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Which Melbourne metropolitan areas are vulnerable to COVID-19 based on age, disability and access to health services? Using spatial analysis to identify service gaps and inform delivery

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1 **Which Melbourne metropolitan areas are vulnerable to COVID-19 based on age, disability and**

2 **access to health services? Using spatial analysis to identify service gaps and inform delivery**

3 **Abstract**

4 Ageing adults (65+) with disability are especially vulnerable to COVID-19 and upon contracting, are

5 a cohort most likely to require palliative care. Therefore, it is very important that health services -

6 particularly health services providing palliative care - are proximately available. Treating the

7 Melbourne metropolitan area as a case-study, a spatial analysis was conducted to clarify priority areas

8 with a significantly high percentage and number of ageing adults (65+) with disability, and high

9 barriers to accessing primary health services. After, travel times from priority areas to (i) palliative

10 medicine, and (ii) hospital services were calculated. The geographic dispersion of areas with people

11 vulnerable to COVID-19 with poor access to palliative care and health services are clarified. Unique

12 methods of health service delivery are required to ensure that vulnerable populations in under-

13 serviced metropolitan areas receive prompt and adequate care. The spatial methodology employed can

14 be implemented in different contexts to support evidence-based COVID-19 and pandemic palliative

15 care service decisions.

16 **Key Words:** COVID-19; palliative care; GIS; spatial analysis; disability; health service access

17 **Key Message:** A spatial analysis identified priority Melbourne metropolitan areas of ageing adults

18 with disability and low access to health services. Priority areas may require unique palliative care

19 offerings in light of the COVID-19 pandemic. The methodology can be applied to clarify priority

20 areas of ageing adults with disability across different settings.

21 **Introduction**

22 In December 2019 a new coronavirus disease (COVID-19) was identified in Wuhan, China.[1] By 26th

23 March 2020, over 450,000 confirmed cases, and over 20,000 deaths across 172 countries had

24 occured.[1] While diverse age groups can experience the severe consequences of COVID-19, the virus

25 has the most detrimental impact on ageing adults over 65.[2] Data from the United States of America

26 (USA) concludes that over 31 percent of adults over the age of 65 require hospitalisation due to

27   COVID-19, while 4 to 11 percent of adults between 65 and 84 years of age die.[2] Furthermore,

28   between 11 and 27 percent of those over 85 die.[2]

29   Countries with ageing populations such as Australia have reason to be concerned. Currently, 17.7

30   percent of people in Australia have a disability and 15.9 percent are over the age of 65 (ABS, 2019).[3]

31   The first four cases of COVID-19 were confirmed in Australia on 26th January and the number has

32   quickly increased with 2,423 confirmed cases as of 25th March.[1] The rapidly rising number of people

33   experiencing ill health during a pandemic has the potential to have a detrimental impact on health

34   service delivery, particularly surrounding the provision of palliative care.[4] Within countries which

35   have comparable demographics to Australia, it is important that priority areas with significantly high

36   numbers of ageing people with disability and poor health service access are identified. Their

37   identification is a seminal first step towards evidence-based health service decisions.

38   Already, geographic information system (GIS) methods (hereafter described as spatial methods) have

39   been consistently employed towards monitoring and tracking the COVID-2019 pandemic.[5] Boulos

40   and Geraghty[5] detail how spatial methods have been essential towards the mapping of incidences of

41   COVID-19 globally. They also suggest that methods that can be useful to identify sites for new health

42   services. As an extension of this work, in the absence of resources and time to build new sites for

43   service delivery, such methods can identify where bespoke health service delivery modes – for

44   example, particular telehealth methods supporting palliative care for ageing people with disability[4] –

45   should be delivered.

46   As a case-study to support future spatial work aimed at addressing service delivery for ageing people

47   with disability during a global pandemic, a spatial analysis was conducted to identify priority

48   Melbourne metropolitan areas with a significantly high percentage and number of ageing adults (65+)

49   with disability, and high barriers to accessing primary health services. After, travel times from priority

50   areas to (i) palliative medicine, and (ii) hospital services were clarified.

51   **Method**

52   *Data sources*

53   Three sources of data were used. Data from the Australian Bureau of Statistics (ABS) 2011 Census of

54   Population and Housing[6] was used to clarify the number of people 65 years and older who require

55   assistance with a core activity (a proxy for disability). The location of palliative medicine providers

56   and hospital services were identified via Health Direct's 2019 National Health Service Directory[7], and

57   the Metro Aria[8] (an accessibility index for key domains across Australian capital cities) health service

58   index was used to measure access to primary care.

