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TWO LEVELS OF NEGATIVE PRESSURE IN OPEN TRACHEAL SUCTIONING AND THEIR EFFECT ON CARDIO-RESPIRATORY INDICES AMONG ADULT PATIENTS IN CRITICAL CARE UNIT AT MACHAKOS LEVEL FIVE HOSPITAL- A RANDOMIZED CONTROLLED TRIAL STUDY DONE IN KENYA

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ABSTRACT

Background: **Tracheal Tube Suctioning is an important procedure performed on intubated patients receiving mechanical ventilation to ensure optimal oxygenation and ventilation. Unfortunately, the most effective and safe negative suction pressure is not yet defined.**

Objective: **To establish safe and effective level of negative pressure in open tracheal tube suctioning based on positive cardio-respiratory indices among adult patients in Intensive Care Unit at Machakos Level Five Hospital.**

Methods: **This was randomized controlled trial study in which 76 participants were randomly allocated to 180mmHg and to 100mmHg negative suction groups to determine the effect of open tracheal tube suctioning on the cardiorespiratory indices of heart rate, respiration rate, peripheral oxygen saturation and blood pressure at four suction time points. Repeated measure analysis of variance and independent t-test were used to assess the differences in the means of the indices within and between groups respectively.**

Results: **The two levels of suctioning caused significant increase in heart rate ($p<0.001$), respiration rate ($p<0.001$), systolic ($p<0.001$), diastolic ($p<0.05$) and mean arterial pressure ($p<0.001$) and significant decrease in peripheral oxygen saturation during suctioning ($p<0.001$), and there were significant differences between the groups in diastolic ($p=0.013$) and in mean arterial pressure ($p=0.015$), where the lower suction level caused a bigger increase in blood pressure.**

Conclusion: **Suctioning at a higher level of 180mmHg does not cause significant additional physiological disturbances compared to a lower level of 100mmHg. The lower suction pressure of 100mmHg elevates blood pressure more and may therefore be of clinical benefit to hypotensive patients.**

INTRODUCTION

Most patients in the Intensive Care Unit (ICU) require a tracheal tube to facilitate mechanical ventilation and allow removal of secretions from the airways. Presence of tracheal tube cause mechanical inhibition of muco-ciliary activity in the airway. Additionally, patients in the ICU commonly experience depressed cough reflex. Tracheal Tube Suctioning (TTS) is therefore inevitably necessary.[1] On the other hand, TTS is accompanied by complications such as hemodynamic instability, desaturation and hypoxia, atelectasis, cardiac dysrhythmias, Ventilator-Associated Pneumonia (VAP), bleeding, pain, anxiety and increased intra-cranial pressure.[2-3] The incidence and intensity of these manifestations depend on the amount of negative suction pressure used.[4] Critical Care in Kenya begun actively during the 3rd Polio outbreak in the 1950s where rudimentary respiratory support was provided to patients at the then King Georges hospital (i.e. the current Kenyatta National Hospital).[5]

ICU mortality in Kenya is approximated at 38.6% while the world-wide ICU mortality is 16.2%.[6-7] TTS, being an invasive procedure is suspect to development of VAP which is still one of the most common infections in the critical care unit.[8]

Low tracheal tube suction pressures in adults (i.e. ≤120mmHg) have been associated with ineffectiveness in secretion removal and more catheter entrances but more stable respiratory and hemodynamic indices.[9] However, they are likely to have higher incidences of lower respiratory system infections. On the other hand, higher suction pressures cause more physiological instability .[4]

Suction pressures ranging from 80-300mmHg have been applied with wide results, opinions and recommendations and therefore leading to controversies, contradictions and confusion. Suction pressures above 150mmHg are associated with higher likelihood for adverse effects, Yet in some studies, suction pressures above 150mmHg (including up to 300mmHg) have been found safe and effective.[4,10-14] Nursing Council of Kenya (NCK) prescribes a suction level of 80-120mmHg, a level that practitioners have exceeded, citing its slowness and inefficiency.[15] Suction levels beyond 200mmHg have increasingly been associated with unwanted effects.[12] The choice of suitable suction pressure is therefore a balance between its effectiveness and potential for harm. In view of the above gap, there was need to determine the relationship between adult TTS at 100mmHg (average of suction pressure prescribed by the Nursing Council of Kenya) and at 180mmHg (selected arbitrarily from literature) and the accompanying cardio-respiratory indices in order to provide insight on their suitability on the bases of preserving physiological stability.

