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Using Timelines to Visualize Service Use Pathways to Alcohol Treatment

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Abstract

Many people in alcohol and other drug treatment are clients of other services, however there is limited consideration of the combinations and sequences of services and systems that they use. We used data visualization to analyze and re-present findings from a large research project on clients' service use and referral sources in the year preceding alcohol treatment entry. Data were from 16 "high-end" service users with alcohol problems and analysis involved constructing individual text and timeline summaries and a visual encoding system to show service type and referral source. Three distinct service use pathways were identified and a visual model of alcohol treatment, other service use and continuity in treatment was constructed. Timelining was a useful means of developing a creative and illuminating perspective during analysis. Although there is a risk of over-simplification, data visualization appears useful for focusing on and communicating the diversity of people's service use pathways.

Keywords

Visual Representation, Timelining, Qualitative Analysis, Alcohol, Treatment Access

Using Timelines to Visualize Service Use Pathways to Alcohol Treatment

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Many people in alcohol and other drug treatment are clients of other services, however there is limited consideration of the combinations and sequences of services and systems that they use. We used data visualization to analyze and re-present findings from a large research project on clients' service use and referral sources in the year preceding alcohol treatment entry. Data were from 16 "high-end" service users with alcohol problems and analysis involved constructing individual text and timeline summaries and a visual encoding system to show service type and referral source. Three distinct service use pathways were identified and a visual model of alcohol treatment, other service use and continuity in treatment was constructed. Timelining was a useful means of developing a creative and illuminating perspective during analysis. Although there is a risk of over-simplification, data visualization appears useful for focusing on and communicating the diversity of people's service use pathways. Keywords: Visual Representation, Timelining, Qualitative Analysis, Alcohol, Treatment Access

Defining "Care Pathways"

There is substantial interest in defining and mapping healthcare pathways (Pinder, Petchey, Shaw, & Carter, 2005) to clarify the most efficient ways for people to move into and through treatment systems. This focus has led to the development of ideal or recommended care and referral pathways for particular types of health issues, which clinicians are advised to follow. In this respect, mapping care pathways of clients may be about compliance or deviance from an ideal formulation; a formulation that is purportedly most likely to result in positive outcomes in a cost-efficient way. However, this top-down discourse about care pathways systematically omits "the plasticity of patients' personal circumstances and lived experience, providing no map of the terrain that the ill person has to traverse" (Pinder et al., p. 775).

Traditional quantitative analyses of service use pathways (e.g., Commander, Cochrane, Sashidharan, Akilu, & Wildsmith, 1999; Hayward & Moran, 2007; Sayal, Taylor, Beecham, & Byrne, 2002) sometimes take individual (and often complex) experiences of service use and re-produce care pathways in terms of neat group averages and proportions. The resultant service use proportions are often used to assess whether treatment is associated with particular client characteristics. For instance, are people with a personality disorder more likely on average than those who do not have a personality disorder to use emergency care? The impact of this is to produce service use (and personality disorders in this instance) as stable and predictable realities independent of context. However, someone with a personality disorder may attend an emergency department for help with a broken leg, or because a General Practitioner (GP) was not available where they live, or as a last resort when other treatments

have been perceived as ineffective. Emergency department use is not, therefore, as simple or as stable a reality as it may appear in conventional quantitative analyses of service use.

In this paper we aimed to describe and critique an approach to analyzing and re-presenting findings from a pre-existing study on service use prior to alcohol and other drug treatment entry. We used timelining and data visualization for analysis and re-presentation. Timelining is a graphic elicitation methodology that involves pulling information together in a visual display of continuity and change over time (Sheridan, Chamberlain, & Dupuis, 2011). Data visualization involves data reduction and the use of spatial variables such as position, size, and shape to re-present selected findings in a form that highlights "key differences in the data and reveal patterns and relations" (Manovich, 2011, p. 36). Our work culminated in a visual model of one service use pathway.