59   *Data analysis*

60   People over the age of 65 were mapped to the Statistical Area 1 [SA1] level (the second smallest

61   statistical area possible within the Australian geography standard, see ABS[9] for more information). To

62   identify areas with significantly high numbers and percentages of ageing people with disability, and

63   also poor access to primary health services, three Hot Spot Analyses using ESRI's ArcMap 10.4.1

64   were conducted. The Hot Spot (Getis-Ord Gi*) analysis identifies areas with significantly high and

65   low numbers of a domain given a geospatial mean. Similar to the approach undertaken by Lakhani et

66   al.[10], areas which met the criteria of being significant (at the $p < .05$ level) during all three analyses

67   were identified as priority areas. After, a centroid (a marker representing the centre of an area) was

68   produced for each priority area, and the travel time via motor vehicle from priority areas to the nearest

69   palliative medicine and hospital service was clarified via two iterations of the origin destination cost

70   matrix geoprocessing tool. Finally, the travel time was averaged.

71   **Findings**

72   Out of 8910 areas, 2085 were identified as having a significantly high level of difficulty accessing

73   primary health services, 807 areas had a significantly high percentage of people with disability, while

74   664 had a significantly high number of people with disability. Thirty areas constituting areas of

75   priority were significant across all three domains. Summary statistics for travel time in minutes to

76   both health services and their averaged travel time are as follows (with mean [m], standard deviation

77   [sd], minimum [min], and maximum [max] in brackets): palliative care travel time (m = 9.96, sd =

78   3.46, min = 3.40, max = 15.45), hospital travel time (m = 9.31, sd = 3.08, min = 2.98, max = 15.68),

79   average travel time (m = 9.64, sd = 1.37, min = 6.92, max = 12.22). Figure 1 clarifies the location of

80   priority areas and palliative medicine and hospital services.

81   [Insert Table 1 Here]

82   [Insert Figure 1 Here]

83   **Discussion**

84   Clearly, in light of COVID-19 (or a comparable rapidly spreading virus), unique service offerings are

85   necessary to ensure health support is offered to those most vulnerable. With Melbourne treated as a

86   case-study, priority areas were identified, and the travel time to essential health services confirmed.

87   The use of such methods, can inform global practices for service delivery.

88   Given the barriers to access for people in priority areas, an overburdened health system, and the

89   potential for further contamination through contact, service delivery lessons can be learned from

90   offerings of palliative care and related approaches within rural and remote settings where similar

91   barriers exist. The six priorities identified within the Rural Palliative Care Program initiated by Spice

92   et al.[11] are relevant. Three of these priorities are particularly suitable given the necessity of isolation:

93   (i) improving psychosocial support for patients and families, (ii) providing resources to support home

94   death and (iii) the development and use of a mobile specialist consultant team. Amending service

95   provision with a focus on these priorities can support the delivery of services to vulnerable people

96   within areas with poor access during COVID-19. The first priority listed is especially pertinent as the

97   emergence of COVID-19 could be argued as causal of psychological distress for patients and families.

98   Essential to providing palliative care services are family caregivers. This is especially so in regions

99   with poor access to health care – once again, for example rural regions[12] - , and where health systems

100   are over-burdened during a time of pandemic crisis.[4] In this regard, telehealth programs which build

101   the skills of family caregivers become paramount. [4] Dionne-Odom et al. [12] describe a telehealth

102   Program to Support Family Members of Individuals with Cancer (herafter the Program). The Program

103   involves six one hour weekly telehealth sessions for family caregivers to support their provision of

104   palliative care for a family member. In the context of COVID-19 such an approach could be amended

4

105   so that these sessions are offered at a higher frequency (for example, daily) and that information

106   surrounding managing relevant COVID-19 symptoms, and addressing psychological complications

107   for family members and patients are delivered. Furthermore, including the perspectives of general

108   practitioners (GPs) with an expertise in palliative medicine for ageing people with disability within

109   telehealth sessions would be of benefit. Information sharing around how to manage the distinct

110   consequences of COVID-19 for ageing people with disability can ensure a tailored approach where

111   those who may not be able to receive inpatient health services due to service proximity and capacity

112   issues, are still able to receive adequate support via informed family members.