Specific Study Objectives

To determine the effects of negative pressures at 100mmHg and 180mmHg on specific cardio-respiratory indices in open tracheal tube suctioning among adult mechanically ventilated patients.

To compare specific cardiorespiratory effects of open tracheal tube suctioning at 100mmHg with those produced at 180mmHg.

Study Hypothesis

H_1: There is a significant difference in the means of cardio-respiratory indices of Heart Rate (HR), Peripheral Oxygen Saturation (SPO_2), Respiration Rate (RR), Systolic Blood

Pressure (SBP), Diastolic Blood Pressure (DBP) & Mean Arterial Pressure (MAP) within the 100mmHg and 180mmHg tracheal suction groups before, during, after 5 minutes and 20 minutes post-suctioning among adult mechanically ventilated patients.

H_1: There is a significant difference in the means of cardio-respiratory indices of HR, SPO_2, RR, SBP, DBP & MAP between the 100mmHg and 180mmHg tracheal suction groups before, during, after 5 minutes and 20 minutes post-suctioning among adult mechanically ventilated patients.

MATERIALS AND METHODS

Study Design: This was a randomized controlled trial double-blind study in which the 180mmHg suction level was the experimental negative pressure while the 100mmHg suction level was the control negative pressure.

Study setting: The study was conducted at Machakos County Level Five Hospital Intensive Care Unit. It's one of the eight counties ranked number six in terms of ICU bed capacity .[16]

Participants/Study Population: 76 ICU intubated and mechanically ventilated patients, 18 years and above were recruited from a total of 137 patients admitted into the ICU from November 2023 to October 2024.

Eligibility Criteria

Inclusion Criteria

Admission into the ICU

Mechanical ventilation through a tracheal tube

Age ≥ 18

Exclusion Criteria

Non-invasive ventilation

Confirmed chest infection.

Patient with/during cardiac arrest

Sample size

The calculated sample size was 38 for each group of the study making a total of 76 participants.[17-19] Out of literature reviewed, the smallest level of $\delta = 6.8$ and the largest of $\sigma = 10.5$ were adopted. A power of 80% was used and alpha level of 0.05 was adopted.

Sampling

Sampling was a two-step process. Participants were placed into diagnostic categories (strata) and then allocated to study groups using simple random sampling. 39 participants were randomly allocated to Experimental Group while 37 participants were randomly allocated to the Control Group (block randomization).

Study Variables:

Independent variable: Suctioning at either 180mmHg (Experimental-Expt) or 100mmHg (Control-Ctrl)

Dependent variables

These are: HR, SPO_2, RR, SBP, DBP and MAP, collectively called the cardio-respiratory indices.

Confounding Variables: Sex, Age, Smoking status, Tracheal Tube Size, Number of observations, Fluid balance, Suction catheter size, Sedation and Mode of mechanical ventilation.

The effects of these variables were mitigated by randomization. Comparison between the groups in respect to these extraneous variables was done using Chi-square and independent t-test or Mann Whitney U test.

Ethical considerations:

Jomo Kenyatta University Scientific and Ethics Review Committee granted permission to undertake the study (REF: JKU/ISERC/02316/0914, with renewal dated 6/6/2024). The National Commission for Science, Technology and Innovation issued study permit (No: NACOSTI/P/23/28497 & NACOSTI/P/24/37702-renewal). The Machakos County government provided authority to conduct the study at the County Level Five Hospital (Ref: MKS/DHES/RSCH/V0L1/317 & MKS/DMS/RESEARCH APPROVALS/2024/30-renewal

Patients' guardians provided informed consent that was documented.

Data collection:

Data on socio-demography, patient assessment and on the six cardiorespiratory indices (Heart Rate, Respiration Rate, Peripheral oxygen saturation, Systolic, Diastolic and Mean Arterial blood pressure) was obtained through a new tool that was developed by the researcher and validated by experts (critical care physician & nurses, anesthesiologists, medical statistician) and subsequently subjected to reliability and validity testing. Content Validity Index was 0.88 while the Reliability index was 0.889 (Cronbach's alpha). Data on cardiorespiratory indices was collected at four suction time points i.e. just before, during, 5 minutes and 20 minutes post suctioning and recorded on the tool.

