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Vital Signs, the Magic Key in Preventing Hospitalization and Death in Nursing Home Residents Aged 65 and Older

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Abstract

Aim: The purpose of this study was to develop a Geriatric Early Warning Instrument (GEWI) able to prematurely identify subtle physical changes that lead to negative health outcomes, such as hospitalization and death.

Methodology: The study was a prospective cohort study where vital signs were assessed over a seven week period of time nursing home residents ages 65 and older living in Antwerp, Belgium. Furthermore, medical records were consulted to register the number of hospitalizations, deaths and Katz-scores.

Findings: Residents encountering a negative outcome (hospitalization or death) had a lower mean systolic blood pressure and a lower blood oxygen level ($p<0.05$). In those residents, systolic blood pressure and blood oxygen level showed a significant but very weak correlation ($0.30>r>-0.30$). Systolic blood pressure, heart rate and blood oxygen level were significant predictors for negative outcomes and hospitalization, whereas a higher heart rate and lower blood pressure were significant predictors for premature death.

Conclusion: While the initial results were promising, a general conclusion was difficult to generate. Initial findings indicated that systolic blood pressure and blood oxygen level may possibly predict negative outcomes, hospitalization and death. Future large multi-centered research is needed to expand the database in order to confirm these findings.

Keywords: Vital signs; Mortality; Population

Introduction

At January 1st 2019, 19% of the Belgian population was aged 65 and older, an increase with 2% in comparison with 2009 [1]. In 2018, life expectancy was 79.2 years for men, 83.7 for women and 81.5 years in general [2]. This is an increase of approximately 15 years compared to 65 years ago [3].

In today's healthcare we try to do as much as possible to prevent disorders and diagnose them early. This contributes to the reduction of preventable mortality. According to recent figures from Belgium, up to 26.3% of the pathologies (lung cancer, ischemic heart diseases) can be treated and death can be avoided. Up to 54.8% of the disorders that cause death could be avoided. In the group of people older than 65 years, the percentage of preventable mortality is comparable. However, numbers for unavoidable mortality are higher than among the younger age groups [4].

During their stay in the nursing home, many residents are admitted to a hospital [5,6]. This number of hospitalizations varies in literature between nine to 60% [7,8]. Hospitalizations are often unnecessary or could be prevented, and may result in giving these residents physical and mental stress [8,9]. There is also a greater chance of falling incidents or developing a delirium when being hospitalized [10,11]. The risk of dying in the hospital is higher for nursing home residents. After all, Alrawi et al. found that up to 23% of the residents die when hospitalized [12]. Van Dijk et al. confirms this by stating that nursing home residents have a 110% greater chance of dying during hospitalization [13].

The risk for chronic conditions increases with age, making the care for these residents complex. Residents with dementia also seem to be admitted to hospitals more frequently [14]. The World Health Organization (WHO) notes that frequent admissions complicate the continuity of care, which is already complex in nursing homes [15].

As nurses often initiate the hospitalization process, they would like to have guidelines and support in making this kind of decision [16]. Hospitals use systems such as the National Early Warning Score to early identify acutely ill patients and follow appropriate prescribed actions [17]. Baeyens et al. are currently designing a study on the development of a screening tool to be used in older adults in acute settings [18]. However, these scoring systems are designed for the (older) adult in a hospital and not for nursing home residents. The age limit suggested by the WHO to refer to a geriatric person is 65 years [19]. These people often have multi-pathology and take multiple medications that can affect the vital parameters.

In this study we aim to develop a Geriatric Early Warning Instrument (GEWI) able to prematurely identify subtle physical changes that lead to negative health outcomes, such as hospitalization and death. For this research the following vital signs of the early warning score were chosen; blood pressure (systolic and diastolic), pulse, saturation, temperature and respiratory rate. In addition, fall incidents, pressure ulcers and Katz scores were also registered.

Methodology

Study design

In this prospective cohort study, initiated by Artesis Plantijn (AP)

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University College Antwerp, vital signs were assessed in nursing home residents living in Antwerp, Belgium. This study was approved by the directorial committee of Zorgbedrijf Antwerp. The study applied an opting-out methodology: residents were provided with study information in the nursing home and could decide not to take part in the study.

Setting and participants

From February until April 2018, data was collected weekly in two nursing homes of Zorgbedrijf Antwerp. Over a seven week period, data was collected from 170 nursing home residents. Participating residents were aged 65 or older, and were not classified as DNR (Do Not Reanimate) level 3 [20]. When persons are DNR level 3, therapy will be reduced and according to the researchers, collecting data is unethical within this group.