Visualising Pathways

Our visualization approach is situated within a growing tradition of visual methods (see Pink, 2012; Quinlan & Quinlan, 2010; Rose, 2012). As Ravn and Duff (2015, p. 126) explained, "the term 'visual methods' covers a range of approaches, from the inclusion of visual materials in research and analysis to non-textual ways of representing empirical findings". The literature puts forth both the benefits and risks of visual methods, during data collection and in the communication of findings. In a review of visual methods in qualitative research, Pain (2012) identified two main benefits; strengthening the relationship between researchers and their participants, and enriching the data collected. There is strong evidence of these positive effects, for example where a timeline is co-constructed and used as a device to expand and clarify information (Sheridan et al., 2011) or a participant's drawing communicates his or her perspective and forms the basis for discussion (Mannay, 2010).

The visual material may also come from researchers who strive to visually document situational elements, as with the use of films or diagrams (Ravn & Duff, 2015). Finally, the analysis itself may involve collating and re-presenting components and their inter-relationships using visual diagrams that enable further consolidation and interpretation of findings (Bazeley, 2009).

Data visualization is a useful way to communicate and advance knowledge based on pre-existing findings, which involves moving beyond conventional approaches to focus on key pieces of information and their significance. For example, images can emphasize key considerations about the prevalence of breast cancer and of false positives so clinicians are better able to make diagnostic inferences about the predictive value of a medical test (Garcia-Retamero & Hoffrage, 2013). These images also facilitate" clear, transparent decision-making" by clarifying the risks and benefits of alternative medical interventions (Hughes et al., 2016, p. 251).

The meaning that is generated will differ according to the method used to produce it, bringing some aspects of experience to the foreground and relegating others to the background. Researchers must be cognizant of the potential for unsought messages to be conveyed. A recent review has identified problems with data visualization whereby aspects of the images have negatively affected the viewer's thinking, caused inappropriate feelings, and interfered with communication (Bresciani & Eppler, 2015). These effects may stem from the designer or the viewer, for example where: the data visualization is overly complex and difficult to understand; when a viewer interprets an image without being aware of contextual factors; or where the encoding system is not universally understandable (Bresciani & Eppler, 2015). Providing visual explanatory cues and contextual information while aiming for simplicity, having ordered data and consistency in the approach to data visualization, are features that enhance impact (Hildon, Allwood, & Black, 2012).

Timelining for Pathways

We used timelining and data visualization to combine event-based data, employing qualitative analysis techniques to develop an in-depth understanding of the complexity and commonalities in service use pathways. We hoped that data visualization would enable data consolidation, overcome any limitations from an event-based orientation, and provide scope for further interpretation. To that effect, timelining should make it possible to identify the *spaces between* specific events and develop inferences about the significance of service use and gaps, while highlighting patterns across multiple pathways. We hoped this would inform future applications of timelining and data visualization to communicate key research findings. Our rationale was to address some of the aforementioned limitations of managerial and traditional quantitative approaches to understanding care pathways by:

> - starting from the bottom-up to follow clients' experiences of service use across health, social service, and criminal justice systems (not just alcohol treatment)
> - maintaining the integrity of individual service use experiences by timelining individual pathways, and using pathways as the main unit of analysis
> - maintaining the complexity of individuals' experiences by including the types of services used, the timing of service access, and the source of referrals
> - identifying patterns of service use pathways rather than a single typical pathway

Our work has involved a purposeful sample, drawn from a large, quantitative project on service use pathways preceding entry to an episode of alcohol and other drug treatment.

The study authors are both qualitative researchers who undertake social research on alcohol and other drug services and systems in Australia. Lynda Berends has previously explored the use of timelines during in-depth interviews (see Berends, 2011) and she designed and led the major project from which the sample is drawn (Berends et al., 2016). Michael Savic was involved in the design of the project, and has a particular interest in the role of research methods, clinical tools and interventions in constituting realities about alcohol and other drug use and addiction (see Savic, Barker, Hunter, & Lubman, 2016; Savic & Fomiatti, 2016).