It was a double-blind study where the participants and the person doing suctioning did not know the suction grouping of the patient. The pressure gauge was set and covered by translucent material upon patient randomization into either group of the study by the principal investigator or the biomedical staff. The person doing the open tracheal tube suctioning was not the one doing the recording of findings, neither were these staff involved in setting the suction pressure level.

Data Analysis: Data was sorted out, cleaned and entered into Statistical Package for Social Sciences (SPSS) software version 26 for analysis. Descriptive and inferential statistics were calculated. Independent t-test or its non-parametric equivalent was used to compare the two groups quantitative confounding variables and also between the two groups cardio-respiratory indices. Chi-square test was used to determine homogeneity of groups categorical variables. Repeated Measures Analysis of Variance (ANOVA) or its non-parametric equivalent was used to determine differences in the physiological indices within each group at the four suction time points. Alpha level of 0.05 was chosen.

RESULTS

Demographics

General: There were 41 male (53.9%) and 35 female (46.0%) subjects, with a mean age of 41.47 years (range 18-96 years).

Within group demographics

ITEM	Expt (180mmHg)	Ctrl (100mmHg)
Age	$\bar{x}$=40.51, SD=17.81, Mdn=35.00, IQR=5.05	$\bar{x}$=42.43, SD=17.63, Mdn=39.00, IQR=30.00
Sex	Male=21 (53.8%) Female=18 (46.2%)	Male= 20 (54.1%) Female= 17 (45.9%)

Ctrl: Control; Expt: Experimental; IQR: Interquartile range; Mdn: Median; SD: Standard Deviation

The two groups of the study were compared on possible Extraneous Variables as shown below: -

Serial	Extraneous Variable	Suction Group		Type of test	Test statistic	p-value
		180mmHg n=39	**100mmHg n=37**			
1.	**Sex**	Male=21 Female=18	Male=20 Female=17	X^2 (1, N=76) =0.000		0.985
2.	**Age**	$\bar{x}$= 40.5128 Mdn=35.00 σ= 17.81022	$\bar{x}$= 42.4324 Mdn=39.00 σ= 17.62817	Mann Whitney U Test	.494	0.621
3.	**Smoking**	Yes=7 No=32	Yes=8 No=29	X^2 (1, N=76) =0.1621		0.688
4.	**ETT size**	$\bar{x}$= 7.04 Mdn=7.00 σ= 0.435	$\bar{x}$= 7.08 Mdn=7.00 σ= 0.464	Mann Whitney U Test	.426	0.670
5.	**No. of Observations**	$\bar{x}$= 7.46 Mdn=4.00 σ= 9.695	$\bar{x}$= 8.68 Mdn=6.00 σ= 9.724	Mann Whitney U Test	1.058	0.290
6.	**Fluid balance**	$\bar{x}$= 1621.04 Mdn=1300.00 σ= 1366.458	$\bar{x}$= 1704.65 Mdn=1600.00 σ= 1020.981	Mann Whitney U Test	1.024	0.306
7.	**Suction Catheter size**	$\bar{x}$=13.20 Mdn=13.89 σ=0.9289	$\bar{x}$=13.44 Mdn=14.00 σ=0.8087	Mann Whitney U Test	-1.192	0.233
8.	**Sedation**	Yes=25 No=14	Yes=29 No=8	X^2 (1, N=76) =1.881		0.170
9.	**Mode of Mechanical Ventilation**	AC= 25 SIMV= 11 CPAP= 3	AC= 22 SIMV= 14 CPAP= 1	X^2 (2, N=76) =1.500		0.472

AC: Assist Control; CPAP: Continuous Positive Airway Pressure; ETT: Endotracheal Tube; Mdn: Median; SIMV: Synchronized Intermitted Mandatory Ventilation

The two groups were therefore similar in terms of these perceived Extraneous Variables ($p>0.05$).

Comparison of Cardio-respiratory effects within and between Experimental and Control suction groups

Comparison on Heart Rate

Comparison of the Means and SD of HR at the various suction time points between and within Experimental and Control groups

Heart Rate	**Negative Pressure (mmHg)**		**Difference between groups at same suction time point Independent t-test**		
Time	**Expt (180) n=39**	**Ctrl (100) n=37**	**P value**	**t**	**Remark**
Pre suction (just before)	116.14±18.42	114.79±20.69	0.764	0.301	no sig. difference between groups
Intra suction	122.71±16.38	120.26±18.87	0.547	0.604	
5 min post suction	117.03±17.54	116.05±20.65	0.824	0.224	
20 min post suction	115.60±19.05	112.79±20.40	0.537	0.621	
Repeated measures ANOVA	[F (3, 152) = 12.464, p<0 .001]. Effect size (pre & intra) Cohen's d =0.38	[F (3, 144) = 13.671, p< 0.001]. Effect size (pre & intra) Cohen's d =0.28	Within group intra-suctioning mean HR was significantly higher than pre, 5 min and 20 min for both groups		

