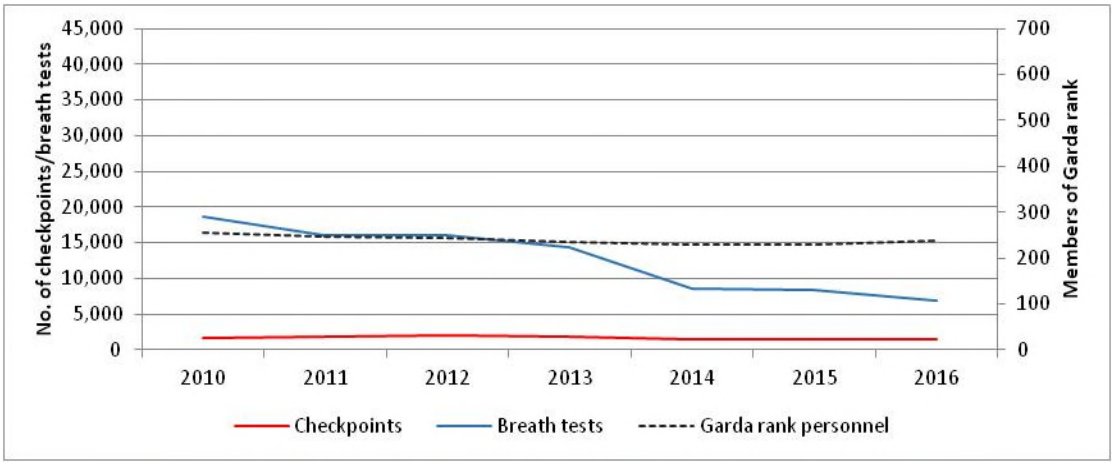
Chart 3: Members of Garda rank, MAT/MIT checkpoints and breath tests at MAT/MIT checkpoints recorded on PULSE, Waterford, 2010-2016



b. Eastern Region

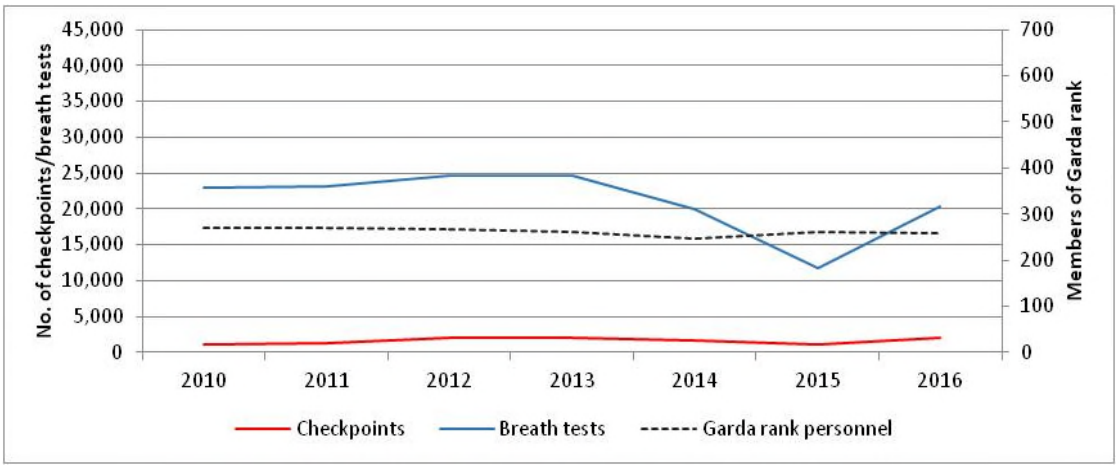
Meath had the largest difference between the number of breath tests recorded on Drägers compared to PULSE in the Eastern Region (315%), followed by Kildare (125%). Meath experienced a 7% drop in the members of Garda rank between 2010 and 2016 (from 254 to 237). The number of checkpoints conducted over the same period went down by 11% and the number of breath tests recorded on PULSE fell by 63% (from 1,686 to 1,495 and from 18,749 to 6,858 respectively) (**Chart 4**). The average checkpoint duration decreased from around 31 minutes in 2010 to around 26 minutes in 2016.

