

## The impact of audio visual links (AVL) in courtrooms on prison transport costs

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**Aims:** To measure the impact of new or upgraded audio visual links (AVL) in local courts on prison transport costs.

**Method:** Monthly in-person (IP) and AVL appearance data for local courts were obtained from Corrective Services NSW. Local courts were classified into one of three groups according to their change in AVL access: (1) received a new AVL facility; (2) received separate AVL facilities having previously shared with another court, and; (3) had extra AVL courtrooms added to their separate AVL access. Intervention time series analyses were conducted for each court to test whether the change in AVL status resulted in a change in the level and/or trend of IP appearances. Where significant changes in IP appearances were found, transport costs avoided or incurred were estimated.

**Results:** Among the nine local courts that had a new AVL facility installed, eight had a significant reduction in the number of IP appearances. In one local court the number of IP appearances increased, however the number of AVL appearances increased in this court as well. In total, the introduction of a new AVL facility resulted in 2,271 fewer IP appearances and \$459,501 in prison transport costs avoided during the post-AVL follow-up period. Among the 12 local courts that received a separate AVL facility after previously sharing, six had significantly lower IP appearances. No change in IP appearances occurred at five of these local courts. In one local court, IP appearances increased, however there was also an increase in the number of AVL appearances in this case. In total the reduction in the number of IP appearances at these 12 local courts with separate AVL access was 1,140 and \$230,790 in prison transport costs avoided during the post-AVL follow-up period. No significant reductions were found in IP appearances for the five Local Courts where extra or upgraded AVL courtrooms were added.

**Conclusions:** There were significant reductions in IP appearances and associated transport costs for local courts where new AVL facilities were installed.

**Keywords:** audio visual link; local courts; prison; program evaluation; time series analysis

### INTRODUCTION

The Department of Justice has been progressively introducing audio visual links (AVL) into court rooms in New South Wales (NSW) since 2002. AVL facilities in local courts enable defendants in custody (either because they have been bail refused or imprisoned for a previous offence) to appear before the court via a video link. It therefore has the potential to significantly reduce the number of prison transports that Corrective Services officers must undertake and avoid any associated costs.

Significant investments in courtroom AVL were made by Justice during the period 2005 to 2013. In some cases this involved

installing new facilities in courts that previously did not have access to AVL. In other cases this involved an increase in the number of court rooms at a particular location with AVL or the upgrading of AVL facilities already available at that location.

Between April 2015 and March 2017 AVL was introduced into 13 local courts that did not previously have access to these facilities (see Table 1). New AVL facilities were installed in local courts at Newtown, Queanbeyan, Fairfield, Katoomba and Toronto in mid-2015, Bega Local Court in October 2015 and local courts at Inverell, Lithgow, Gunnedah and Young in mid-2016. Local courts at Kempsey and Ballina had AVL installed in late 2016 and Moss Vale had AVL installed in March 2017.<sup>1,2</sup>

**Table 1. Local courts with a new AVL facility installed (previously no AVL access)**

Local Court	New AVL installation date
Newtown	April 2015
Queanbeyan	June 2015
Fairfield	July 2015
Katoomba	August 2015
Toronto	August 2015
Bega	October 2015
Inverell	May 2016
Lithgow	June 2016
Gunnedah	July 2016
Young	July 2016
Kempsey	December 2016
Ballina	December 2016
Moss Vale	March 2017

**Table 2. Local courts that previously shared access to AVL and then had their own separate AVL facility**

Local Court	Separate AVL courtroom date
Goulburn	May 2015
Gosford	July 2015
Lismore	July 2015
Tamworth	September 2015
Armidale	September 2015
Port Macquarie	October 2015
Penrith	November 2015
Griffith	May 2016
Broken Hill	June 2016
Bourke	July 2016
Grafton	July 2016
Campbelltown	October 2016

Table 2 shows the local courts that previously shared access to AVL with the district court in their area but then received their own separate AVL. These included local courts at Goulburn, Gosford and Lismore in mid-2015; Tamworth, Armidale, Port Macquarie and Penrith in late-2015; and Griffith, Broken Hill, Bourke and Grafton in mid-2016. In Campbelltown Local Court, four courtrooms had their AVL upgraded in October 2016 but had previously been sharing AVL facilities with Campbelltown District Court until July 2016.

Table 3 shows the local courts that had their AVL capacity enhanced through the installation of new AVL facilities in additional magistrates' courts or technically upgrading those that were already available. These included local courts at Central and Downing Centre in late-2015/early-2016, Bankstown in late-2016, Burwood in mid-2017 and Penrith in late-2017.

One method to assess if the introduction or upgrading of AVL has reduced prison transports is the number of defendants in

**Table 3. Local courts that previously had their own AVL courtroom(s) and then got extra or upgraded AVL courtrooms**

Local Court	New or upgraded AVL courtroom(s) date
Central	November 2015
Downing Centre	February 2016
Bankstown	November 2016
Burwood	June 2017
Penrith	November 2017

custody who appear in-person (IP) in court each month before and after the AVL change. Where a significant reduction in IP has occurred, costs avoided in transport related to this can be estimated. The current study will measure what effect the introduction of new or upgraded AVL access has had on the number of IP appearances in the local courts listed above. Specifically it aims to answer the following research questions;

*Question 1.* Among local courts with a new AVL facility installed:

*Question 1a.* Was there a reduction in the number of in-person (IP) appearances?

*Question 1b.* What were the prison transportation costs avoided with the change in IP appearances?

*Question 2.* Among local courts that received separate AVL facilities after sharing with another District Court:

*Question 2a.* Was there a reduction in the number of in-person (IP) appearances?

*Question 2b.* What were the prison transportation costs avoided with the change in IP appearances?

*Question 3.* Among local courts that had extra or upgraded AVL courtrooms added to their separate AVL access:

*Question 3a.* Was there a reduction in the number of in-person (IP) appearances?

*Question 3b.* What were the prison transportation costs avoided with the change in IP appearances?

## METHOD

### Data

Corrective Services NSW provided monthly data on in-person (IP) appearances and AVL court appearances over the period July 2014 to June 2018. The IP appearance count represents the number of times per month that adult defendants were transported from correctional centres to appear at individual local courts. The AVL count represents the number of times per month that courtroom AVL was used for adult defendants held in custody. Where a given defendant made several IP appearances at a local court during the same month these were counted multiple times. The same applies for the number of times per month that AVL was used for a given defendant. It is also possible that a given defendant made several in-person and AVL appearances at a court during the same month: each of these appearances were counted separately.

## Statistical analyses

### Changes in IP appearances and associated net costs avoided

To answer the first two parts of Questions 1, 2 and 3, the following approach was used with monthly IP appearance data. This approach will be described in terms of Question 1 where AVL access was introduced to a local court for the first time.

