Disruption of a primary health care domestic violence and abuse service in two London boroughs: interrupted time series evaluation

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Abstract

Background Domestic violence and abuse (DVA) remains a major health concern affecting an estimated 15%-71% of women worldwide. IRIS (Identification and Referral to Improve Safety of women affected by DVA) is a complex, system-level, training and support programme, designed to improve the primary healthcare response to DVA. Following a successful trial, since 2011 IRIS has been implemented in eleven London boroughs. In two boroughs the service was disrupted for a period of time and this work evaluates the impact of this service disruption.

Methods We used anonymised data on daily referrals received by DVA service providers from general practices in two IRIS implementation boroughs that had service disruption for a period of time (six and three months). In line with previous work we refer to these as boroughs B and C. The primary outcome was the number of daily referrals received by the DVA service provider across each borough over 48 months (March 2013-April 2017) in borough B and 42 months (October 2013-April 2017) in borough C. The data were analysed using interrupted-time series, non-linear regression analysis with sensitivity studies exploring different regression models. Incidence Rate Ratios (IRRs) and 95% confidence intervals and p-values associated with the disruption were reported for each borough.

Results Mixed-effects negative binomial regression was the best fit model to the data. In borough B, the disruption, that occurred towards the end of the implementation period and lasted for about 6 months, significantly (p=0.006) reduced the referral rate by about 70% (95%CI= (23%,87%)). In borough C, the three-month service disruption that occurred towards the middle of the implementation period, also significantly (p=0.005) reduced the referral rate by about 49% (95% CI=(18%,68%)).

Conclusions Disrupting the IRIS service has substantially reduced the rate of referrals to DVA service providers. Our findings are evidence in favour of continuous funding of IRIS as a system level programme. Funding National Institute for Health Research (NIHR), Collaboration for Leadership in Applied Health Research and Care (CLAHRC) North Thames. Keywords domestic violence and abuse, interrupted time-series, non-linear regression

Background

Domestic violence and abuse (DVA) includes threatening behaviour, violence or psychological, physical, sexual, financial, or emotional abuse between adults that are relatives, partners or ex-partners [1]. DVA is a major health concern with an estimated 15%-71% of women worldwide having experience of it [2]. In England and Wales an estimated 2 million women aged 16 to 59 years have experienced DVA in the year ending March 2018 with on average two women killed by their partner or ex-partner every week *[3]*. In addition to physical effects, women affected by DVA can also suffer chronic health problems including gynaecological problems, gastrointestinal disorders, neurological symptoms, chronic pain, cardiovascular conditions and mental health problems [4-7].

Over recent years, a consensus has been emerging that in order to improve the healthcare of women affected by DVA, greater health services involvement and better experiences of health services for these patients are necessary [3,8,9]. For example, for improved delivery of sexual and reproductive health for all, identification and management of DVA needs to be central not a tangential add on service [10]. Therefore, commissioning of health services that are able to respond to DVA, should occur in a unitary, coordinated fashion - not be fragmented by a responsibility split between multiple organisations [11].

IRIS (*I*dentification and *R*eferral to *I*mprove *S*afety of women affected by DVA) is a complex, unifying system-level, training and support programme, designed to improve the primary healthcare response to DVA [12,13]. The programme focuses on primary care clinicians identifying women who experience domestic abuse, discussing and offering, and, if the woman agrees to it, a referral to a named specialist within a DVA

advocacy service. Between September 2007 and September 2010, over a period of 18 months, a cluster randomised controlled trial (RCT) evaluated the IRIS intervention in 24 intervention practices across two areas (London Borough of Hackney and Bristol) and compared the impact to 12 control practices [12]. Results, 12 months after the trial start, have shown that IRIS had been very impactful with large (2110%; 95%CI=(1150%, 4240%)) increase in the number of referrals (223 vs 12 in absolute numbers between intervention and control practices) to DVA service providers [12]. Furthermore, the trial was shown to be cost-effective, with alluded NHS and societal cost savings of £1 and £37 respectively per female patient aged 16 and over per practice per year [14].