Chart 4: Members of Garda rank, MAT/MIT checkpoints and breath tests at MAT/MIT checkpoints recorded on PULSE, Meath, 2010-2016



In Kildare, on the other hand, the number of checkpoints over the same period increased by 69%, while the number of breath tests reduced by 12% (from 1,149 to 1,937 and from 22,983 to 20,249 respectively) (**Chart 5**). The number of personnel of Garda rank dropped by 4%, from 271 to 259. Checkpoints, similarly to other divisions, became shorter – from around 31 minutes, on average, in 2010 to around 22 minutes in 2016.

Chart 5: Members of Garda rank, MAT/MIT checkpoints and breath tests at MAT/MIT checkpoints recorded on PULSE, Kildare, 2010-2016

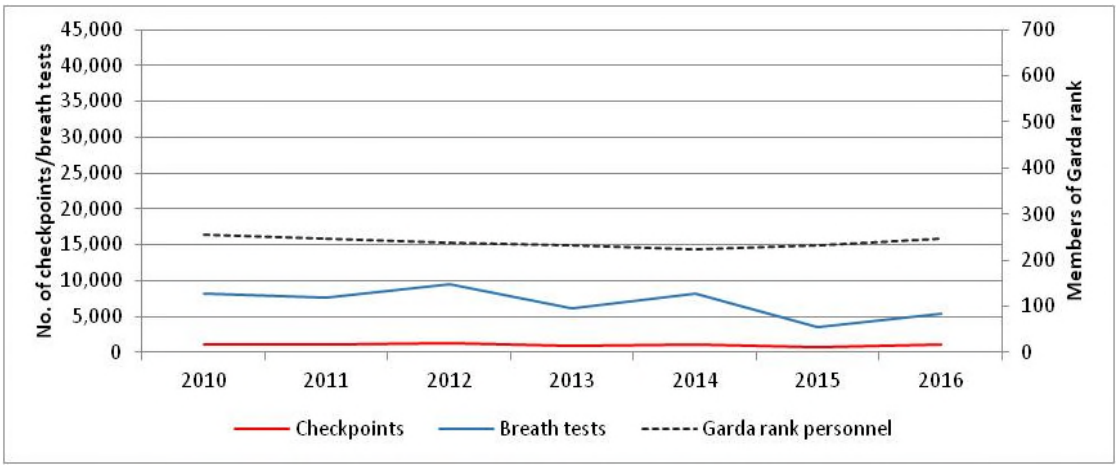


c. Northern Region

Louth was the only division in the Northern Region where the discrepancy between the number of breath tests recorded on the Dräger devices and PULSE was more than 100% (213%).

In terms of trends, the number of checkpoints in Louth, similar to Kildare and Tipperary, went up between 2010 and 2016, albeit only by 1% (from 1,052 to 1,061). The number of breath tests fell by 35% (from 8,231 to 5,338) (**Chart 6**). The personnel of Garda rank went down by 3% over the same period (from 254 to 246), while the average checkpoint length increased from around 22 minutes in 2010 to over 29 minutes in 2016.

Chart 6: Members of Garda rank, MAT/MIT checkpoints and breath tests at MAT/MIT checkpoints recorded on PULSE, Louth, 2010-2016

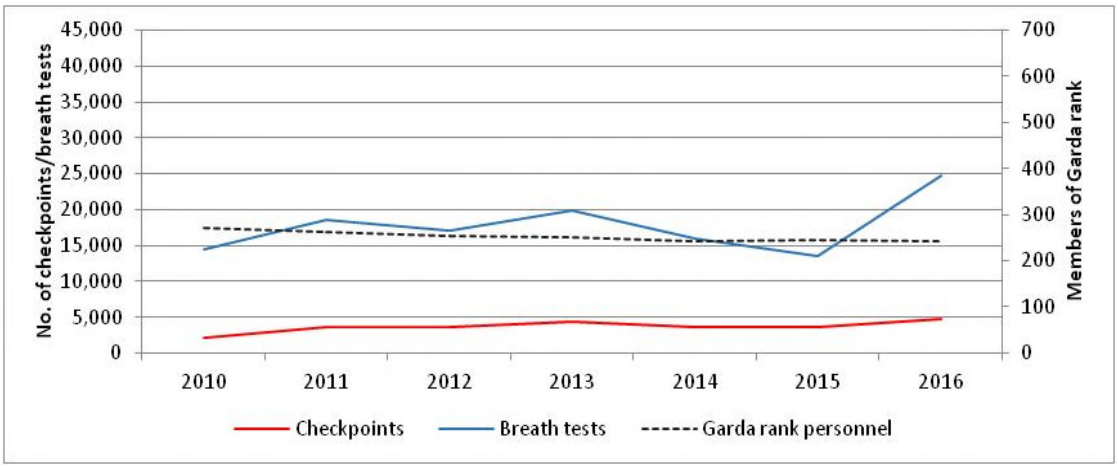


d. Western Region

Clare was the only division in the Western Region with more than a 100% gap between the Dräger and PULSE breath test figures (105%).

