Why do electronic health records reveal oral anticoagulant prescription after haemorrhagic stroke?

Running head: Warfarin and Haemorrhagic stroke

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46 Oral anticoagulation (OAC) is used to prevent stroke in patients with atrial fibrillation or heart

47 valve disorders. However, OAC may cause haemorrhagic stroke. We completed a randomised

48 trial of stroke secondary prevention [1], using primary care electronic health records (EHRs)

49 collected into the UK Clinical Practice Research Datalink (CPRD). A small proportion of

50 participants were prescribed warfarin following a haemorrhagic stroke diagnosis. The present

51 research aimed to explain this observation.

52

53 Participants were selected from all 11,391 patients with prevalent stroke, from 106 family

54 practices in England and Scotland, included in the trial [1]. Patients were included if they had a

55 record of haemorrhagic stroke before the trial and were treated with warfarin during the trial.

56 Family physicians were sent a postal questionnaire asking respondents about the nature of the

57 stroke suffered by the patient and indications for warfarin therapy. Type of stroke was coded

58 using the International Classification of Diseases 10th Revision [2]. Warfarin accounts for 99% of

59 OAC prescriptions in CPRD. The project was approved by external scientific and ethical review

60 committee (ISAC protocol 08_083A2). GPs consented to their practice's participation. Fully

61 anonymised data were used and no patient consent was sought.

62

63 There were 134 (1.2%) participants with EHRs documenting previous haemorrhagic stroke who

64 were prescribed warfarin during the trial. The index stroke event was coded into the EHR as a

65 sub-arachnoid haemorrhage for 25 (24%) of cases and as intracerebral haemorrhage (ICH) for 78

66 (76%) of cases. There were 40 (47%) women and the mean age was 75 years (range 40 to 94

67 years). Questionnaire responses were obtained for 103 (77%) patients with sufficient information

68 to confirm the type of stroke obtained for 86 (64%) (Figure 1).

69

70   Questionnaire responses revealed that there were 41 (48%) patients with a physician-confirmed

71   diagnosis of cerebral infarction (n=39) or other non-haemorrhagic stroke (n=2). The diagnosis

72   was confirmed by imaging reports recorded for 36 (88%) of patients. There were five patients

73   with a code for ischaemic stroke recorded after the initial haemorrhagic stroke but only two of

74   these were within one year of the index stroke, possibly representing a clarification of the initial

75   diagnosis. Indications for OAC in this group of participants included atrial fibrillation (n=27),

76   disease of pre-cerebral and cerebral arteries (n=4), venous thromboembolism and other and not

77   known (n=10).

78

79   There were 45 patients with a physician-confirmed diagnosis of haemorrhagic stroke including

80   sub-arachnoid haemorrhage (n=17) and ICH (n=28). The diagnosis was supported by imaging

81   results for 38 (84%) patients. Indications for OAC therapy included atrial fibrillation (n=20),

82   venous thrombosis (n=10), pulmonary embolism (n=5), aortic valve replacement (n=3),

83   percutaneous coronary intervention, vasculitis and not known (n=7).

84

85   We conclude that in the EHRs of a large population of stroke patients, there may be appreciable

86   numbers with a diagnosis of haemorrhagic stroke who are treated with OAC therapy. We

87   reported previously on the clinical coding of stroke in EHRs [3] and the potential for

88   misclassification of stroke diagnoses. The present results should not be considered to evaluate

89   the overall reliability of stroke coding in EHRs, because the sample was one in which data

90   discrepancies were expected.

91

92   In about half of patients, the stroke event was mis-coded as a haemorrhagic stroke when the

93   physician-reported diagnosis for the same event date was one of cerebral infarction.

94   Misclassification might sometimes result from haemorrhagic transformation, which is not

95   necessarily a contra-indication to OAC therapy. Physicians may draw on sources of data from

96   outside the EHR. Nevertheless, it is concerning that appreciable numbers of stroke patients are

97   prescribed OAC therapy with incorrect diagnostic information coded into their EHRs, with

98   potential medico-legal implications. Improved information sharing between providers would be

99   of benefit to physicians.

100

101   A second group comprises patients with a confirmed diagnosis of haemorrhagic stroke who were

102   treated with OAC therapy for co-existing thromboembolic disorders. This highlights the difficult

103   balance of risks and benefits that may sometimes be required in clinical practice. However, the

104   use of OAC therapy in patients with previous ICH remains controversial [4]. Improved evidence

105   and decision support are required for these high-risk patients.

106

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121

122 **Figure 1 Legend: Flow chart showing physician-reported data for confirmed stroke type**

123 **and indication for OAC therapy in 103 participants with electronic records for**

124 **haemorrhagic stroke.**

125

Figure 1.

126

11,391 participants with previous stroke included in point-of-care trial

127 → 11,263 not eligible

128
129
130

134 participants with electronic health record of previous haemorrhagic stroke and current warfarin prescription during trial intervention period

131 → 31 did not provide responses

132

103 participants with questionnaire response obtained

→ 17 excluded, insufficient information

133

86 participants with type of stroke determined by questionnaire

45 (52%) participants with physician-confirmed diagnosis of sub-arachnoid haemorrhage (17) or intracerebral haemorrhage (28)

41 (48%) participants with physician-confirmed diagnosis of cerebral infarction or other non-haemorrhagic stroke

Indications for OAC therapy include: atrial fibrillation (20); venous thrombosis (10); pulmonary embolism (5); aortic valve replacement (3); other and not known (7)

Indications for OAC therapy include: atrial fibrillation (27); disease of pre-cerebral or cerebral arteries (4); venous thromboembolism, other and not known (10)