The Study

The original study involved interviews with people entering alcohol and other drug treatment in two Australian states, from January 2012 and January 2013 (see Berends et al., 2016 for details). We identified a purposeful sample of 16 participants: with concerns about their alcohol use, as treatment seeking typically occurs long after the onset of problems (Chapman, Slade, Hunt, & Teesson, 2015); who were entering outpatient (not residential) treatment, to allow sufficient time where other service use may occur prior to the current episode; and with a considerable history of service use in the past year (defined as four or more instances of service use, excluding GP and self-help services, and including at least one non-alcohol and other drug service).

The data collected were: participant demographics; instances of health and welfare service use (and referral source where relevant), and criminal justice encounters during the past year. Participants were asked to estimate how many GP visits, attendances at self-help meetings (AA, SMART) and attendances at employment services they had experienced in the year. They were also asked whether they had used specific treatments/service types (e.g., alcohol and other drug counselling, ambulance, hospital in-patient, housing) and how often. For each attendance, the timing (number of months ago) and referral source (e.g., self, family, friend, alcohol and

other drug service, GP) was recorded. We limited the use of questions on specific services to five occurrences, to stay within the interview time and to avoid participant fatigue. Encounters with the criminal justice system (e.g., from court attendances and parole to prison) were recorded in the same way.

Ethical approval for the original study was obtained from National Health and Medical Research Ethics Committees at Eastern Health, Monash University, and Curtin University.

Analysis and Visualization

Our initial approach to analysis involved data description, using both text and visual methods. A matrix with axes for participant and month was populated with each instance of service use and referral source, and criminal justice encounter. Participant estimates of the number of GP, employment, and self-help group visits were entered at the beginning of each matrix row. Next, a text summary of each participant's service use was developed to shift the analytical focus from events to pathways. These summaries followed a set structure that detailed each participant's: age and sex; estimates of GP, self/mutual help, and employment service visits; health and welfare service use and referrals, and contacts with the criminal justice system.

The second stage of analysis involved developing and applying a visual encoding system for data display. Information from the matrix was plotted on a timeline to show every instance of service use and the referral source by month prior to the current treatment episode. Symbols were used to signify the service type (color) and referral source (shape). For example, an instance of alcohol and other drug treatment that resulted from a family referral was shown by a blue circle, while a hospital admission involving a GP referral was indicated by a red hexagon (see Figure 1).

Key

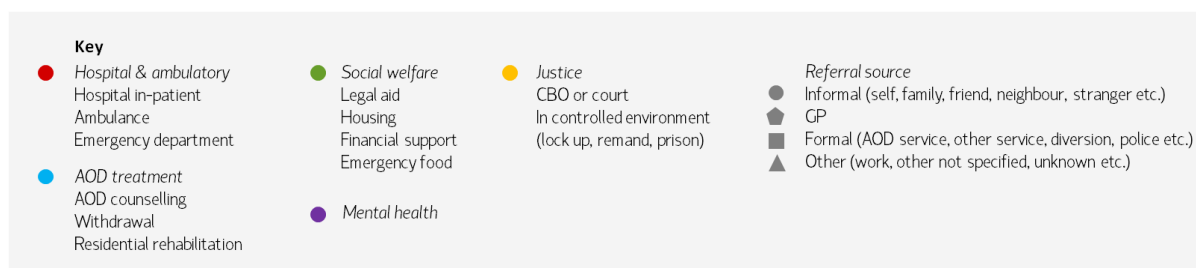| ●	*Hospital & ambulatory*	●	*Social welfare*	●	*Justice*		*Referral source*
	Hospital in-patient		Legal aid		CBO or court	●	Informal (self, family, friend, neighbour, stranger etc.)
	Ambulance		Housing		In controlled environment	⬠	GP
	Emergency department		Financial support		(lock up, remand, prison)	■	Formal (AOD service, other service, diversion, police etc.)
			Emergency food			▲	Other (work, other not specified, unknown etc.)
●	*AOD treatment*						
	AOD counselling	●	*Mental health*				
	Withdrawal						
	Residential rehabilitation						