Following the successful trial, IRIS became a commissionable programme in 2010 [13] and has been implemented across over 40 different sites in England and Wales. Recent findings from our group show that implementing IRIS, over 53 months, across 144 practices in four London boroughs resulted in large (3024%; 95%CI=(2055%,4477%), $p<0.001$) increase in referrals received by DVA service providers [15]. In addition, IRIS has been able to make a real difference to women experiencing DVA since 2010, referring over 14,000 women in over 40 local areas in England and Wales to specialist support through their GPs [13]. Implementation of IRIS is ongoing with over 850 general practices fully IRIS trained to date and estimated over 50,000 women having discussed DVA with a primary care clinician [13]. Finally, IRIS has been found to be an acceptable intervention for both clinicians and patients [16-18].

Sadly, however, around one quarter of areas that have commissioned IRIS since 2010, are no longer funding IRIS, for a variety of reasons. Ongoing discussions with the team responsible for facilitating the commissioning IRIS (IRISi, www.irisi.org) and IRIS workers, suggest that some local IRIS services have higher referral rates than others. Our mixed-method process evaluation of the IRIS implementation suggests that short-term funding and disruption of the service provision result in the loss of trust in service and drop in referral rates [19]. Securing long-term funding may be a factor in this, but confirming this requires more evidence on the efficacy of IRIS outside of a trial setting and as a continual service provision. Recent results by our group suggest that although IRIS has been successfully implemented across a number of northeast London boroughs since 2011, there is a difference in both the intervention delivery methodology and the impact of the intervention across the different boroughs [15,19]. In two of these boroughs, the provision of IRIS service was disrupted for a period of three and six months respectively. Our research question is whether the service disruption in each borough had an effect on the referral rate, during the period within which the disruption occurred. Using statistical analysis we thus quantify the impact of this disruption of IRIS as a service providing support to women affected by DVA, and hence learn lessons for future implementation of IRIS.

Methods

Data

We used anonymised data on daily referrals received by DVA specialists from general practices in two boroughs, referred to as borough B and borough C in line with our previous work [15,19]. In these places IRIS has been implemented since 2013, but had a disruption of service for a period of time (Table 1). In borough B this was due to funding of IRIS temporarily stopping, with general practitioners being advised to refer women affected by DVA, to a different but longstanding DVA service provider. In borough C the service disruption was due to staff leaving with no replacement of this staff although funding was still in place. For each borough, in our study, we included data from female patients aged 16 and above, registered at each general practice within the two boroughs. As part of the IRIS intervention, within each practice women affected by DVA were identified by the general practitioner and offered a referral to the named IRIS advocate-educator. Referrals also included self-referrals to the IRIS educators by women who may have seen IRIS publicity material. The primary outcome was the number of daily referrals received by

the DVA service provider from each of the 36 and 37 general practices in boroughs B and C respectively over the 48 months (March 2013 and April 2017) in borough B and 42 months (October 2013-April 2017) in borough C (details in Table 1).

IRIS service provision was disrupted for a period of six and three months respectively in boroughs B and C. The timeline of data availability, noting the dates of data collection, of the start of the IRIS implementation, of the start of the disruption of IRIS service, of the end of disruption of IRIS service and the end time of data collection (respectively times „and in Figures 1(a)-(b)) are listed in Table 1 and labelled in Figures 1(a)-(b)).

Statistical analysis

Our outcome of interest was the number of daily referrals received by the DVA service provider from general practices, with the rate per 10,000 patients calculated as . We modelled this outcome separately for each borough and testing different regression models (negative binomial, mixed-effect negative binomial models or mixed-effect Poisson model- details in Appendix A). Practice size was included in the model as an offset term. The model allowed for differences in referral rates between GP practices via a random intercept for GP practice. Since the daily number of referrals contained a large proportion of zeroes, we also assessed whether a zero-inflated mixed effects negative binomial model or a zero-inflated mixed effects Poisson model improved the fit to the data. For each regression model, we calculated the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) to compare models. The best-fit model was chosen based on the smallest values of these quantities (details are in Table S1 of Appendix A).