113   Finally, attention need be directed to distinct palliative care models that can support the health and

114   wellbeing of vulnerable populations in priority areas with poor access to health services during a

115   pandemic. Downar et al.[4] provide a palliative care pandemic plan which includes palliative care

116   considerations which are applicable. Their plan includes the domains 'stuff', 'staff', 'space' and

117   'systems'. In relation to the domain 'stuff', Donwar et al.[4] highlight the need for the adequate stock

118   and delivery of medicine and medical equipment relevant to the particular pandemic. Under the

119   context of COVID-19, an amendment to the 'stuff' component of their plan includes the potential use

120   of unmanned aerial technology (UAV) – as identified by Boulos and Geraghty[5] - to deliver medicine

121   and collect samples.

Conclusion

123   Spatial methods are increasingly becoming an essential method to inform health service planning.

124   However, in the realm of service provision for people with disability and ageing people, spatial

125   methods are seldom employed.[10] The case study provides a spatial method framework which can be

126   followed to identify priority areas for palliative care services in a time of crisis. Irrespective of

127   COVID-19, it expected that these methods have broader applications in ageing societies where

128   palliative care is increasingly becoming utilized. Coupling spatial methods with contextually

129   appropriate palliative care service offerings are essential towards the delivery of evidence-based,

130   effective palliative care.

131 **Conflict of Interest**

132 The author has no conflict of interest to declare.

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Legend

- ● Palliative Medicine Service
- ● Hospital Service
- ■ Priority Area
- □ Melbourne Metropolitan Statistical Area

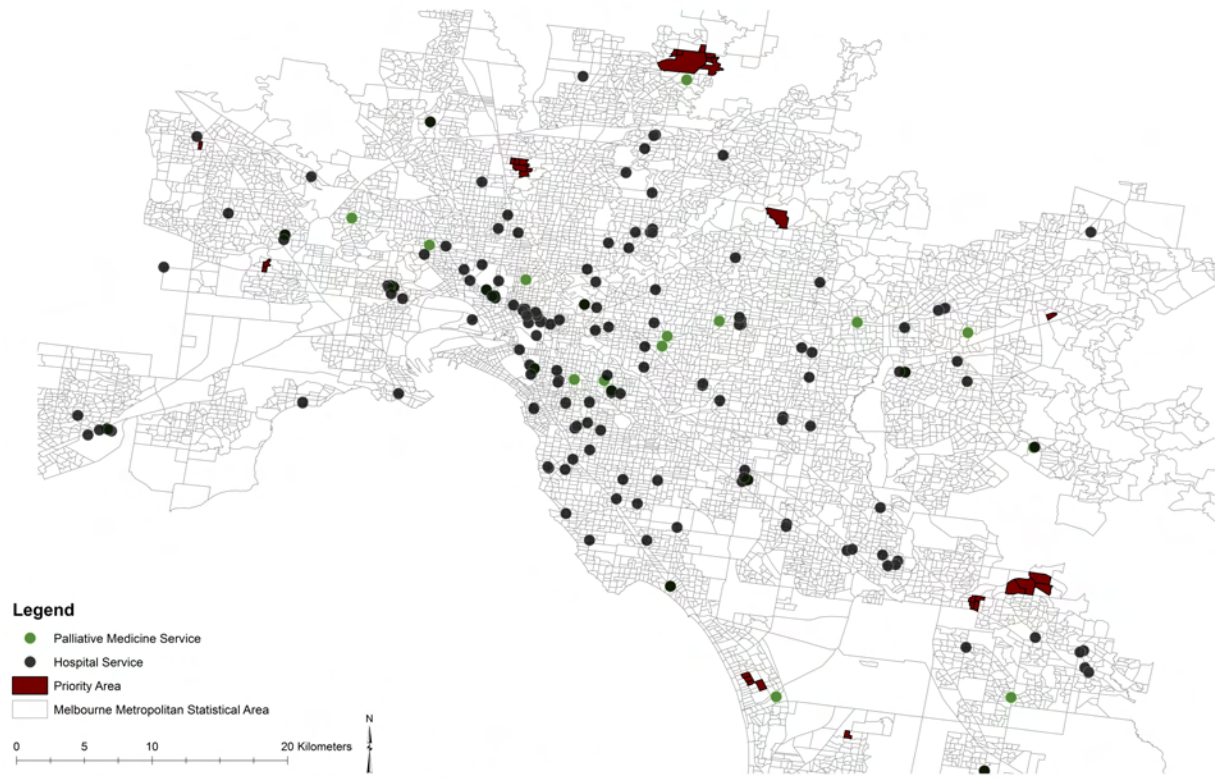0   5   10   20 Kilometers

N

Figure 1: Melbourne metropolitan priority areas and palliative medicine and hospital services