Figure 1. Encoding System for Timelining

During this process, our analysis involved organizing the descriptive codes (e.g., service types and referral sources) into categories. These categories were developed from our understanding of health and social services and formal versus informal referral types. For example, the category of alcohol and other drug treatment includes all specialist treatments directly targeting substance dependence and the category of hospital and ambulatory is concerned with ambulance, emergency department, and hospital inpatient services. Social welfare includes legal aid, housing financial support and emergency food services. Informal referrals include self and family, while formal sources include other services and police (see Figure 1).

The third stage involved importing the text summaries and corresponding timelines into QSR International's (2014) NVivo 10 Software for interpretive analysis. Initially, the authors independently coded five summaries and timelines, working from both visual and text representations of service use pathways and using descriptive and then focused coding (Saldana, 2009). We developed a hierarchical coding framework based on three areas of

interest (when does alcohol treatment occur; what patterns of alcohol treatment and general service use are apparent; who refers people to alcohol treatment) and we independently populated the framework with descriptive codes. Any coding discrepancies were reconciled through discussion. Berends then coded the entire sample using the framework and Savic reviewed the coding and any adjustments to the framework that had been made during coding.

To maintain the focus on pathways, each participant summary and timeline was then categorized as a whole in relation to emergent patterns of service use. Cross-tabulations in NVivo were used to check for overlapping and independent constructs between these pathway types and the coding framework.

The final stage of analysis involved a single presentation of the findings. We combined all 16 timelines in a single figure and ordered these timelines by high/low number of GP visits. Text descriptions of the service use pathways were developed and cross-referenced to timelines illustrating these pathways.

Participants and their Service Use Pathways

Participants were predominantly male (9; 7 females) and aged 35-57 years (median 45 years). They reported a total of 466 instances of service use in the past year. The most commonly used health services were GPs (157), hospital and ambulatory (83), and alcohol and other drug treatment (37). Welfare service use was dominated by employment services (158 visits). Six participants reported contacts with the criminal justice system (20 contacts). Formal referrals, from health or other services, were most common (74) and this was followed by informal referrals (63), which usually involved self or family.

As shown in Figure 2, timelining participants' service use and referral source and combining these timelines in a single figure has made visible the temporal relations between service use events and the patterns of service use across multiple participants. Three types of care pathways were identified.

The first pathway involved six participants who had received alcohol and other drug treatment over several months in the past year. For example, P10 attended alcohol and other drug treatment services in all four months prior to the current episode, P9 had blocks of alcohol and other drug treatment early and late in the year, and P5 reported only alcohol and other drug service use – which occurred in the two months prior to the current treatment episode.

The second pathway was concerned with five participants who had no alcohol and other drug treatment in the year preceding the current episode. Some of these pathways involved multiple instances of hospital and ambulatory service use (and one participant used mental health services multiple times). For example, P15 used hospital and ambulatory services intermittently from nine months prior to the current treatment episode, along with mental health services from three months ago to the current episode. In another example, P8 used hospital and ambulatory services one, nine, and twelve months before the current alcohol treatment episode. Two of these pathways included extensive contact with the criminal justice system (P13, P14).

The third pathway involved four participants with multiple health service use in the past year. Two of these pathways included multiple instances of welfare service use. For example, P7 used hospital and ambulatory services one, two, and eight months ago, and alcohol and other drug treatment once prior to the current episode, while P1 used multiple systems (hospital and ambulatory services, social welfare, mental health, and alcohol and other drug treatment services) through the year. Across the pathways, there was no discernable association between the patterns of service use and formal versus informal referral sources or with low versus high GP visits and this information was not pursued further.