1. Relevant local courts were combined, based on the date when the AVL was introduced and similarities in the trend pattern of each series over time.
2. Methods such as augmented Dickey-Fuller tests were used to test whether each IP appearance series was difference or trend stationary. These tests showed that, across all local courts, monthly IP appearance data was trend stationary and did not need to be differenced (Enders, 2015).
3. Interrupted time series models were estimated which included: (i) a term measuring underlying trend in IP appearances prior to AVL; (ii) a term measuring any change in the level of IP appearances after AVL was introduced and; (iii) a term measuring change in the trend of IP appearances after AVL was introduced (Chatfield, 2004; Hyndman & Athanasopoulos, 2014).
4. The time series analyses also included terms to take account of autocorrelation between monthly IP appearances at particular lags. These include autoregressive (AR) and moving average (MA) terms. The Ljung-Box test was used to ensure whether the residuals from the final model were randomly distributed (Chatfield, 2004).
5. If a significant reduction (or increase) in the level and/or trend of IP appearances was found, the pre-intervention data were used to forecast what the IP appearances would have been had the AVL access not occurred. The change in IP appearances was calculated by comparing the values estimated from the full model with those forecast from time series models using pre-AVL data only.
6. Where a reduction in the number of IP appearances was found across the post-AVL months we multiplied the IP reduction by the cost of transporting a defendant to and from the correctional centre. Court level estimates of the number of trips required for an in-person court appearance or the cost of each trip were not available. We therefore applied an average cost of \$95 per trip and an average of 2.13 trips per court appearance. Average trips is slightly over two because many defendants first travel to a different gaol and then are placed in holding cells for two days before they travel to court. Prison transport costs avoided or incurred were therefore estimated by multiplying the reduction in the number of IP appearances by \$95 and 2.13.

There were a number of challenges when conducting these statistical analyses.

Firstly, there were only 48 months of data, which is quite small for time series analyses. This is particularly the case when

conducting intervention analyses such as the introduction of AVL technology where the series needs to be divided into pre- and post-intervention segments. From Table 1 it can be seen that new AVL facilities were introduced into local courts at Newtown, Queanbeyan, Fairfield, Katoomba and Toronto between April and August 2015. This only allows between nine and 13 pre-intervention months from which to forecast the post-AVL IP appearances (which would be compared with the estimated post-intervention appearances from the full model). We decided to combine these five local courts and define the post-AVL period starting at August 2015. Also, for a small number of courts, where the number of pre-intervention months was either short (fewer than 14 months) or there was no significant pre-intervention trend, the forecasts were based on the mean level of this series rather than including a term for underlying trend.<sup>3</sup> This was done to provide more stable forecasts to compare with the actual post-intervention IP counts.

The second issue relates to the number of IP appearances per month for particular local courts. While for some local courts the mean number per month is reasonably large (e.g. greater than 30), for many others the mean number per month may be quite low (e.g. fewer than 15). Where the mean number per month is larger, it is possible to use the traditional autoregressive integrated moving average (ARIMA) approach to time series analyses. When the mean number is smaller it cannot be assumed that the series is normally distributed and the data should be analysed as count data. It is possible to analyse these smaller count IP appearance data using the generalised linear autoregressive moving average (GLARMA) approach. These are time series models for count data where a Poisson distribution was specified (Dunsmuir & Scott, 2015). In what follows we will indicate which form of analysis was used.

The third challenge was that, even when using a GLARMA approach, there were some local courts that had a lot of zero values for their monthly IP appearance counts. These local courts include: Young with 25 (52.1% of total); Gunnedah with 19 (39.6% of total); Moss Vale with 16 (33.3% of total), and; Bega with 15 (31.3% of total). Given the relatively short length of the pre-intervention series potentially leading to unstable forecasts, these local courts were excluded from the analyses.

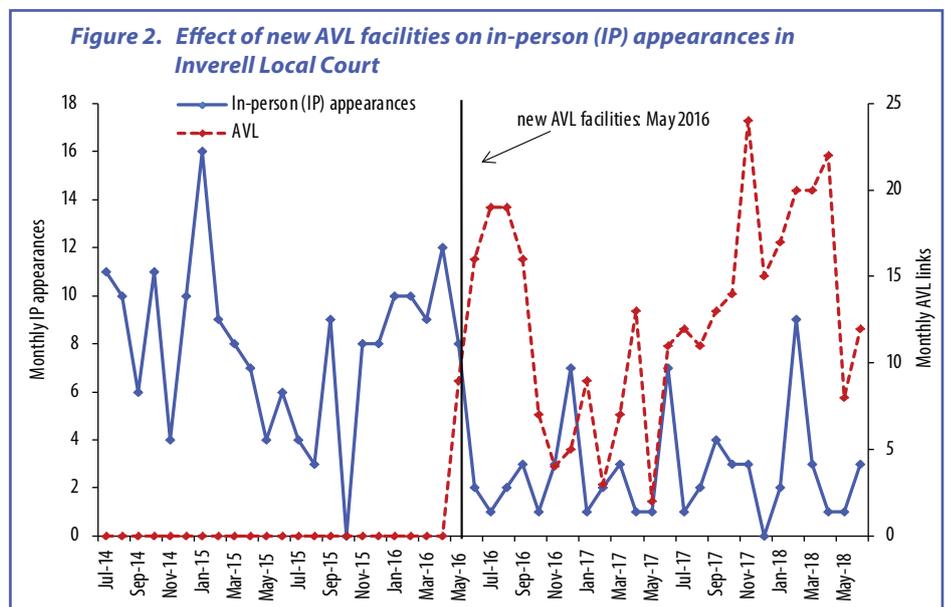
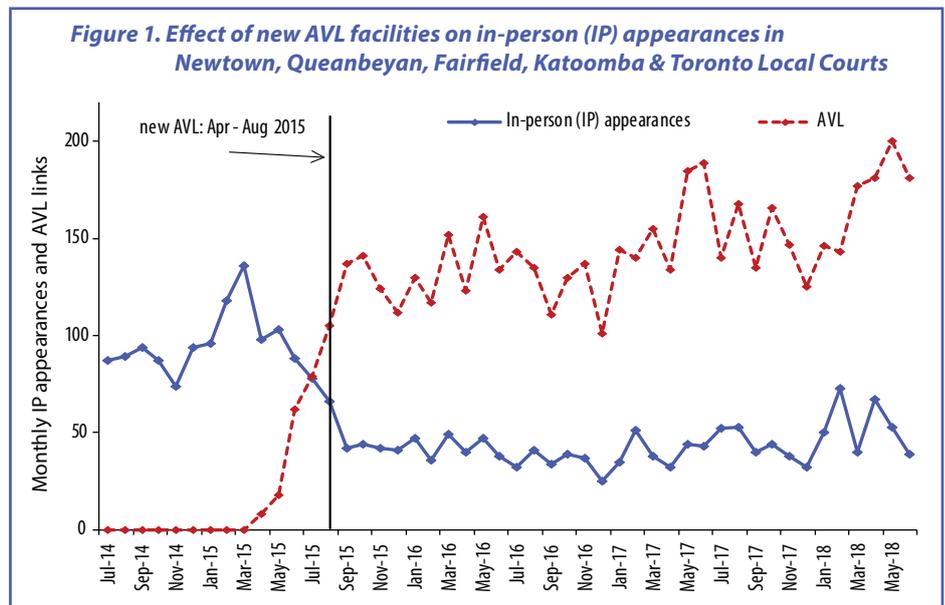
The fourth issue was that the remand population was growing over the period of this study and this alone may have generated an increase in IP appearances in the post-AVL period (NSW Bureau of Crime Statistics and Research, 2018). We can get around this problem for courts where the AVL facilities were simply upgraded by examining differences pre- and post-AVL in the percentage of total appearances which were IP. Sub-analyses using this outcome were conducted using ARIMA time series.<sup>4</sup> These ARIMA time series included a term for before and after the AVL upgrade and also for the underlying trend. Where the underlying trend was not statistically significant it was not included in the final ARIMA model. Autocorrelation was also controlled for when present. These sub-analyses were not applied to local courts that previously had no AVL facilities as all of their months before the new AVL facility started had a value of 100 per cent.