Table 1 shows, separately for each borough, the dates of data collection start and end, the times of IRIS service disruption, as well as the average referral rate in the periods before, during, and after the service interruption. Exploratory analysis showed that the referral rate during the IRIS implementation period was not constant over time, even outside the period of interruption. We therefore modelled the post-implementation trend of the referral rate as a non-linear function of time. This allows us to derive a model-based estimate of the referral rate over the whole period under consideration in this analysis. By adding an indicator variable for days falling into the disruption period, we could estimate the difference in the referral rate due to the interruption during the period within which it occurred.

We used fractional polynomials, with two time transformations as well as an indicator variable for the disruption period, to identify the optimal transformations of time for our models separately for each borough (Model 1 in Appendix A with details of the transformations in Tables S3 and S4). For graphical display, we smoothed the observed average daily referral rate over all practices using a moving average with uniform weights (101 and 45 lagged and forward terms for each referral respectively in boroughs B and C respectively).

Sensitivity analyses

To investigate the robustness of our model fit and account for different ways of modelling temporal fluctuations in the referral rate, we conducted a sensitivity analysis for each borough by fitting both a simpler and a more complex model in comparison to Model 1. The simple model (Model 2 in Appendix A) assumes that the referral rate is constant over time, other than during the disruption period, and calculates and tests the simple difference in the average referral rate between the implementation and disruption periods, albeit controlling for between-practice

differences in the base referral rate. Within this Model 2, the model included two predictors: one time transformation, as the random intercept for time, and the indicator variable for the disruption period (see Appendix A for details). In contrast, for the more complex model (Model 3 in the Appendix A), we allowed 5 predictors within the mixed effects negative binomial model: four time transformations as well as the indicator variable for the disruption period. By allowing the fractional polynomials to have higher number of terms, we allowed a closer fit of the modelled referral rate to the observed referral rate over time (see Appendix A for details).

For each of the Models 1-3, and for both boroughs B and C, we calculated the incidence rate ratio (IRRs), their 95% CI and the p-value, quantifying the impact and significance of the IRIS service disruption (details in tables S3 and S4 in Appendix A). To add robustness to the results, we added bootstrapped calculations for the standard errors with 500 replications. All analyses were done in STATA version 15.1.