Figure 2. Timelines of Service Use and Referral Sources in the 12 Months Prior to Alcohol Treatment Entry
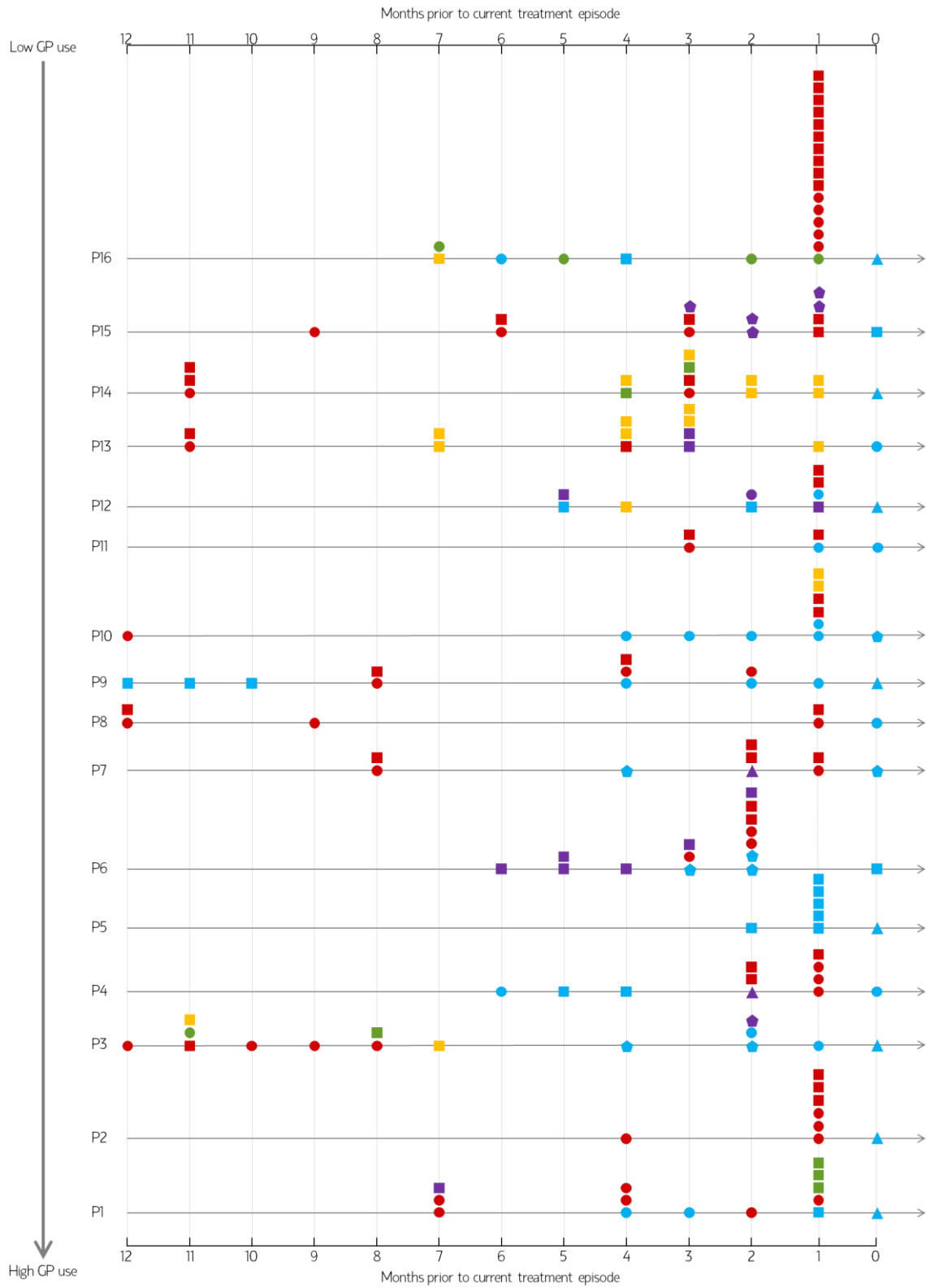
Finally, a simple model was developed to represent one of the pathways, using the service use recounted by P1 (see Figure 3). This involved highlighting two main categories of service use (alcohol and other drug services, and