## RESULTS

### Local courts that had a new AVL facility installed

Figure 1 shows monthly counts of IP appearances in the combined local courts of Newtown, Queanbeyan, Fairfield, Katoomba and Toronto. August 2015 was defined as the starting date for AVL in these courts. The average number of IP appearances prior to AVL being introduced was 96 per month. After the full AVL roll out in these five local courts the average number of IP appearances was 44 per month. The first row of Table 4 shows the findings from the ARIMA time series model of the effect of the new AVL facility on the IP appearance levels at these five Local Courts. There was a statistically significant reduction in the mean level of the series ( $b = -60.462$ ,  $p < .001$  \*\*).<sup>5</sup> There were 1,814 fewer IP appearances after the AVL commenced compared with what was forecast based on the pre-AVL months, which equates to a 54.7% reduction. We estimate that this avoided \$367,118 in prison transport costs over the period August 2015 through June 2018.

Figure 2 shows monthly counts of IP appearances in Inverell Local Court where the new AVL facility commenced in May 2016. Prior to the availability of AVL, the average number of IP appearances at Inverell Local Court was eight per month. After AVL it reduced to around three per month. The ARIMA time series model shown in Table 4 revealed a statistically significant reduction in the mean level of IP appearances at Inverell Local Court ( $b = -4.326$ ,  $p = .011$  \*). There were 133 fewer IP appearances after the AVL



commenced compared with what was forecast from the pre-AVL months, which equates to a 64.2% reduction.<sup>6</sup> We estimate that this avoided \$26,876 in prison transport costs over the period May 2016 through June 2018.

**Table 4. Effect of new AVL facility in local courts on the number of in-person appearances (IPs) and transport costs avoided or incurred**

Local Court(s)	New AVL intervention date	Underlying trend	Level change	Trend change	Change in no. of IP appearances	Estimate of changes in IP transport costs
Newtown, Queanbeyan Fairfield, Katoomba & Toronto (ARIMA)	August 2015	0.229 $p = .101$	-60.462 $p < .001$ **	-	1,814 fewer IPs 54.7% reduction	\$367,118 costs avoided
Inverell (ARIMA)	May 2016	-0.033 $p = .569$	-4.326 $p = .011$ *	-	133 fewer IPs 64.2% reduction	\$26,876 costs avoided
Lithgow (GLARMA)	June 2016	-0.089 $p < .001$ **	-	0.134 $p < .001$ **	66 more IPs 609.1% increase	\$13,393 costs incurred
Kempsey (GLARMA)	December 2016	0.044 $p < .001$ **	-1.173 $p < .001$ **	-	246 fewer IPs 61.9% decrease	\$49,779 costs avoided
Ballina (GLARMA)	December 2016	0.022 $p = .054$	-	-0.058 $p = .042$ *	78 fewer IPs 54.3% decrease	\$15,728 costs avoided

Figure 3 shows monthly counts of IP appearances in Lithgow Local Court where the new AVL facility commenced in June 2016. Prior to the AVL facility commencing, a marked reduction in IP appearances had already occurred from 7.7 on average per month before July 2015 to 2.4 per month afterwards. Once the AVL facility commenced in June 2016 the average IP appearances per month was 3.1. GLARMA time series was used given the low IP attendance counts per month. As shown in Table 4 it was found that a significant decreasing trend before the AVL commenced was followed by a significant increasing change in trend afterwards ( $b = .134, p < .001 **$ ). This resulted in 66 more IP appearances after AVL began with an estimated increase in transport costs of \$13,393 over the period June 2016 through June 2018. However as seen from Figure 3 there was a substantial increase in the number of AVL court appearances in Lithgow Local Court (averaging about 14 per month). It is likely this fact, rather than the introduction of AVL, is responsible for the growth in IP appearances following the introduction of AVL.