A different pattern to that observed in the divisions above could be seen in Clare. The number of personnel of Garda rank, similarly to the other divisions, decreased by 10% between 2010 and 2016, from 271 to 243. However, in Clare, unlike in the other divisions, both the number of MAT/MIT checkpoints and the number of breath tests increased over the same time period, by 118% and 72% respectively. The number of checkpoints went up from 2,207 in 2010 to 4,815 in 2016, while the number of positive/negative breath tests increased from 14,435 to 24,796 (**Chart 7**). The average checkpoint length reduced from around 33 to 25 minutes.

Chart 7: Members of Garda rank, MAT/MIT checkpoints and breath tests at MAT/MIT checkpoints recorded on PULSE, Clare, 2010-2016



e. Dublin Region

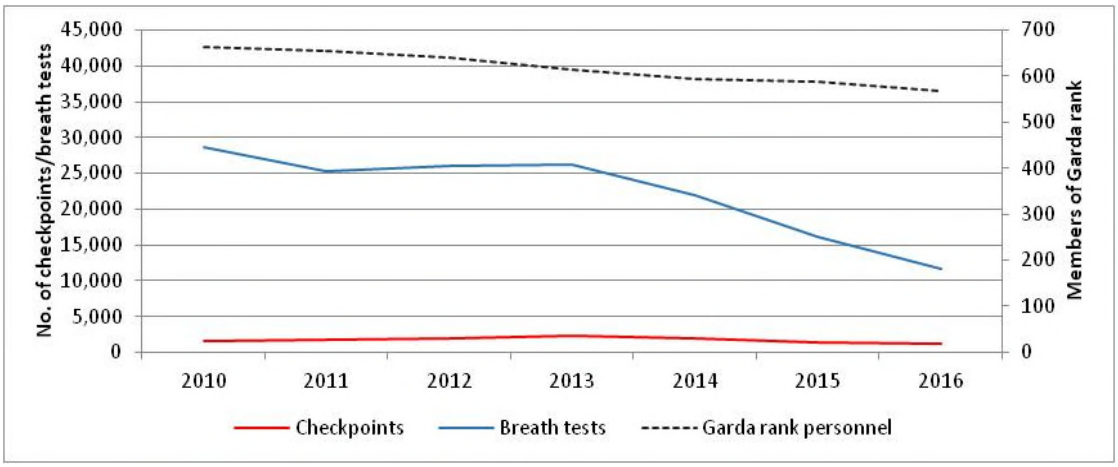
There were three divisions in the Dublin Region with differences of more than 100% between the number of breath tests recorded on the Drägers compared to PULSE: DMR West (373%), DMR North Central (103%) and DMR Northern (101%). The gaps between the Dräger and PULSE figures for these divisions, in reality, are smaller, as they currently do not take into account the DMR Traffic breath tests that belong to these divisions[9]. However, due to challenges in accurately apportioning DMR Traffic breath tests among the DMR divisions, the decision was made to treat DMR Traffic separately. Thus only the breath tests directly attributable to each DMR division were used in the calculations.

Looking at the trends, the number of checkpoints conducted in the DMR West between 2010 and 2016 went down by 29%, while the number of breath tests recorded declined by 59% (from 1,629 to 1,164 and from 28,681 to 11,721 respectively) (**Chart 8**). DMR West saw a 14% reduction in the personnel of Garda rank over this time period (from 663 to 569). The average length of the

[9] DMR Traffic conduct checkpoints anywhere in the DMR Region.