other services) and representing the level of continuity in service use over time. As shown, P1 had limited continuity of care across both alcohol and other drug services and other service types. His or her pathway included multiple spikes in service use, including a spike just prior to entering the current alcohol treatment episode.
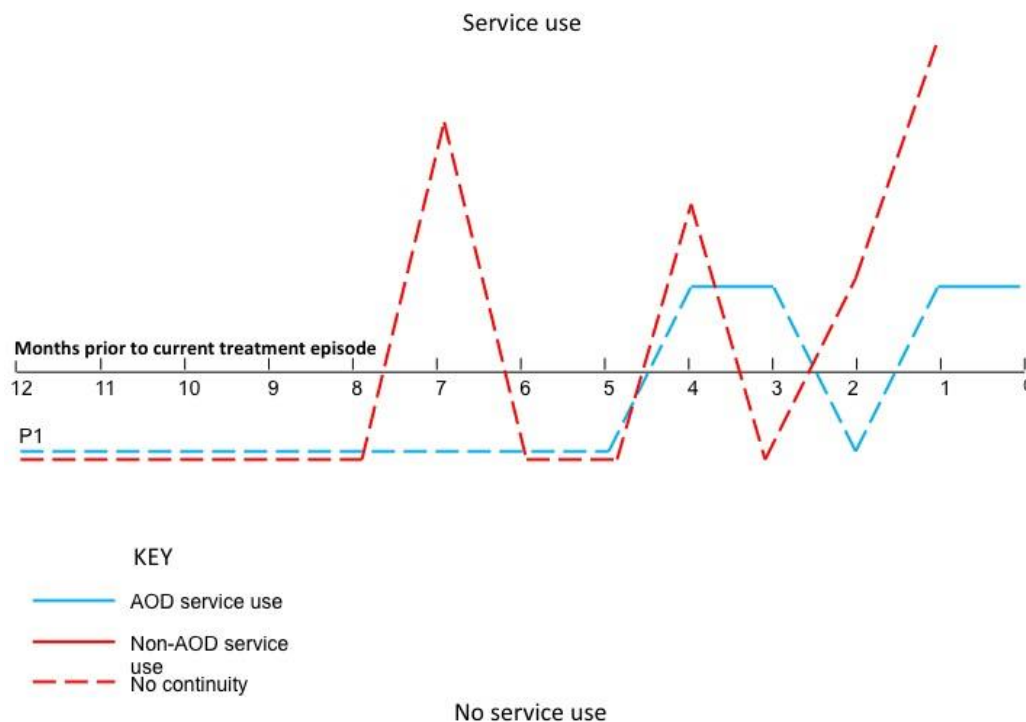