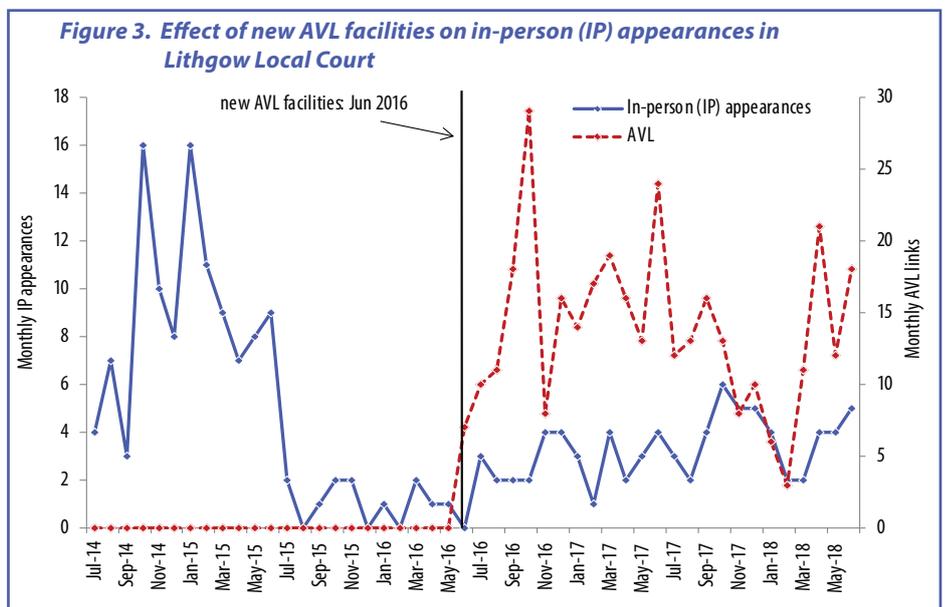


Figure 4 shows monthly counts of IP appearances in Kempsey Local Court where the new AVL facility commenced during December 2016. This showed a large increase in monthly IP appearances in the second half of 2016 before the AVL facility commenced. Once AVL was introduced there appeared to be a marked reduction in the mean level of IP appearances. Table 4 shows the findings from the GLARMA time series model. The significant increase in IP appearances prior to the AVL facility was followed by a significant reduction in the mean level of IPs ( $b = -1.173, p < .001 **$ ). There were 246 fewer IP appearances after the AVL commenced compared with what was forecast from the pre-AVL months, which equates to a 61.9% reduction. We estimate that \$49,779 in transport costs were avoided over the period December 2016 through June 2018.

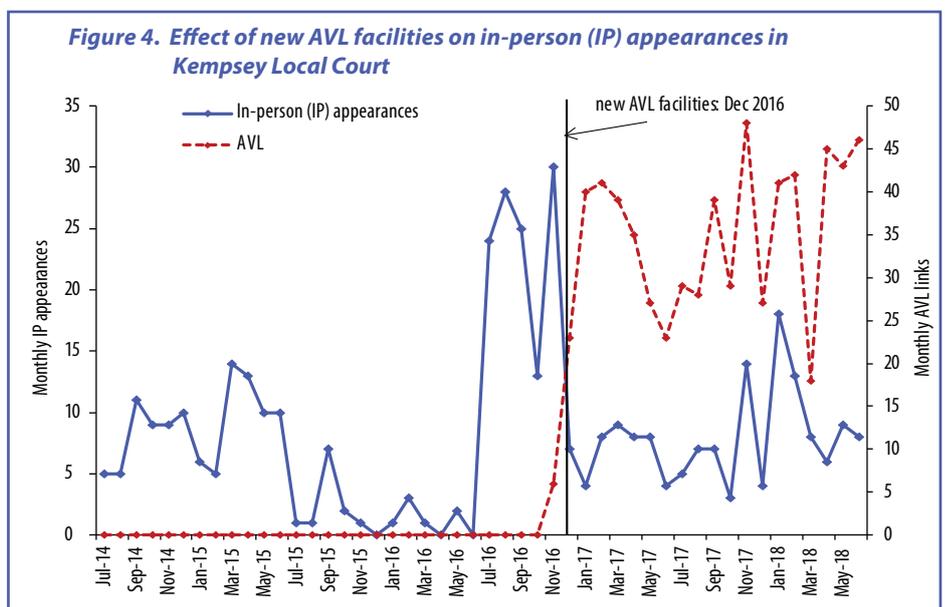
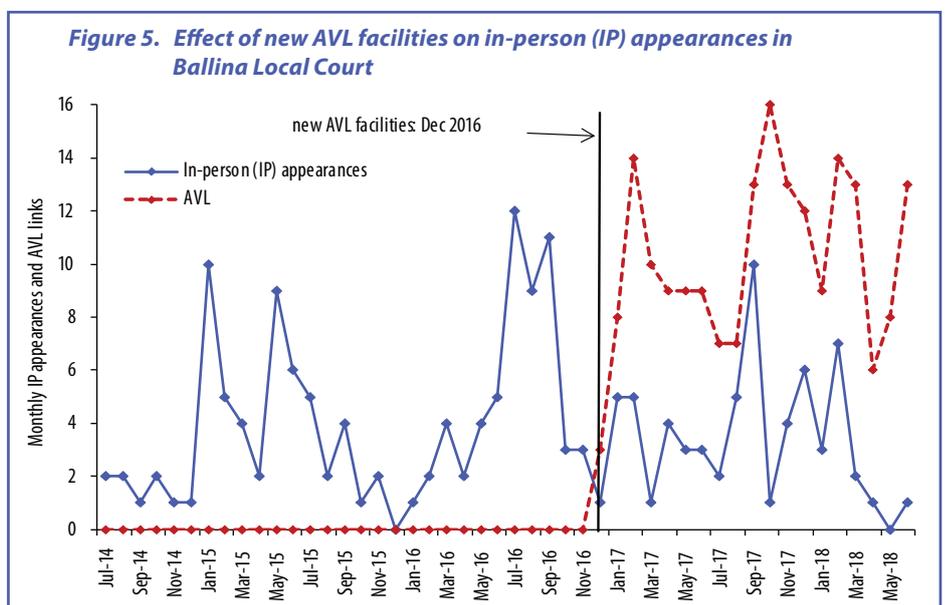


Figure 5 shows counts of IP appearances in Ballina Local Court where the new AVL facility commenced during December 2016. Prior to AVL, the average number



of IP appearances was four per month: afterwards it was 3.4 per month. The findings from the GLARMA time series model are shown in Table 4. While the increasing underlying trend in IP appearances was not statistically significant ( $b = 0.022, p = .054$ ) there was a significant reduction in this trend after the AVL commenced ( $b = -0.058, p = .042^*$ ). This resulted in 78 fewer IP appearances compared with what was forecast from the pre-AVL months, which equates to a 54.3% reduction. The amount of transport costs avoided was estimated at \$15,728 for Ballina Local Court over the period December 2016 through June 2018.

In summary the introduction of a new AVL facility resulted in significant reductions in IP appearances at Local Courts including Newtown, Queanbeyan, Fairfield, Katoomba, Toronto, Inverell, Ballina and Kempsey. There were 2,271 fewer IP appearances and the transport costs avoided totalled \$459,501. There was a significant increase in IP appearances at Lithgow Local Court after AVL was installed but for reasons already explained, this is likely a consequence of the general growth in cases coming before the courts, rather than a perverse effect of AVL.

### Local courts with an upgraded AVL facility

#### Separate AVL facilities for local courts that previously had shared access to AVL

We turn now to the question of whether upgrading pre-existing AVL facilities had a significant effect on IP appearances. There were 12 local courts that previously had shared access to AVL with the district court in their locality. All of these local courts

received their own separate AVL access during the four year study period, although this occurred at different times.<sup>7</sup> In summary, six of these local courts had a significant reduction in IP appearances associated with the upgrade, five had no significant change and one had a significant increase. These changes in IP appearances and associated transport costs avoided or incurred are summarised in Table 5.