Variables and measurement methods

Several vital signs were assessed weekly over a seven week period of time: blood pressure (systolic and diastolic), heart rate, blood oxygen level, temperature and respiratory rate. To avoid measurement bias, all five assessors were trained in order to correctly collect the data. Furthermore, we always used the same calibrates measurement tools. Medical records were consulted for the registration of negative health outcomes: hospitalization, death, fall incidents and pressure ulcers.

Hospitalization and death were both analysed separately and clustered as a 'negative outcome'. Furthermore, Katz-scores and general basic characteristics were collected through the medical records. The Katz-index of independence evaluates the level of performance in activities of daily living (bathing, dressing, toileting, transferring, continence and feeding) and classifies people into different categories of care needs: O=independent, A=in need of light care, B=in need of more elaborate care and C=in need of complete care [21].

%	Total (n=170)	Male (n=36)	Female (n=134)
Belgian	99.4	97.2	100.0
Age (mean ± SD)	87.47 ± 6.64	86.11 ± 6.87	87.96 ± 6.54
Marital status			
Widow (er)	68.7	46.9	74.6*
Married	18.6	34.4	14.4*
Unmarried	6.0	12.5	4.3
Divorced	4.0	3.1	4.2
Unknown	2.7	3.1	2.5
Dementia (n=154)			
None	33.8	35.5	33.3
Mild	39.6	41.9	39.0
Moderate	22.1	19.4	22.8
Severe	4.5	3.2	4.9
Katz			
O	8.8	19.4	6.0*
A	17.6	8.3	20.1
B	35.9	36.1	35.8
C	17.6	19.4	17.2
Cd	20.0	16.7	20.9

Table 1: Basic characteristics of the population; *p<0.05; Chi²

%	Total (n=170)	Male (n=36)	Female (n=134)
Negative outcome	12.4	19.4	10.4
Hospitalization	10.0	16.7	8.2
Death	2.9	5.6	2.2
Falls	12.9	19.4	11.2
Pressure ulcer	2.9	2.8	3.0

Table 2: Description of the negative outcomes; *p<0.05; Chi²

Statistical Methods

Statistical analysis was performed using Microsoft Excel 2016 and SPSS version 22.0 (2013, SPSS Inc. New York, USA). First, descriptive statistics were used to present the study population. Males and females were compared by using unpaired samples t-tests and chi². Significance levels are displayed in the tables' legends. Since the outcome groups were rather small (n<30), nonparametric statistics were used to assess correlation levels between vital signs and negative health outcomes (Spearman's rho). Correlations were reported as strong (cut off level 0.70), moderate (>0.50), weak (>0.30) or very weak (0-0.30). Logistic regression was used to evaluate the influence of vital signs on the occurrence of a negative health outcome and was reported as regression coefficients (B), odds ratios (OR) and their respective confidence intervals (CI).

Results and Discussion

The mean respondent was 87.47 ± 6.64 years old, widow (er) (68.7%), had mild dementia (39.6%) and was care dependent with Katz-score B (35.9%) (Table 1). In total, 12.4% of the population experienced a negative outcome, with 10% being admitted to the hospital and 2.9% who died (Table 2).

In respondents experiencing a negative outcome, a significant difference was found in the mean systolic blood pressure and the blood oxygen level ($p<0.05$). Those two parameters were also significantly different between the respondents who were hospitalized and those who were not ($p<0.05$). None of the parameters showed a significant difference when comparing those who died and those who did not (Table 3).

Both systolic blood pressure and blood oxygen level showed significant but very weak (0.30>r>-0.30) negative correlations towards negative outcome and hospitalization (Table 4). Regression analysis showed similar results: systolic blood pressure, heart rate and blood oxygen level were significant predictors for negative outcome and hospitalization. In addition, a higher heart rate and lower blood oxygen levels were significant predictors for premature death (Table 5).