Figure 3. Service Use and Continuity in the 12 Months Prior to Alcohol Treatment Entry

Revisiting the Purpose

Our goal was to explore the nature of and diversity in service use prior to and in combination with alcohol treatment to develop a better understanding of service use pathways. We hoped to develop a visual model of key findings that would enable a sound understanding of the information conveyed and its possible implications, in this case regarding opportunities for early intervention and co-ordinated care. An iterative and reflective approach was essential throughout the process and in developing the final model.

Possibilities and Pitfalls in the Approach to Analysis

We re-presented people's service use events as a sequential pathway to alcohol treatment entry and we encountered a number of benefits and challenges during this process. Timelining was useful in that it prescribed a structure for organizing findings. This structure highlighted the temporal relationships between specific service use events and encounters with criminal justice in terms of the combinations and frequencies of services used. It also made possible the analysis of service use patterns involving multiple participants. Fortunately, the structure was consistent with the way service use events had been recorded in the original study

and it facilitated our intention to focus at person rather than event level. Within this framework, descriptive and conceptual qualitative analysis techniques could easily be applied.

There are specific risks in data visualization (Bresciani & Eppler, 2015) and the decisions we made about how to re-present the data involved developing and critiquing the encoding system throughout the analytic process. We made decisions about what visual codes to use and how much information to include, such as all aspects of service use and referral pathways as well as criminal justice encounters. Throughout this exercise, the timeline structure and symbols we developed were based on principles of simplicity, transparency, and completeness (Hildon et al., 2012; Richards, 2005).

On a related matter, decisions had to be made about the comprehensiveness of the data at person level, about whether to include all participant timelines. We opted for a comprehensive approach given the exploratory nature of this paper, thereby including all timelines for completeness (Richards, 2005) and allowing for the illumination of contrasting pathways from the identification and comparison of divergent cases (Bazeley, 2009).

The iterative nature of the analytic process was essential as the significance (or otherwise) of data elements at person level was only apparent when the timelines were combined into a single diagram (Figure 2). This diagram has been designed to draw the researchers' attention to the nature and frequency of service use and to intervals without any service use, while allowing the identification of additional patterns (e.g., the extent of criminal justice contact or the possible relationship between GP visits and welfare service use). The figure is the means by which emergent themes become visible through comparative analysis (Bazeley, 2009). It is thus a tool for the analytical process. However, if used as a final re-presentation of detailed findings then some editing may be required. For example, the referral sources data did not reveal much and ordering timelines by the number of GP visits did not highlight any particular trends. These findings could arguably be omitted from a final version. As this paper involves considering an approach to visualizing and re-presenting data the information has been retained in the figure.

The final visual model (Figure 3) has the aim of communicating key messages and our construction of the model involved selecting an example to illustrate one of the pathways and simplifying the information that has been represented. Such models need to retain substantial meaning and build a coherent argument (Bazeley, 2009; Richards, 2005) while conveying messages quickly and efficiently. Over-simplification is hard to overcome when aiming for an efficient and impactful visualization, although there are examples demonstrating that this is possible (e.g., Garcia-Retamero & Hoffrage, 2013; Kemp, 1999 in Bazeley, 2009). Further, simplicity in the presentation of findings is a sign of analytic completeness. As with other forms of qualitative analysis, the true test of the visual model is its clarity for the audience, its completeness, and its relevance to comparable data sets (Richards, 2005). This is untested in our work and an exploration of the quality and efficiency of the model would be useful.

Limitations and Reflections

It is important to acknowledge that the work we have documented here represents a small case study and a first step in explicating an approach to understand and communicate service use pathways at the person rather than event level. However, we cannot pretend to have uncovered an 'understanding' that is more objective or more complete than understandings developed through other methods. The process of visualizing the data, developing, and then interpreting the timelines involved layers of reconstruction. Further, the data document discrete service use events that have been represented on the timelines as separate experiences, although they may be connected. The pathways model that we produced (Figure 3) does not illuminate *why* someone accesses particular combinations of services (and not others), his/her experiences

of service use, or the impacts of service use. As may be expected, data visualization and timelining has raised uncertainties that warrant further research, possibly involving other subsamples from the existing data set and also qualitative research on people's explanations for patterns of service use over time.

Conclusion

The approach to analysis that we have put forward demonstrates the potential of data visualization in making sense of large and complex data sets where clarity on the temporal relationships between events is sought. For the larger study, the purpose of data collection was to clarify service use pathways within a sample of sufficient size to represent the diverse service/system use histories of those seeking alcohol and other drug treatment. However, in order to adequately "describe or discover, to find meaning" (Morse, 2003, p. 193) in the data set and accommodate the size of the entire sample it was essential to analyze a subset of the data and use an approach that enabled a simple, clear, and comprehensive re-presentation of findings.

We suggest that data visualization and timelining is useful for studies dominated by quantitative methods. It may be applied as an analytical phase to obtain clarity and directions for quantitative analysis. This is particularly useful when the quantitative data include activity across a substantial time period and multiple variables in the areas of client characteristics and service/system use. It does not preclude further application of data visualization and timelining for subsamples defined along other variables, for example sex or age or involving high levels of social welfare service utilization. Nor does it preclude the merit of findings from the data visualization and timelining exercise itself.

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