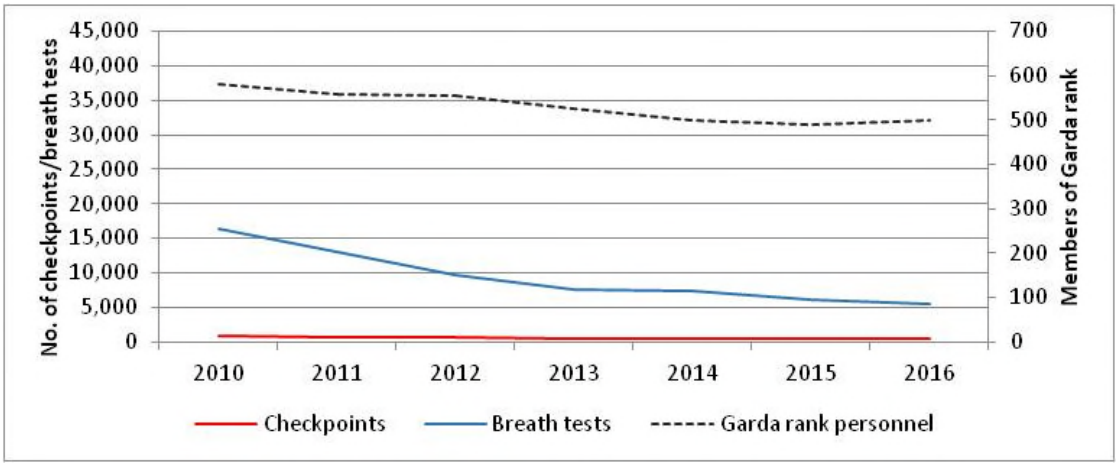
checkpoints also reduced from around 44 minutes in 2010 to 32 minutes in 2016.

Chart 8: Members of Garda rank, MAT/MIT checkpoints and breath tests at MAT/MIT checkpoints recorded on PULSE, DMR West, 2010-2016



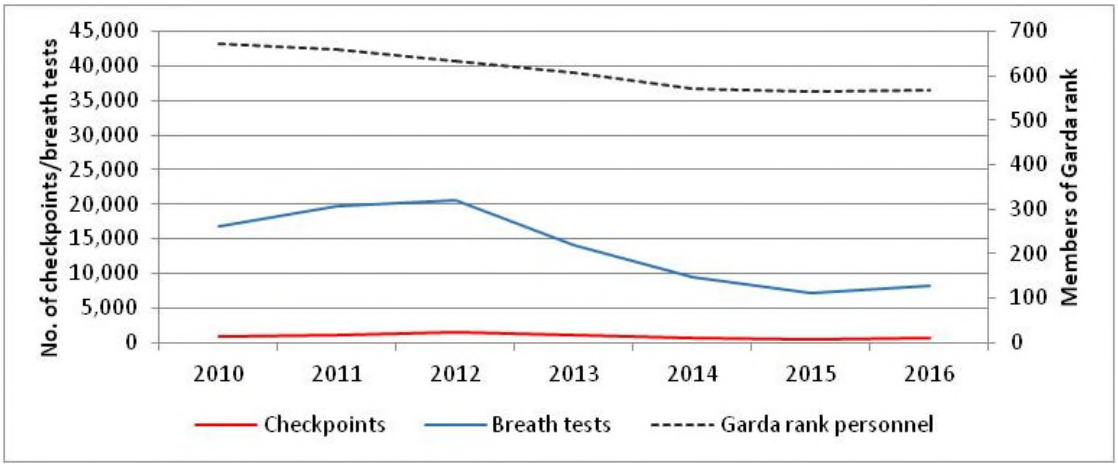
A similar pattern could be observed in the DMR North Central, where the number of checkpoints over the period went down by 51% (from 824 to 404) and the number of breath tests recorded on PULSE fell by 66% (from 16,335 to 5,539) (**Chart 9**). The division experienced a 14% reduction in the members of Garda rank. Checkpoints reduced, on average, by around 8 minutes. The average length of the checkpoint in DMR North Central in 2010 was around 36 minutes. It fell to around 28 minutes in 2016.

Chart 9: Members of Garda rank, MAT/MIT checkpoints and breath tests at MAT/MIT checkpoints recorded on PULSE, DMR North Central, 2010-2016



DMR North, similarly, experienced a 28% reduction in the number of checkpoints conducted and 51% reduction in the number of breath tests recorded on PULSE (**Chart 10**). There were 864 checkpoints conducted in the DMR North in 2010 with 16,803 breath tests recorded. This reduced to 619 checkpoints in 2016 with 8,226 breath tests recorded. The checkpoint length over the period reduced by about 8 minutes, on average, from 37 minutes to 29 minutes. The reduction in the personnel of Garda rank was 15%.