ANOVA: Analysis of Variance; HR: Heart Rate; SD: Standard Deviation; Expt: Experimental; Ctrl: Control; Sig: Significant

Each level of suctioning increased heart rate significantly ($p<0.05$) during suctioning and both groups did not differ at pre-suction, intra-suction, 5 min and 20 min post suction time points ($p=0.764$, $p=0.547$, $p=0.824$ and $p=0.537$ respectively).

Comparison on Peripheral Oxygen Saturation

Comparison of the Means and SD of SPO_2 at the various suction time points between and within Experimental and Control groups

SPO_2	**Negative Pressure (mmHg)**		**Difference between groups at same suction time point Mann Whitney U test**		
Time	**Expt (180) n=39**	**Control (100) n=37**	**P value**	**z**	**Remark**
Pre suction (just before)	97.71±3.70	97.82±3.06	0.810	-.240	no sig. difference between groups
Intra suction	95.29±4.95	95.82±4.52	0.526	.635	
5 min post suction	96.52±5.16	98.27±2.09	0.212	1.248	
20 min post suction	97.19±4.12	98.43±2.02	0.248	1.156	
Repeated measures ANOVA (Friedman test)	X^2 (3) = 36.193, p<0 .001 Effect size (pre & intra) Cohen's d =0.55	X^2 (3) = 38.906, p<0 .001 Effect size (pre & intra) Cohen's d =0.52	Within group intra-suctioning mean SPO_2 was significantly lower than pre, 5 min and 20 min post for both groups		

ANOVA: Analysis of Variance; SD: Standard Deviation, SPO_2: Peripheral Oxygen Saturation; Sig: Significant

Each level of suctioning decreased SPO_2 significantly ($p<0.05$) during suctioning and both groups did not differ at pre-suction, intra-suction, 5 min and 20 min post suction time points (p=0.810, p=0.526, p=0.212 and p=0.248 respectively).

Comparison on Respiration Rate

Comparison of the Means and SD of RR/min at the various suction time points between and within Experimental and Control groups

Respiration Rate	**Negative Pressure (mmHg)**		**Difference between groups at same suction time point Mann Whitney U test**		
Time	**Expt (180) n=39**	**Control (100) n=37**	**P value**	**z**	**Remark**
Pre suction (just before)	18.84±4.17	20.03±5.31	0.391	.858	no sig. difference between groups
Intra suction	22.18±4.31	21.70±4.82	0.574	-.561	
5 min post suction	19.41±4.50	19.27±5.06	0.674	-.421	
20 min post suction	19.25±6.69	19.47±7.59	0.823	-.224	
Repeated measures ANOVA (Friedman test)	X^2 (3) = 33.926, p<0 .001 Effect size (pre & intra) Cohen's d =0.79	X^2 (3) = 24.842, p<0 .001 Effect size (pre & intra) Cohen's d =0.33	Within group intra-suctioning mean RR was statistically higher than pre, 5 min and 20 min post suctioning for both groups		

ANOVA: Analysis of Variance; RR: Respiration Rate; SD: Standard Deviation; Sig: Significant

Each level of suctioning increased respiration rate significantly ($p<0.05$) during suctioning and both groups did not differ at pre-suction, intra-suction, 5 min and 20 min post suction time points (p=0.391, p=0.574, p=0.674 and p=0.823 respectively).

Comparison on Systolic Blood Pressure (SBP)

Comparison of Means and SD of SBP at the various suction time points between and within Experimental and Control groups

SBP	**Negative Pressure (mmHg)**		**Difference between groups at same suction time point Independent t- test**		
Time	**Expt (180) n=39**	**Control (100) n=37**	**P value**	**t**	**Remark**
Pre suction (just before)	110.07±26.00	119.43±26.05	0.121	-0.1567	no sig. difference between groups
Intra suction	118.43±28.50	131.17±31.54	0.068	-0.1850	
5 min post suction	112.17±29.97	122.32±30.05	0.159	-0.1423	
20 min post suction	109.64±26.94	114.30±27.32	0.457	-0.748	