The six local courts that had significantly reduced IP appearances after obtaining separate AVL access included Goulburn, Lismore, Tamworth, Griffith, Bourke and Grafton. At Goulburn Local Court there were 90 fewer IP appearances after receiving separate AVL access (28.7% reduction) and an estimated \$18,185 in prison transport costs avoided over the period May 2015 through June 2018. At Lismore Local Court there were 127 fewer IP appearances (16.1% reduction) resulting in estimated costs avoided of \$25,756 over the period July 2015 through June 2018. While statistically significant, the effect was smaller at Tamworth Local Court, with 39 fewer IP appearances (3.9% reduction) and \$7,955 in costs avoided over the period September 2015 through June 2018. The effect was larger at Griffith Local Court where there were 485 fewer IP appearances (66.7% reduction) compared with what was forecast and \$98,163 in costs avoided over the period May 2016 through June 2018. At Bourke Local Court there were 145 fewer IP appearances (68.4% reduction) with estimated transport costs avoided of \$29,420 over the period July 2016 through June 2018. At Grafton Local Court there were 254 fewer IP appearances (54.7% reduction) with estimated transport costs

**Table 5. Effect of separate AVL facility in local courts that previously had shared access on the number of in-person appearances (IPs) and transport costs avoided or incurred**

Local Court	Separate AVL access	Underlying trend	Level change	Trend change	Change in no. of IP appearances	Estimate of changes in IP transport costs
Goulburn (GLARMA)	May 2015	0.215 $p < .001^{**}$	-0.961 $p < .001^{**}$	-0.233 $p < .001^{**}$	90 fewer IPs 28.7% reduction	\$18,185 costs avoided
Gosford (ARIMA)	July 2015	0.434 $p = .087$	-	-0.238 $p = .409$	No change	-
Lismore (ARIMA)	July 2015	0.618 $p = .106$	-	-1.029 $p = .019^*$	127 fewer IPs 16.1% reduction	\$25,756 costs avoided
Tamworth (ARIMA)	September 2015	0.964 $p < .001^{**}$	-	-0.650 $p = .009^{**}$	39 fewer IPs 3.9% reduction	\$7,955 costs avoided
Armidale (GLARMA)	September 2015	0.059 $p = .069$	-	-0.060 $p = .114$	No change	-
Port Macquarie (ARIMA)	October 2015	0.021 $p = .719$	5.959 $p < .001^{**}$	-	188 more IPs 124.7% increase	\$38,071 costs incurred
Penrith (ARIMA)	November 2015	0.780 $p = .012^*$	-	-0.726 $p = .068$	No change	-
Griffith (ARIMA)	May 2016	0.597 $p < .001^{**}$	-	-1.088 $p < .001^{**}$	485 fewer IPs 66.7% reduction	\$98,163 costs avoided
Broken Hill (GLARMA)	June 2016	-0.010 $p = .117$	-	0.003 $p = .800$	No change	-
Bourke (GLARMA)	July 2016	0.046 $p = .002^{**}$	-	-0.120 $p < .001^{**}$	145 fewer IPs 68.4% reduction	\$29,420 costs avoided
Grafton (GLARMA)	July 2016	0.025 $p < .001^{**}$	-	-0.063 $p < .001^{**}$	254 fewer IPs 54.7% reduction	\$51,311 costs avoided
Campbelltown (ARIMA)	October 2016	0.567 $p = .008^{**}$	-	-0.616 $p = .133$	No change	-

avoided of \$51,311 over the period July 2016 through June 2018.

There were no significant changes in IP appearances associated with the separate AVL facilities at Gosford, Armidale, Penrith, Broken Hill and Campbelltown Local Courts. Port Macquarie Local Court was the only court that showed an increase in IP appearances after obtaining separate AVL access in October 2015. As seen in Table 5, while the underlying trend was flat ( $b = 0.021, p = .719$ ) once separate AVL access occurred there was a significant increase in the mean level of IP appearances ( $b = 5.959, p < .001^{**}$ ). This resulted in 188 more IP appearances compared to what was forecast with estimated transport costs incurred of \$38,071 over the period October 2015 through June 2018. Once again, it is doubtful this effect is attributable to the introduction of IP given that the number of AVL appearances increased over the same period.

In summary, the introduction of separate AVL facilities resulted in significant reductions in IP appearances at six local courts including Goulburn, Lismore, Tamworth, Griffith, Bourke and Grafton. There were 1,140 fewer IP appearances and the transport costs avoided totalled \$230,790.

Earlier we foreshadowed our intention to try and deal with the general rise in court appearances by examining changes in the *percentage* that were IP rather than the number. Table 6 shows changes in the percentage of total appearances of defendants in custody which were in-person (IP) before and after each local court was given separate access to AVL. These were examined using ARIMA time series analyses. In four local courts, the mean percentage of IP appearances significantly declined after separate AVL access was introduced and this was not confounded by any declining underlying trend over time. These were the local courts at Goulburn (from 15% to 11%), Griffith (from 21% to 16%), Grafton (from 35% to 23%) and Campbelltown (from 14% to 13%). While there was a significant decline in the mean percentage of IP appearances at Lismore and Broken Hill Local Courts, each of these was explained by a general declining trend over time rather than a specific pre-versus post-effect of separate AVL access.

The only Local Court to show an increase in the mean percentage IP appearances was Port Macquarie (from 7% to 16%) however this was explained by a general increasing trend

**Table 6. Change in mean percentage IP appearances among local courts that changed from shared to separate AVL access (ARIMA analyses)**

Local Court	Shared AVL access	Separate AVL access	Unadjusted for underlying trend	Adjusted for underlying trend
	mean percentage IP	mean percentage IP	p value	p value
Goulburn	15.1%	10.7%	= .033 *	n/a <sup>#</sup>
Gosford	19.5%	20.0%	= .696	n/a <sup>#</sup>
Lismore	28.3%	21.6%	= .007 **	= .523
Tamworth	38.5%	38.8%	= .925	n/a <sup>#</sup>
Armidale	13.7%	14.8%	= .639	n/a <sup>#</sup>
Port Macquarie	6.5%	16.3%	< .001 **	= .461
Penrith	14.5%	14.5%	= .182	n/a <sup>#</sup>
Griffith	21.4%	16.3%	= .025 *	n/a <sup>#</sup>
Broken Hill	48.5%	36.5%	= .001*	= .934
Bourke	17.7%	13.9%	= .224	n/a <sup>#</sup>
Grafton	35.2%	23.0%	< .001*	n/a <sup>#</sup>
Campbelltown	13.8%	12.8%	= .034 *	n/a <sup>#</sup>

