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Evaluating the Embalming Procedures of Putrefying Bodies in Relation to Age in Anambra State, Nigeria

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ABSTRACT

The practice of embalming putrefying bodies involves the restoration of body features damaged by diseases or accidents of different forms and it requires special skill or training. The present study was designed to investigate the embalming techniques (methods), storage (post mortem management) procedures, and different embalming fluid composition used at the six study areas in order to determine the success or failure rate for preserving putrefying bodies in Anambra state in relation to age range. Two study areas were randomly selected from each of the three senatorial zones in Anambra state. A total of 2523 bodies were brought in for embalmment out of which 351 bodies were at the early stages of putrefaction. The embalmment procedure, storage and embalmment fluid composition for these putrefying bodies were evaluated with respect to age. The individual result on age range showed significant association between embalming procedure and age range at five study areas. Three study areas recorded some levels of failure outcome which was determined using checklist and empirical observations during the study. The results noted that failure of embalming putrefying bodies at the study areas were dependent on the age range, as well as on the embalming fluid composition and embalming management (storage) procedures. This study revealed that age range and embalming fluid composition contributes to the outcome of embalming putrefying bodies in Anambra state.

Keywords: Embalming Procedures, Putrefying Bodies, Age Range and Embalming Fluid.

INTRODUCTION

Embalming is the art and science of preserving a dead body so as to achieve an aseptic condition, a pre-mortem appearance and preservation of the body for a long period of time[1]. Putrefaction is the fifth stage of death, following pallor mortis, algor mortis, rigor mortis, and livor mortis[2]. In addition, putrefaction is the process of breakdown of the human body after death. In broad terms, putrefaction can be viewed as the decomposition of proteins, and the eventual breakdown of the cohesiveness between tissues, and the liquefaction of most organs. This is caused by the decomposition of organic matter by bacterial or fungal digestion, which causes the release of gases that infiltrate the body's tissues, and leads to the deterioration of the tissues and organs[3]. Several stages have been proposed for the decomposition process[4]. Five stages have been recognized and these appear to be easily applied to studies conducted in temperate areas[5,4]. These stages are: Fresh, Bloated, Decay, Post-decay and Skeletal or Remains. The most common modification of this set is to subdivide the Decay Stage into Active Decay and Advanced Decay stages[4].

The final stage of embalmment requires preparing a body for public display at a funeral, or for religious reasons, or for medical or scientific purposes which involves the following: Body Sanitization – To destroy microbial activities leading to putrefaction; Body Preparation – The embalming process; Body Preservation – The proper storage and management of body in the mortuary; and Body Presentation – The Funeral service preparation[6]. There are four process involved in embalming, thus: arterial embalming, hypodermic embalming, surface embalming and cavity embalming[3]. Arterial embalming involves the injection of embalming chemicals into the blood vessels, usually via the common carotid artery. Blood and interstitial fluids are displaced by this solution. Hypodermic embalming is a supplemental method which refers to the injection of embalming chemicals into tissue with a hypodermic needle and syringe, generally used as needed on a case by case basis to treat areas where arterial fluid has not been successfully distributed. Surface embalming is another supplemental method which is used to preserve and restore areas directly on the skin's surface and other superficial areas as well as areas of damage. Cavity embalming refers to the replacement of internal fluids inside body cavities with embalming chemicals via the use of an aspirator and trocar.

In recent times, arterial embalming (modern embalming) is the commonest technique used to

embalm bodies in the mortuaries all over the world[7].

The five stages involved in embalming dead bodies include: the phase of embalming fluid preparation, the embalming process phase, temporary storage phase, the permanent storage stage and the presentation or cosmetic application stage[2]. The embalming fluid shall constitute a dilute solution of Formalin, glycerine and water. During the embalming process, proper venous drainage should be ensured to ensure a good result. The body should be placed on a temporary storage slab where it is monitored to abate further autolysis activity. The body is finally preserved in a permanent storage location where it is allowed to dry. The cosmetic application involves proper preparation of the corpse for funeral purpose. A lot of scientists have developed different chemicals for the preservation of the dead and have improved on the different approaches used to preserve human remains. This study evaluated and documented the practice and procedures of preserving putrefying bodies in Anambra state, Nigeria. However, most records from Anatomist or other scholars tend to ignore embalming of putrefying bodies. This practice of embalming putrefying bodies involves the restoration of body features damaged by diseases and / or accidents of different forms; and it is commonly called restorative art or demi-surgery, which should be performed by qualified embalmers with training or certain degrees such as Anatomy, Embalming Science or Thanatology[3].

Hence, there is need for further studies on embalming of putrefying bodies; and so many authors have highlighted the need for special attention / approach on the embalmment of putrefying bodies[5,6,4,2,1,7]. Hence, this is the reason for this study because this study aims to investigate the embalming procedures of putrefying bodies in Anambra state in relation to various age differences so as to draw models that will be used to improve the embalming practices on putrefying bodies. This study brought to limelight the materials, methods and procedures employed in embalming putrefying bodies in Anambra state, Nigeria.

MATERIALS AND METHODS

The study area for this research covered mortuaries in the three senatorial zones of Anambra state, namely: Hosanna Hospital Modern Embalmment Centre, Ekwulumili, Nnewi South L.G.A., Anambra South Senatorial zone; Nnewi Diocesan Hospital Modern Embalmment Centre, Akwudo-Nnewi, Nnewi North L.G.A, Anambra South Senatorial zone; General Hospital Modern Embalmment Centre, Enugwu-Ukwu, Njikoka L.G.A., Anambra Central Senatorial zone; Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Mortuary, Amaku-Awka, Awka South L.G.A., Anambra Central Senatorial zone; Hens Funeral Home, Aguleri, Anambra East L.G.A., Anambra North Senatorial zone; and General Hospital Mortuary, Umueri, Anambra East L.G.A., Anambra North Senatorial zone.