Repeated measures ANOVA	[F (3, 152) = 12.828, p<0 .001]. Effect size (pre & intra) Cohen's d =0.31	[F (3, 144) = 17.288, p<0 .001]. Effect size (pre & intra) Cohen's d =0.41	Within group intra-suctioning mean SBP was statistically higher than pre, 5 min and 20 min post suctioning means for both groups

ANOVA: Analysis of Variance; SBP: Systolic Blood Pressure, SD: Standard Deviation; Sig: Significant

Each level of suctioning increased systolic blood pressure significantly ($p<0.05$) during suctioning and both groups did not differ at pre-suction, intra-suction, 5 min and 20 min post suction time points ($p=0.121$, $p=0.068$, $p=0.159$ and $p=0.457$ respectively).

Comparison on Diastolic Blood Pressure (DBP)

Comparison of Means and SD of DBP at the various suction time points between and within Experimental and Control groups

DBP	**Negative Pressure (mmHg)**		**Difference between groups at same suction time point t- test**	
Time	**Expt (180) n=39**	**Control (100) n=37**	**P value**	**t**
Pre suction (just before)	69.32±16.98	76.23±16.23	0.074	-1.813
Intra suction	73.70±18.70	84.47±18.24	**0.013*** Effect size (Hedge's g) =0.58	-2.539
5 min post suction	70.95±18.84	76.23±19.47	0.234	-1.201
20 min post suction	70.11±17.49	71.67±18.92	0.711	-0.372
Repeated measures ANOVA	[F (3, 152) = 3.689, p= 0.025]. Effect size (pre & intra) Cohen's d =0.25	[F (3, 144) = 15.557 p<0.001]. Effect size (pre & intra) Cohen's d =0.48	There is a significant difference between pre and intra suction means for expt group and significant difference between intra and pre, 5 min and 20 min post suction means for the control group Again, there is a significant difference between the groups on intra suctioning diastolic means	

ANOVA: Analysis of Variance; DBP: Diastolic Blood Pressure, SD: Standard Deviation.

Each group had significant difference between intra and other suction time point(s) means. The two groups demonstrated a significant difference on intra suction mean diastolic pressure ($p=0.$ **013**). The lower suction level of 100mmHg caused a bigger increase in diastolic blood pressure (larger Cohen's d).

Comparison on Mean Arterial Pressure (MAP)

Comparison of Means and SD of MAP at the various suction time points between and within Experimental and Control groups

MAP	**Negative Pressure (mmHg)**		**Difference between groups at same suction time point Test statistic**	
Time	**Expt (180) n=39**	**Ctrl (100) n=37**	**P value**	**t or z**
Pre suction (just before)	81.12±17.58	88.09±17.86	0.091	-1.713
Intra suction	86.04±19.78	97.65±20.79	**0.015* Effect size (Hedge's g) =0.57**	-2.495
5 min post suction	82.77±21.19	89.82±21.00	0.150	-1.456
20 min post suction	81.89±19.30	84.26±20.45	0.489	-.691
Repeated measures ANOVA & Friedman test	X^2 (3) = 23.922, p<0.001 Effect size (pre & intra) Cohen's d =0.26	[F (3, 144) = 16.553, p<0 .001] Effect size (pre & intra) Cohen's d =0.49	Sig. difference between pre and intra suction means for expt group and sig. difference between intra and pre, 5 min and 20 min post suction means for Ctrl group Sig. difference between the groups on intra suctioning MAP	

ANOVA: Analysis of Variance; MAP: Mean Arterial Pressure; SD: Standard Deviation; Sig: significant; Expt: Experimental; Ctrl: Control

Each group had significant difference between intra and other suction time point(s) means. The two groups demonstrated a significant difference between their intra suction mean arterial pressure (p=**0.015**). The lower suction level of 100mmHg caused a bigger increase in MAP (larger Cohen's d).

DISCUSSION

The two groups of the study constituted a good balance of participants in terms of mean age (40.51 vs 42.43 years) and sex (53.8% vs 54.1% for male; 46.2% vs 45.9% for female).

Open tracheal tube suctioning using either of the negative pressures tested increased Heart Rate (HR), Respiration Rate (RR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) and Mean Arterial Pressure (MAP) and reduced Peripheral Oxygen Saturation (SPO_2) significantly (p<0.05) during suctioning and normalization occurred in about 20 minutes post suctioning. This is similar to several other studies.[20-22] The changes noted were below 20% of the baseline in both groups and therefore less likely to constitute a significant physiological change unless for those patients at the extreme of physiological limits.