Results

Descriptive results Table 1 shows the mean referrals rates over all practices in each borough in the periods before, during, and after disruption of the IRIS service, noting a reduction in the mean referral rate during the disruption period in both boroughs. The mixed-effect negative binomial model was the best-fit model for the data in both boroughs, since both AIC and BIC were minimal for this model (see Table S1 in Appendix A for details). The best-fit models superimposed over the corresponding smoothened time-series of the data for boroughs B and C are shown in Figures 1(a)-(b). Descriptively, in both boroughs we see a steep increase of the referral rate after the start of the IRIS intervention. The referral rate then remains high for a few months, before declining over time in both boroughs. For a few months before the disruption period, there is a surge in referral rates in both boroughs, before a sharp decline in both boroughs during the disruption period. The referral rate stays approximately stable during the disruption period with referral rate recovering to pre-suspension levels in borough C, but not in borough B, where it remains low. Estimated effect of the service disruption The estimated IRRs for the effect of the suspension in each borough are shown in Table 2. In borough B, our model estimated an IRR of 0.301 (95% CI=(0.128,0.774), p = 0.006). Thus we estimate that the referral rate was reduced by about 70 % (between 23% and 87%) during the disruption period, compared to what it would have been without the service disruption. In borough C, our model estimated an IRR of 0.513 (95% CI=(0.322,0.817), p = 0.005). Thus we estimate that the referral rate was reduced by about 49% (between 18% and 68%) during the disruption period, compared to what it would have been without the service disruption. Sensitivity analyses For both boroughs, our chosen model fitted the data best, the simpler model being underfitted, and the complex model being overfitted (Tables S3 and S4 in Appendix A). However, in each borough all three models gave approximately equivalent results: both in terms of the IRRs and their 95% CI (see Table S3 and S4 in Appendix A) and the detected statistically significant difference in the referral rate during the disruption period (p-value is less than 0.05 across all three models – see Tables S3-S4 for details). Discussion Our results suggest that the temporary disruption of IRIS, as a service providing support to woman affected by DVA had a substantial effect on referrals of women affected by DVA to specialist services in both implementation boroughs. In borough B, where the disruption occurred towards the end of the implementation period and lasted for about six months, the referral rate to DVA specialists was reduced by about 70% (95%CI =(23%,87%)) during the disruption. This may be because the disruption was lengthy and the service provision did not recover after the disruption. Indeed, comparing referral rate before, during and after disruption, Table 1 shows that, in borough B, the lengthy disruption dramatically reduced mean referral rate and the service did not recover post-disruption. In borough C, the disruption was shorter, lasting three months, and occurred towards the middle of the implementation period. During this disruption, the referral rate was reduced by 49% (95% CI=(18%,68%)). However, in this borough, although the disruption reduced the referral rate, it was only temporary. Once the disruption stopped, the mean referral rate recovered to almost pre-disruption levels (Table 1 and Figure 1(b)). Our results are in line with the qualitative findings from the process evaluation of the IRIS implementation on the importance of IRIS service provision [15]. The novelty of our work is that it is a first study that quantifies the impact and significance of disrupting a system-level programme that offers support to woman who experience DVA outside of a trial setting. Since the disruption was shown to be substantial in both settings, our study provides evidence that continued commissioning of such programme embedded in general practices is necessary. It raises the important question of how IRIS sustainability can be asserted, hence assuring continual support and care being offered to women affected by DVA. The challenge in the current commissioning and financial climate is to ensure that IRIS programmes are prioritised in local health policy and wider needs assessments. IRIS is widely cited as best practice and needs to be understood as core to improving local health care and responding to patients affected by DVA [16]. IRIS offers a cost effective and evidence-based solution along with simple, specialised and effective care pathways. It should be funded and sustained as routinely as other health care services. Our work extended previous work of our groups utilising a rich data set comprising of DVA referrals from a large number of practices across two London boroughs [15,19]. Furthermore, this research is the product of multidisciplinary collaboration between academic GPs, DVA specialists and quantitative and qualitative academic researchers. In this work we utilised ITS and non-linear regression analysis to make predictions from a data set comprising of DVA referrals from a large number of practices across two London boroughs. This is accepted as a robust and efficient method for evaluation of public health and primary care evaluations [20,21]. Whilst regression modelling is useful in

drawing conclusion for the duration of the study where fitted curves mimic the data, the presence of turning points in the non-linear fits makes them unreliable for prediction beyond the period for which data are available. An alternative would be to develop and utilise dynamic temporal models that use the data to calibrate the equations to the historic pattern, and then be used to make future prediction. As further data on the DVA referrals in IRIS implementation settings become available, further analysis can be utilised to explore the longer time impact of the intervention. Additionally, contrasting the IRIS implementation across different settings would be an interesting extension of this work. Furthermore, evaluating adapted versions of the IRIS model that are currently being piloted is a feasible extension of this work. For example, an adapted version for dentistry is underway and following a successful pilot in two sexual health clinics, further work is ongoing to develop this into a commissionable service.

Discussion

Our results suggest that the temporary disruption of IRIS, as a service providing support to woman affected by DVA had a substantial effect on referrals of women affected by DVA to specialist services in both implementation boroughs. In borough B, where the disruption occurred towards the end of the implementation period and lasted for about six months, the referral rate to DVA specialists was reduced by about 70% (95%CI =(23%,87%)) during the disruption. This may be because the disruption was lengthy and the service provision did not recover after the disruption. Indeed, comparing referral rate before, during and after disruption, Table 1 shows that, in borough B, the lengthy disruption dramatically reduced mean referral rate and the service did not recover post-disruption.

In borough C, the disruption was shorter, lasting three months, and occurred towards the middle of the implementation period. During this disruption, the referral rate was reduced by 49% (95% CI=(18%,68%)). However, in this borough, although the disruption reduced the referral rate, it was only temporary. Once the disruption stopped, the mean referral rate recovered to almost pre-disruption levels (Table 1 and Figure 1(b)).