Chart 10: Members of Garda rank, MAT/MIT checkpoints and breath tests at MAT/MIT checkpoints recorded on PULSE, DMR North, 2010-2016



f. Divisional trends overall

Trend analysis of the divisions with the biggest gaps between the Dräger and PULSE breath test figures showed that there was no one distinct pattern that these divisions had followed. The commonalities between the divisions might have helped to explain the large discrepancies between the Dräger and PULSE figures observed in these divisions. However, no distinct commonalities could be identified from the analysis.

While in Tipperary, Louth and Kildare divisions the number of checkpoints conducted between 2010 and 2016 increased, the number of breath tests recorded on PULSE went down. In Clare, on the other hand, both the number of checkpoints and the number of breath tests went up over the same period; both fell in the remaining six divisions. There was no common pattern even between the divisions within the same region. For example, Tipperary appears to have followed a different trend compared to the other three divisions in the region. The number of checkpoints in Tipperary over the 2010 – 2016 period increased, while it decreased in the other three divisions. The reduction in the number of breath tests was also relatively small in Tipperary: -14% compared to between -71% and -79% in the other three divisions (**Table 8**).

Table 8: Divisional trends, 2010-2016

Region/Division	% Difference between breath tests on Dräger vs. PULSE*	% Change in checkpoints recorded on PULSE	% Change in breath tests recorded on PULSE	% Change in personnel of Garda rank	Change in the checkpoint duration (min:sec)
Dublin Region	**47%**	**-41%**	**-65%**	**-16%**	**-09:39**
D.M.R. Eastern	71%	-70%	-81%	-21%	-11:00
D.M.R. North Central	103%	-51%	-66%	-14%	-08:05
D.M.R. Northern	101%	-28%	-51%	-15%	-07:58
D.M.R. South Central	34%	-33%	-67%	-20%	-07:26
D.M.R. Southern	17%	-53%	-68%	-16%	-06:42
D.M.R. Western	373%	-29%	-59%	-14%	-11:19
Eastern Region	**104%**	**+7%**	**-37%**	**-9%**	**-06:05**
Kildare Div	125%	+69%	-12%	-4%	-09:11
Laois/Offaly	59%	-9%	-24%	-7%	-01:33
Meath Div	315%	-11%	-63%	-7%	-05:44
Westmeath Div	87%	-33%	-63%	-10%	-06:24
Wicklow	54%	+49%	-32%	-18%	-10:26
Northern Region	**74%**	**+37%**	**-35%**	**-13%**	**-01:05**
Cavan/Monaghan	48%	+63	-24%	-19%	-03:03
Donegal	61%	+30%	-35%	-17%	-03:37
Louth Div	213%	+1%	-35%	-3%	+7:44
Sligo/Leitrim	76%	+49%	-44%	-9%	-01:05
South Eastern Region	**142%**	**-16%**	**-62%**	**-8%**	**-04:02**
Kilkenny/Carlow	158%	-51%	-79%	-11%	-08:01
Tipperary	385%	+46%	-14%	-4%	-01:34
Waterford Div	105%	-54%	-78%	-8%	-06:40
Wexford Div	18%	-60%	-71%	-7%	-03:22
Southern Region	**46%**	**+107%**	**-9%**	**-10%**	**-04:39**
Cork City	90%	+49%	-24%	-9%	-03:52
Cork North	45%	+168%	-6%	-2%	-04:57
Cork West	41%	+162%	+21%	-13%	-04:38
Kerry	9%	+34%	-30%	-10%	-04:47
Limerick	39%	+121%	+6%	-14%	-06:32
Western Region	**69%**	**+80%**	**-6%**	**-6%**	**-09:22**
Clare	105%	+118%	+72%	-10%	-07:53
Galway Div	53%	+125%	-16%	-6%	-11:57
Mayo	75%	+17%	-30%	-5%	-08:33
Roscommon/ Longford Div	53%	+22%	-45%	-4%	-06:30
Total	**71%**	**+34%**	**-40%**	**-12%**	**-05:44**

**Cells with the difference between PULSE and Dräger of more than 100% are highlighted in red.*

As mentioned before, intuitively, one would expect the number of breath tests to increase as more checkpoints are conducted. We tested if there was a statistically significant relationship between these two variables by running a correlation test[10]. Correlation is a measure of the linear relationship between

[10] As variables were not normally distributed, Spearman's correlation test was used.

variables. Variables can be positively or negatively related, or not related at all. Correlation coefficient is a standardised measure of the strength of relationship between two variables. It can take any value between -1 and 1. A negative correlation coefficient indicates a negative linear relationship between the variables (as one variable changes, the other changes in the opposite direction). A positive correlation coefficient indicates a positive linear relationship between the variables (as one variable changes, the other changes in the same direction). A correlation coefficient of "0" indicates that no linear relationship exists between two variables; while -1 or 1 indicates a perfect linear relationship.