	Negative outcome		Hospitalization		Death	
	Yes (n=22)	No (n=149)	Yes (n=22)	No (n=148)	Yes (n=5)	No (n=165)
Systolic pressure (mmHg)	117.52 ± 20.14	127.99 ± 19.86*	117.06 ± 18.47	127.46 ± 20.08*	116.20 ± 26.71	127.01 ± 19.92
Diastolic pressure (mmHg)	68.86 ± 10.98	72.64 ± 11.71	68.00 ± 6.51	72.64 ± 12.02	71.00 ± 20.70	72.21 ± 11.39
Heart rate (BPM)	80.95 ± 16.00	73.05 ± 12.91	80.65 ± 14.42	73.29 ± 13.27	86.80 ± 23.45	73.64 ± 13.04
Temperature (°C)	36.11 ± 0.95	35.98 ± 0.56	36.11 ± 1.04	35.98 ± 0.56	36.20 ± 0.49	35.99 ± 0.62
Blood oxygen level (%)	91.57 ± 7.38	95.41 ± 2.51*	92.18 ± 5.26	95.24 ± 3.35*	89.60 ± 12.46	95.10 ± 3.05
Respiratory rate (/min)	18.21 ± 4.65	18.84 ± 5.67	17.53 ± 4.29	18.89 ± 5.66	20.60 ± 4.98	18.71 ± 5.57

Table 3: Comparison of mean values ± standard deviation per negative outcome; *p<0.05; Unpaired samples t-test

	Negative outcome (n=22)	Hospitalization (n=22)	Death (n=5)
Systolic pressure (mmHg)	-0.176*	-0.166*	-0.94
Diastolic pressure (mmHg)	-0.112	-0.114	-0.043
Heart rate (BPM)	0.147	0.144	0.090
Temperature (°C)	-0.003	-0.001	0.040
Blood oxygen level (%)	-0.224**	-0.219**	-0.094
Respiratory rate (/min)	-0.053	-0.094	-0.081

Table 4: Correlations; *p<0,05; **p<0,01; Spearman

	Negative outcome (n=22)		Hospitalization (n=22)		Death (n=5)	
	B	OR (CI)	B	OR (CI)	B	OR (CI)
Systolic pressure (mmHg)	-0.028*	0.972 (0.948-0.997)	-0.029*	0.972 (0.945-0.999)	-0.029	0.972 (0.926-1.019)
Diastolic pressure (mmHg)	-0.032	0.969 (0.927-1.013)	-0.040	0.961 (0.913-1.010)	-0.009	0.991 (0.915-1.073)
Heart rate (BPM)	0.042*	1.043 (1.008-1.079)	0.039*	1.040 (1.002-1.078)	0.067*	1.069 (1.003-1.140)
Temperature (°C)	0.366	1.442 (0.677-3.074)	0.348	1.416 (0.621-3.228)	0.546	1.727 (0.438-6.816)
Blood oxygen level (%)	-0.221**	0.802 (0.696-0.924)	-0.142*	0.867 (0.777-0.968)	-0.152*	0.859 (0.761-0.969)
Respiratory rate (/min)	-0.024	0.977 (0.884-1.079)	-0.630	0.939 (0.822-1.073)	0.042	1.043 (0.933-1.166)

Table 5: Regression analysis; *p<0.05; **p<0.01; logistic regression; B = regression coefficient, OR = Odds Ratio CI = Confidence interval

Strengths and Limitations

Despite the low number of respondents with negative outcomes (hospitalization and death) included and the limited data, we already achieved interesting first findings in our data. Systolic blood pressure and blood oxygen level showed significant but weak negative correlations towards negative outcome and hospitalization. The data analysis also showed that a higher heart rate and lower blood oxygen level were significant predictors for premature death. This is similar to some important symptoms for admission that Ashcraft et al. have cited in their research (need reference here). Shortness of breath and decreased oxygenation are two important symptoms which may lead to hospitalization and are correlated to a lower blood oxygen level [22]. By collecting extra data in a future-oriented manner, in which a higher number of negative outcomes can also be included, we hope to analyze a higher and stronger negative correlation for these parameters in relation to a negative outcome and hospitalization. Consequently, we can then take more targeted preventive actions against both outcomes and the residents of nursing homes can stay in their familiar surroundings for a longer time thus making it less likely that they develop co-morbidities. The prevention of hospitalizations can also lead to a further decrease in health care costs in society [23,24].

However, there were some limitations when collecting the data. The data were collected by five different researchers, which could cause them to be noted in a different way or the respiratory rate could be measured in a different way. However, the assessors were trained thoroughly to avoid measurement bias.

Despite the limited database, we achieved some significant results. Initial findings indicated that systolic blood pressure and blood oxygen level can be seen as vital signs which may possibly predict negative outcome, hospitalization or death. While the initial data was promising, a general conclusion cannot yet be generated due to the lack of data and the limited number of residents with a negative outcome. Future studies initiated by the researchers will focus on additional multi-center data collection in order to confirm or dispute our current results.

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