The negative pressure of 180mmHg produced bigger changes in HR, SPO_2, and RR during suctioning compared to 100mmHg negative suction pressure as depicted by the larger Effect Size of the change between pre and intra suctioning levels. A similar study by Rajakumari et. al. in the year 2020, using a higher negative suction pressure of 200mmHg found statistically significant increase in HR (p<0.0001) & Respiration Rate (p=0.046) and a statistically significant decrease in SPO_2 (p<0.0001) but no significant increase in MAP (p>0.05) probably due to the higher pressure involved.[9]

On the other hand, open tracheal tube suctioning at 100mmHg produced bigger changes in Systolic BP, Diastolic BP and MAP during suctioning than the 180mmHg negative pressure as demonstrated by bigger Effect Sizes. Rajakumari et al. in the year 2020, while comparing pre and intra suctioning mean values of MAP, found a significant increase in MAP during suctioning ($p=0.012$) at the lower suction pressure of 120mmHg compared to a higher suction pressure of 200mmHg ($p=0.112$), a finding shared by Suparti et al. in 2021.[9,20] The convergence in this finding strongly supports the assertion that lower suction pressure increases blood pressure more than higher suction pressure. Such finding suggests that lower suction pressure may be beneficial to hypotensive patients.

Suparti et al. with a sample size of 40 subjects tested a pressure of 20kPa (150mmHg) and 25kPa (187mmHg) on cardiorespiratory indices during open endotracheal tube suctioning during which he found significant changes in HR, SPO_2 and MAP within each group ($p<0.001$) during suctioning.[20] Similar results were shared by Shamali et al. in 2019 who found significant changes in SPO_2, SBP, DBP and MAP ($p<0.05$) within the routine suction group compared to the minimally invasive suction group in a study with a sample size of 64 patients.[21] These results are consisted with several other studies.[22-23]

There was no significant difference between experimental and control group in the means of HR, SPO_2, RR, and SBP pre, intra, 5 minutes and 20 minutes post suctioning ($p>0.05$), similar to several other studies.[9,20-23] However, there was a significant difference between the two groups regarding DBP and MAP during suctioning ($p<0.05$) time point, the bigger change in these two variables is attributed to the lower suction level of 100mmHg.

The 2020 American Association of Respiratory Care (AARC) Clinical Practice Guidelines (CPG) had recommended a negative suction pressure of less than 200mmHg for adults albeit existence of low evidence on the matter.[12]

Suctioning at a negative pressure of 180mmHg is therefore a low-risk procedure i.e. not associated with additional harm relating to hypoxaemia, tachycardia, bradycardia, tachypnoea or elevation in blood pressure compared to a negative pressure of 100mmHg.

Study limitations

This study was confined to adult mechanically ventilated patients. The findings are therefore not tailored to pediatrics and neonates. Though, the study was double blind, the nurses were able to guess the suction level set by judging from the flow rate of secretions, nevertheless, they were encouraged to bear with the seemingly slow suction level of 100mmHg and the pressure gauge remained covered with a translucent material. The study dealt with open tracheal tube suctioning as opposed to closed tracheal tube suctioning and the highest suction pressure tested was 180mmHg.

CONCLUSION

Tracheal tube suctioning is an important procedure for ensuring adequate oxygenation and ventilation of intubated, mechanically ventilated patients and requires safe and effective negative suction pressure. The 180mmHg suction pressure tested in this study demonstrated comparable level of disturbance on physiological indices of heart rate, peripheral oxygen saturation, respiration rate, systolic, diastolic and mean arterial blood pressure compared to 100mmHg but it's inherently more powerful with potential for better removal of tracheal secretions. The lower suction pressure of 100mmHg caused an increase in diastolic and mean arterial pressure more than a higher suction pressure

of 180mmHg and could therefore be beneficial to hypotensive patients.

CONSORT-SPI reporting guidelines were used in preparation of this manuscript especially the methods section .[24]

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Declaration of Conflict of Interest (COI)

The corresponding author and the co-authors/ research supervisors: Dr. Elijah Githinji Mwangi, (PhD, RN); Dr. Albanus Kyalo Mutisya (PhD, RN) and Dr. Fatuma Aden Affey, (PhD, RN) have no conflicts of interest to disclose regarding this research work.

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