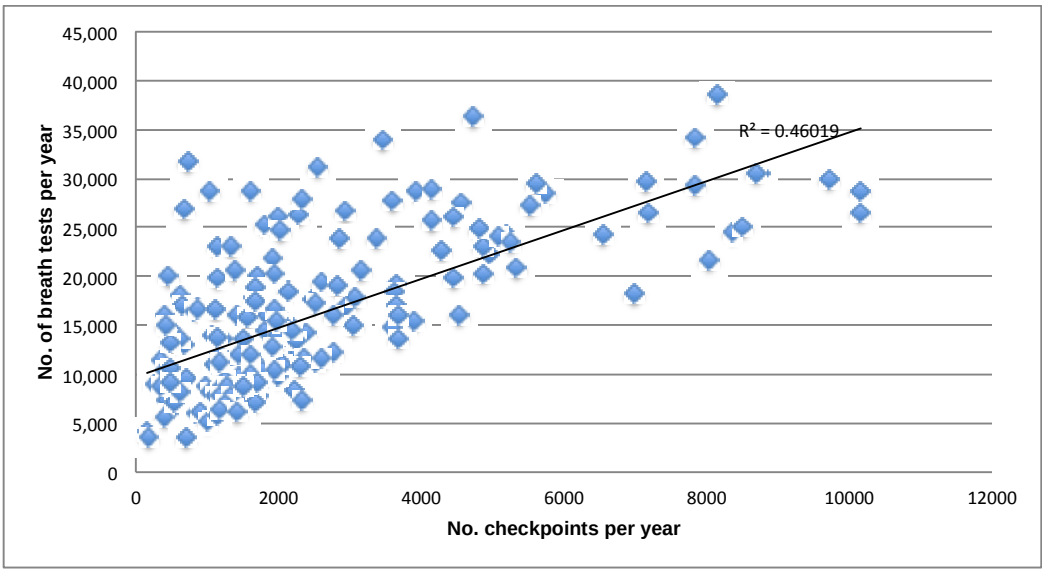
The obtained correlation coefficient in our case was $r_s = 0.65$ (p[11] (one-tailed) < 0.001) indicating a moderate positive linear relationship between the checkpoints and breath tests. That is, if checkpoints increase, breath tests also tend to increase[12] (see **Chart 11**). The relationship remained significant when the effects of the checkpoint length and personnel of Garda rank were controlled[13]. As the correlation was statistically significant, it is unlikely that the observed relationship between the checkpoints and breath tests occurred by chance alone.

[11] To determine whether the correlation between variables is significant, we need to compare the p-value to our significance level (denoted as α or alpha), which is usually 0.05 or lower. An α of 0.05 indicates that the risk of concluding that a correlation exists—when, actually, no correlation exists—is 5%. The p-value tells us whether the correlation coefficient is significantly different from 0. If the p-value is less than or equal to the significance level, then we can conclude that the correlation is different from 0.

[12] Or the other way around, as breath tests increase, checkpoints also increase. This is because we cannot assume causality between checkpoints and breath tests.

[13] r_s (partial) = 0.79, p (one-tailed) < 0.001.

Chart 11: Scatter plot of breath tests and checkpoints per year for all divisions, 2010 - 2016



The graph shows the number of breath tests per year for each division plotted against the number of checkpoints per year.

However, the relationship between the checkpoints and breath tests, overall, does not appear to hold true for about half of the divisions (Kildare, Wicklow, Cavan/Monaghan, Donegal, Louth, Sligo/Leitrim, Tipperary, Cork City, Cork North, Kerry, Galway, Mayo and Roscommon/Longford). In these divisions, the overall number of checkpoints conducted between 2010 and 2016 increased, while the number of breath tests recorded on PULSE fell. This indicates that there are other factors at play in these divisions which affect the overall trend.

As already mentioned, factors such as the time of the day when the checkpoint is conducted, location, the number of vehicles passing through could all be important in explaining why there were fewer breath tests recorded in these divisions when the number of checkpoints increased. Recording errors and potential over-recording of checkpoints on PULSE could also be contributing factors in explaining a different pattern observed in these divisions. A more in-depth analysis of each division would be required to explain these differences, which is outside of this examination's scope.