# underlying trend was not statistically significant

**Table 7. Effect of new or upgraded AVL courtrooms to Local Courts that had separate AVL access on the number of in-person appearances (IPs) and transport costs avoided or incurred**

Local Court	Upgraded AVL			Trend change	Change in no. of IP appearances	Estimate of changes in IP transport costs
	intervention date	Underlying trend	Level change			
Central (ARIMA)	November 2015	-1.038 $p = .047 *$	-	0.865 $p = .196$	No change	-
Downing Centre (ARIMA)	February 2016	0.078 $p = .618$	-	-0.032 $p = .883$	No change	-
Bankstown (ARIMA)	November 2016	-0.011 $p = .903$	-	0.262 $p = .202$	No change	-
Burwood (ARIMA)	June 2017	0.380 $p = .080$	-	-0.559 $p = .482$	No change	-
Penrith (ARIMA)	November 2017	.225 $p = .021 *$	-	0.260 $p = .761$	No change	-

over the study period rather than the separate AVL access. No changes in mean percentage IP appearances were found at Gosford, Tamworth, Armidale, Penrith or Bourke Local Courts.

#### Extra or upgraded AVL courtrooms for local courts that had separate AVL access

Five local courts that had their own separate access to AVL facilities received AVL in additional courtrooms or had existing facilities upgraded during the study period. These were the local courts at Central, Downing Centre, Bankstown, Burwood and Penrith.<sup>8</sup> The results from the time-series analysis of monthly IP appearance counts and associated transport costs avoided or incurred are summarised in Table 7. None of these five local courts showed any significant change in IP appearances after their AVL capacity was enhanced.

**Table 8. Change in mean percentage IP appearances among Local Courts with separate AVL access that received extra or upgraded AVL courtrooms (ARIMA analyses)**

Local Court	Before extra or upgraded AVL courtrooms	After extra or upgraded AVL courtrooms	Unadjusted for underlying trend	Adjusted for underlying trend
	mean percentage IP	mean percentage IP	p value	p value
Central	13.4%	10.7%	< .001 **	= .516
Downing Centre	33.5%	25.0%	< .001 **	= .736
Bankstown	26.0%	23.9%	= .190	n/a <sup>#</sup>
Burwood	14.5%	14.9%	= .687	n/a <sup>#</sup>
Penrith	14.2%	13.3%	= .390	n/a <sup>#</sup>

<sup>#</sup> underlying trend was not statistically significant

Table 8 shows the changes in the mean percentage of total IP appearances of defendants in custody before and after each Local Court boosted their AVL capacity. These were examined using ARIMA time series analyses. While there was a significant decline in the IP percentages at Central Local Court and at Downing Centre Local Court these were explained by a general declining trend over time rather than the AVL upgrade. No significant changes in the mean percentage IP appearances occurred at Bankstown, Burwood or Penrith Local Courts.

## DISCUSSION

The main aim of this research was to measure the effect of courtroom AVL on the number of defendants in custody who appear in-person in the Local Court and to estimate any associated prison transport costs which were avoided or incurred. For this analysis, interrupted time-series analyses were undertaken to test for any significant change in the monthly number of in-person court appearances across NSW local courts before and after AVL was newly installed or greatly enhanced.

The results show that for eight of the nine local courts that received new AVL facilities the monthly number of IP appearances significantly decreased once AVL was installed. The one exception was Lithgow Local Court where there was a significant increase in IP appearances for reasons we suspect are unrelated to the introduction of AVL, as the number of new AVL appearances also increased. Overall, we estimate that installation of the new AVL facilities in these nine courts resulted in 2,271 fewer IP appearances and \$459,501 in prison transport costs avoided during the post-AVL follow-up period.

We turn now to the 12 local courts that initially had access to AVL through shared arrangements with the district court in their location but received a new separate AVL facility during the study period. We found six of these local courts had significantly lower monthly IP appearance counts after the AVL upgrade. No reduction in IP appearances was found at five local courts but a significant increase was observed at Port Macquarie Local Court with 188 extra IP appearances estimated for the post intervention period. As Port Macquarie also had a large increase in AVL appearances when separate access commenced we do not see the increase in IP appearances as having been due to

the upgraded AVL access. Overall, we estimate that across these 12 Local Courts the number of IP appearances decreased by 1,140 after their courtroom AVL facilities were upgraded, with \$230,790 in prison transport costs avoided during the post-AVL follow-up period.

Finally, among the five local courts that had their previous separate AVL access upgraded by including new AVL courtrooms or technical upgrades there was no evidence for any significant changes in the number of in-person court appearances. This is not surprising because in many cases the upgrade would have resulted in other benefits, such as reduced waiting times or improved picture quality.

It should be emphasised in conclusion that, over the time period examined for this study, there was a significant increase in the NSW prison population, particularly the number of prisoners on remand (NSW Bureau of Crime Statistics and Research, 2018). This would impact the total number of offenders appearing before the courts who are in custody. Our reliance on counts of in-person court appearances therefore potentially underestimates the size of the AVL effect. To address this issue, further sub-analyses using ARIMA time series were undertaken comparing the mean percentage of total prisoner appearances which were in-person before and after the AVL upgrade or enhancement. Local courts at Goulburn, Griffith and Grafton had a decline in the percentage of total appearances which were IP consistent with their finding of a reduced number of IP appearances per se. At Lismore Local Court it was found that there was a general decline in the percentage of IP appearances over the study period which did not change after the separate AVL access commenced. This would suggest that AVL was already having benefits at Lismore.

The overall conclusion from this study is that among local courts that had a new AVL installation there was a substantial reduction in the number of IP appearances and transport costs. Among local courts that changed from shared to separate AVL access there was some evidence of a reduction in IP appearances in just over half of them. Even though the size of the remand population was increasing there was a clear benefit of new and upgraded AVL in reducing transport costs.

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## NOTES

1. There were 2 district courts where AVL was also installed for the first time at Queanbeyan (September 2015) and Bega (October 2015). These are not included in the analyses as the primary research question is about what happened in local courts after AVL was introduced.
2. AVL was installed at Kempsey Local Court during November 2016 but was only used 6 times suggesting it was installed late during that month. From December 2016 through December 2018 the average number of times AVL was used per month was a lot higher at around 35. December 2016 was used as the effective AVL installation month for the time series analyses.
3. These forecasts included: (i) Newtown, Queanbeyan, Fairfield, Katoomba and Toronto combined; (ii) Goulburn; (iii) Lismore, and; (iv) Inverell.
4. The percentage was calculated for each of the 48 months and was found to be relatively normally distributed. The mean of these percentages was not very close to zero with the lowest being 12 for two local courts.
5. This forecast was based on the mean level of the 13 pre-AVL months. This ARIMA time series model contained a constant term and a moving average (MA) term of lag 1. It was more stable to base the forecast on the mean level rather than including an increasing trend term over only 13 pre-AVL months.
6. This forecast was based on the mean level of the 22 pre-AVL months. This ARIMA time series model contained a constant term.
7. Graphs of changes in IP appearances and AVL appearances over time are available from author upon request.
8. See note 7.