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Whilst regression modelling is useful in drawing conclusion for the duration of the study where fitted curves mimic the data, the presence of turning points in the non-linear fits makes them unreliable for prediction beyond the period for which data are available. An alternative would be

to develop and utilise dynamic temporal models that use the data to calibrate the equations to the historic pattern, and then be used to make future prediction.

Conclusions

Disrupting the IRIS primary healthcare domestic violence service has substantially reduced the rate of referrals to DVA service providers. Overall, our work adds to existing literature on the negative effect from disrupting a primary care service for woman who experience DVA, hence highlights the need for continual support of such service provision.

Declarations

Ethics approval and consent to participate

This study used secondary anonymised data set for which no ethics approval or consent to participate was required.

Consent for publication

All authors gave their consent for publication of this work.

Availability of data and material

The datasets used and analysed during this study and the numerical codes used to generate the outcomes of this paper are available from the corresponding author on reasonable request.

Competing interests

AH and MJ were DVA IRIS advocate educators, at time of original IRIS trial; and are now both funded to facilitate IRIS dissemination in the UK, with MJ the CEO of IRISi. Positive trial findings would support their career development. GF is an IRISi board member. The other authors declare that they have no competing interests.

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Authors' contributions

The study was led by JPG and AS. AS had the idea of the study and JPG designed and undertook the statistical analysis with input from PM. SE provided statistical oversight for the study. MJ and AH delivered core components of the intervention. AS, NL, MJ and AH collected and collated the data for analysis. JPG and AS drafted the paper with inputs from PM, SE, EBC, MJ, GF, NL and CC. All authors contributed to the manuscript's revision, refinement and final approval. All authors read and approved the final manuscript.

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Tables

Due to technical limitations, tables are only available as a download in the supplemental files section.

Figures

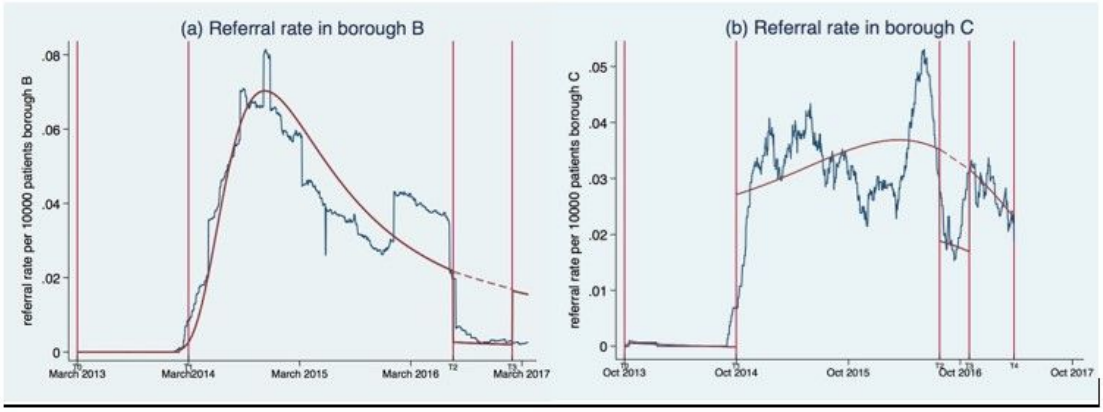

Figure 1

Smoothened time series of the data from 73 GPs across two different boroughs (blue lines) and best fit fractional polynomial to the data (maroon solid and dashed lines) with equation and specific parameters outlined in the supplementary material. The graphs show the daily referral rate ((number of referrals)/(GP size)*10,000)) over the period for which we have data. Boroughs B and C had a disruption of IRIS service for respectively six and three months (time period 〖(T〗_3-T_2) in Figures 1(a)-(b)). The dashed lines in (a) and (b) illustrate the temporal trajectory of the fitted polynomials in the scenario where “no disruption of IRIS service” would have occurred in these boroughs B and C.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

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- IRISBMCHealthServiceResearchAppendix.docx
- Tables.docx