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## APPENDIX A: Final time series models of in-person (IP) appearances for each Local Court

### Local courts that had a new AVL facility installed

**Table A1. Effect of new AVL facility on the number of in-person (IP) appearances in Newtown, Queanbeyan, Fairfield, Katoomba and Toronto Local Courts: ARIMA time series**

Variable	Estimate	Standard		t value	p value
		Error			
Constant	96.166	2.166		44.39	< .001 **
Underlying trend	0.229	0.140		1.64	= .101
Level change	-60.462	4.539		-13.32	< .001 **
Trend change	-	-		-	-
Moving Average (lag 4)	0.490	0.154		3.18	= .001 **

AIC = 372.82; Ljung-Box test:  $\chi^2_{11} = 5.26, p = .918$

**Table A2. Effect of new AVL facility on the number of in-person (IP) appearances in Inverell Local Court: ARIMA time series**

Variable	Estimate	Standard		t value	p value
		Error			
Constant	8.329	0.951		8.76	< .001 **
Underlying trend	-0.033	0.062		-0.53	= .596
Level change	-4.326	1.710		-2.53	= .011 *
Trend change	-	-		-	-

AIC = 243.97; Ljung-Box test:  $\chi^2_{12} = 13.57, p = .329$

**Table A3. Effect of new AVL facility on the number of in-person (IP) appearances in Lithgow Local Court: GLARMA time series**

Variable	Estimate	Standard		z ratio	p value
		Error			
Constant	2.512	0.196		12.84	< .001 **
Underlying trend	-0.089	0.015		-5.82	< .001 **
Level change	-	-		-	-
Trend change	0.134	0.028		4.82	< .001 **
Autoregressive (lag 1)	0.126	0.046		2.77	= .006 **

AIC = 215.87; Ljung-Box test:  $\chi^2_{11} = 10.85, p = .456$

**Table A4. Effect of new AVL facility on the number of in-person (IP) appearances in Kempsey Local Court: GLARMA time series**

Variable	Estimate	Standard Error	z ratio	p value
Constant	1.383	0.230	6.02	< .001 **
Underlying trend	0.044	0.011	4.03	< .001 **
Level change	-1.173	0.286	-4.10	< .001 **
Trend change	-	-	-	-
Autoregressive (lag 1)	0.159	0.018	8.85	< .001 **
Autoregressive (lag 2)	0.088	0.019	4.65	< .001 **

AIC = 359.88; Ljung-Box test:  $\chi^2_{10} = 14.51, p = .151$

**Table A5. Effect of new AVL facility on the number of in-person (IP) appearances in Ballina Local Court: GLARMA time series**

Variable	Estimate	Standard Error	z ratio	p value
Constant	0.925	0.223	4.14	< .001 **
Underlying trend	0.022	0.012	1.93	= .054
Level change	-	-	-	-
Trend change	-0.058	0.029	-2.04	= .042 *
Autoregressive (lag 1)	0.108	0.049	2.18	= .029 *
Moving Average (lag 9)	-0.177	0.069	-2.57	= .010 *

AIC = 228.61; Ljung-Box test:  $\chi^2_{10} = 10.26, p = .418$

## Separate AVL facilities for local courts that previously had shared access to AVL

**Table A6. Effect of separate AVL facility on the number of in-person (IP) appearances in Goulburn Local Court: GLARMA time series**

Variable	Estimate	Standard Error	z ratio	p value
Constant	0.896	0.246	3.65	< .001 **
Underlying trend	0.215	0.032	6.63	< .001 **
Level change	-0.961	0.155	-6.20	< .001 **
Trend change	-0.233	0.033	-7.15	< .001 **
Autoregressive (lag 1)	-0.110	0.050	-2.19	= .029 *

AIC = 250.41; Ljung-Box test:  $\chi^2_{11} = 3.42, p = .984$

**Table A7. Effect of separate AVL facility on the number of in-person (IP) appearances in Gosford Local Court: ARIMA time series**

Variable	Estimate	Standard Error	t value	p value
Constant	8.969	2.462	3.64	< .001 **
Underlying trend	0.434	0.254	1.71	= .087
Level change	-	-	-	-
Trend change	-0.238	0.288	-0.83	= .409
Autoregressive (lag 1)	-0.398	0.139	-2.87	= .004 **

AIC = 295.35; Ljung-Box test:  $\chi^2_{11} = 10.17, p = .515$

**Table A8. Effect of separate AVL facility on the number of in-person (IP) appearances in Lismore Local Court: ARIMA time series**

Variable	Estimate	Standard Error	t value	p value
Constant	18.652	3.666	5.09	< .001 **
Underlying trend	0.618	0.383	1.61	= .106
Level change	-	-	-	-
Trend change	-1.029	0.440	-2.34	= .019 *
Autoregressive (lag 1)	-0.017	0.151	-0.11	= .910

AIC = 322.15; Ljung-Box test:  $\chi^2_{11} = 12.05, p = .360$

**Table A9. Effect of separate AVL facility on the number of in-person (IP) appearances in Tamworth Local Court: ARIMA time series**

Variable	Estimate	Standard Error	t value	p value
Constant	9.754	2.276	4.29	< .001 **
Underlying trend	0.964	0.207	4.65	< .001 **
Level change	-	-	-	-
Trend change	-0.650	0.248	-2.62	= .009 **
Autoregressive (lag 1)	-0.466	0.136	-3.41	< .001 **

AIC = 308.94; Ljung-Box test:  $\chi^2_{11} = 9.88, p = .541$

**Table A10. Effect of separate AVL facility on the number of in-person (IP) appearances in Armidale Local Court: GLARMA time series**

Variable	Estimate	Standard Error	z ratio	p value
Constant	0.804	0.371	2.17	= .030 *
Underlying trend	0.059	0.032	1.82	= .069
Level change	-	-	-	-
Trend change	-0.060	0.038	-1.58	= .114
Autoregressive (lag 1)	0.126	0.051	2.46	= .014 *

AIC = 229.82; Ljung-Box test:  $\chi^2_{11} = 10.19, p = .513$

**Table A11. Effect of separate AVL facility on the number of in-person (IP) appearances in Port Macquarie Local Court: ARIMA time series**

Variable	Estimate	Standard Error	t value	p value
Constant	3.629	0.998	3.64	< .001 **
Underlying trend	0.021	0.059	0.36	= .719
Level change	5.959	1.775	3.36	< .001 **
Trend change	-	-	-	-

AIC = 256.53; Ljung-Box test:  $\chi^2_{12} = 12.49$ , p = .408

**Table A12. Effect of separate AVL facility on the number of in-person (IP) appearances in Penrith Local Court: ARIMA time series**

Variable	Estimate	Standard Error	t value	p value
Constant	28.750	3.727	7.71	< .001 **
Underlying trend	0.780	0.312	2.50	= .012 *
Level change	-	-	-	-
Trend change	-0.726	0.398	-1.82	= .068
Moving Average (lag 8)	0.631	0.172	3.66	< .001 **

AIC = 341.27; Ljung-Box test:  $\chi^2_{11} = 8.88$ , p = .633

**Table A13. Effect of separate AVL facility on the number of in-person (IP) appearances in Griffith Local Court: ARIMA time series**

Variable	Estimate	Standard Error	t value	p value
Constant	2.819	1.714	1.65	= .100
Underlying trend	0.597	0.111	5.40	< .001 **
Level change	-	-	-	-
Trend change	-1.088	0.176	-6.19	< .001 **

AIC = 275.89; Ljung-Box test:  $\chi^2_{12} = 7.39$ , p = .831

**Table A14. Effect of separate AVL facility on the number of in-person (IP) appearances in Broken Hill Local Court: GLARMA time series**

Variable	Estimate	Standard Error	z ratio	p value
Constant	3.051	0.118	25.92	< .001 **
Underlying trend	-0.010	0.008	-1.35	= .177
Level change	-	-	-	-
Trend change	0.003	0.013	0.25	= .800
Autoregressive (lag 1)	0.071	0.024	2.89	= .004 **

AIC = 310.33; Ljung-Box test:  $\chi^2_{11} = 5.69$ , p = .893

**Table A15. Effect of separate AVL facility on the number of in-person (IP) appearances in Bourke Local Court: GLARMA time series**

Variable	Estimate	Standard Error	z ratio	p value
Constant	0.712	0.268	2.66	= .008 **
Underlying trend	0.046	0.015	3.05	= .002 **
Level change	-	-	-	-
Trend change	-0.120	0.028	-4.34	< .001 **
Autoregressive (lag 1)	0.073	0.058	1.25	= .212

AIC = 213.93; Ljung-Box test:  $\chi^2_{11} = 14.09$ , p = .228

**Table A16. Effect of separate AVL facility on the number of in-person (IP) appearances in Grafton Local Court: GLARMA time series**

Variable	Estimate	Standard Error	z ratio	p value
Constant	1.997	0.099	20.20	< .001 **
Underlying trend	0.025	0.006	4.39	< .001 **
Level change	-	-	-	-
Trend change	-0.063	0.011	-5.98	< .001 **
Autoregressive (lag 5)	-0.146	0.041	-3.53	< .001 **

AIC = 271.35; Ljung-Box test:  $\chi^2_{11} = 14.92$ , p = .186

**Table A17. Effect of separate AVL facility on the number of in-person (IP) appearances in Campbelltown Local Court: ARIMA time series**

Variable	Estimate	Standard Error	t value	p value
Constant	32.074	4.197	7.64	< .001 **
Underlying trend	0.567	0.213	2.66	= .008 **
Level change	-	-	-	-
Trend change	-0.616	0.410	-1.50	= .133
Autoregressive (lag 1)	0.391	0.182	2.15	= .032 *

AIC = 369.13; Ljung-Box test:  $\chi^2_{11} = 8.07$ , p = .707

## Extra or upgraded AVL courtrooms for local courts that had separate AVL access

**Table A18. Effect of upgraded AVL facility on the number of in-person (IP) appearances in Central Local Court: ARIMA time series**

Variable	Estimate	Standard Error	t value	p value
Constant	88.259	6.633	13.31	< .001 **
Underlying trend	-1.038	0.522	-1.99	= .047 *
Level change	-	-	-	-
Trend change	0.865	0.668	1.29	= .196
Autoregressive (lag 12)	0.340	0.159	2.14	= .032 *

AIC = 397.81; Ljung-Box test:  $\chi^2_{11} = 6.99$ , p = .800

**Table A19. Effect of upgraded AVL facility on the number of in-person (IP) appearances in Downing Centre Local Court: ARIMA time series**

Variable	Estimate	Standard		p value
		Error	t value	
Constant	17.481	2.178	8.03	< .001 **
Underlying trend	0.078	0.157	0.50	= .618
Level change	-	-	-	-
Trend change	-0.032	0.221	-0.15	= .883
Autoregressive (lag 2)	-0.312	0.143	-2.19	= .029 *

AIC = 315.16; Ljung-Box test:  $\chi^2_{11} = 12.43$ , p = .332

**Table A21. Effect of upgraded AVL facility on the number of in-person (IP) appearances in Burwood Local Court: ARIMA time series**

Variable	Estimate	Standard		p value
		Error	t value	
Constant	30.059	4.779	6.29	< .001 **
Underlying trend	0.380	0.217	1.75	= .080
Level change	-	-	-	-
Trend change	-0.559	0.795	-0.70	= .482
Autoregressive (lag 1)	0.410	0.137	2.99	= .003 **

AIC = 348.85; Ljung-Box test:  $\chi^2_{11} = 9.99$ , p = .531

**Table A20. Effect of upgraded AVL facility on the number of in-person (IP) appearances in Bankstown Local Court: ARIMA time series**

Variable	Estimate	Standard		p value
		Error	t value	
Constant	16.574	1.760	9.42	< .001 **
Underlying trend	-0.011	0.094	-0.12	= .903
Level change	-	-	-	-
Trend change	0.262	0.205	1.28	= .202

AIC = 289.05; Ljung-Box test:  $\chi^2_{12} = 10.99$ , p = .530

**Table A22. Effect of upgraded AVL facility on the number of in-person (IP) appearances in Penrith Local Court: ARIMA time series**

Variable	Estimate	Standard		p value
		Error	t value	
Constant	34.567	2.308	14.98	< .001 **
Underlying trend	0.225	0.097	2.31	= .021 *
Level change	-	-	-	-
Trend change	0.260	0.854	0.30	= .761
Autoregressive (lag 8)	-0.406	0.138	-2.95	= .003 **

AIC = 351.86; Ljung-Box test:  $\chi^2_{11} = 10.34$ , p = .500