The sample size for this study is 351. This sample was determined using a quota sampling method due to the unavailability of putrefying bodies at the study areas.

This is a prospective cross-sectional study. The data were collected by the researchers via observation of the embalming procedures and outcomes of embalmment on putrefying bodies received at the study areas. Data were drawn out from checklist (prepared by the researchers) and questionnaires given to the chief morticians at the study areas with respect to retrieving information on the Biodata – age differences and cause of death. The researchers also observed the outcome (progress) of the embalmed bodies weekly. In addition, the researchers were notified by the chief morticians at the study areas whenever a putrefying body is received or whenever an embalmed body starts to putrefy (for example accident cases). The data were collected in two phases - during and after the embalming process using a checklist and with questionnaires obtained from the respective mortuaries for the study. In addition, the researchers visited all the six study areas weekly to observe the post-mortem changes. The embalming procedures applied (to preserve such body) on any newly received putrefying body at the study areas were carefully documented. The age differences of the putrefying bodies with respective to embalming process and outcome were also documented. Other data that were collected include: embalming techniques, management procedures and storage procedures.

The following data were collected and analyzed - the number of putrefying bodies compared to total number of bodies received (embalmed) in the mortuaries and the embalming fluid composition for putrefying bodies used at the various study centres. The various study adopted the following embalming fluid composition formulae:

Hosanna Hospital Mortuary, Ekwulumili – 20% conc. Formalin solution (40 litres) + Water (80 litres) + Arterial Dye (150g) + Glycerine (5 litres) + Ammonium salt (150g) + 50% conc. Methanol (10 litres) + 10g of Thymol (used only during rainy season). This composition was used to embalm both normal bodies and putrefying bodies. What varied was the volume used – about 5 – 7 litres of embalming fluid (in relation to variations in body mass) was used to embalm normal bodies while 8 – 15 litres was used for bodies undergoing putrefaction. However, it was identified from the questionnaire that a different composition was used whenever cases of drowned bodies were received at this mortuary. The difference is that water will not be added to the composition of the embalming fluid. But during the period of this study, there was no case of drowned body received at this study area.

Nnewi Diocesan Hospital Mortuary, Nnewi – 20% conc. Formalin solution (40 litres) + Water (80 litres) + Arterial Dye (150g) + Glycerine (5 litres) + 50% conc. Methanol (5 litres) + 10g of Thymol (used only during rainy season). This composition was used to embalm both normal bodies and putrefying bodies. What varied was the volume used – about 5 – 7 litres of embalming fluid (in relation to variations in body mass) was used to embalm normal bodies while 8 – 15 litres was used for bodies undergoing putrefaction. However, it was identified from the questionnaire that a different composition was used whenever cases of drowned bodies were received at this mortuary. This mortuary also adopted the mixture of which was devoid of water for embalming drowned bodies. But within the period of this study, there was no case of any drowned body received at this mortuary.

General Hospital Mortuary, Enugwu-Ukwu adopted a mixture of 20% conc. Formalin solution (40 litres) + Water (80 litres) + Arterial Dye (150g) + Glycerine (5 litres) + 50% conc. Methanol (5 litres). This composition was used to embalm both normal bodies and putrefying bodies. What varied was the volume used – about 5 – 7 litres of embalming fluid (in relation to variations in body mass) was used to embalm normal bodies while 8 – 15 litres was used for bodies undergoing putrefaction.

Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Mortuary, Amaku-Awka adopted a mixture of 40% conc. Formalin solution (40 litres) + Water (120 litres) + Ammonium salt (20g). This composition was used to embalm both normal bodies and putrefying bodies. What varied was the volume used – about 7 – 10 litres of embalming fluid (in relation to variations in body mass) was used to embalm normal bodies while 7 – 15 litres was used for bodies undergoing putrefaction.

Hens Funeral Home, Aguleri adopted a mixture of 40% conc. Formalin solution (40 litres) + Water (120 litres). This composition was used to embalm both normal bodies and putrefying bodies. What varied was the volume used – about 5 – 7 litres of embalming fluid (in relation to variations in body mass) was used to embalm normal bodies while 8 – 15 litres was used for bodies undergoing putrefaction.

General Hospital, Umueri adopted a mixture of 20% conc. Formalin solution (40 litres) + Water (120 litres) + Glycerine (5 litres) + Ammonium salt (150g). This composition was used to embalm both normal bodies and putrefying bodies. What varied was the volume used – about 7 – 10 litres of embalming fluid (in relation to variations in body mass) was used to embalm normal bodies while 8 – 15 litres was used for bodies undergoing putrefaction.

The data were inferentially analyzed using *Statistical Package for Social Science* (SPSS) version 20.0.0. The data were analyzed using Pearson's Chi-square. The level of significance on the association of different variables with respect to its embalmment outcome among the age ranges was obtained. The level of significance was set at 0.05.

RESULTS

Table 1: Table showing the number of putrefying bodies (PB) and total bodies brought for embalming in the various mortuaries used for study in Anambra state

The table below show that the highest percentage of putrefying bodies from total bodies brought for embalming was observed in Nnewi Diocesan Hospital Modern Embalmment Centre. This is one of the biggest centers that embalm putrefying bodies in Anambra state.

MORTUARIES IN ANAMBRA STATE	TBR	%	PB	%
Nnewi Diocesan Hospital Modern Embalmment Centre, Akwudo -Nnewi.	993	39.358	158	45.014
Hosanna Hospital Modern Embalmment Centre, Ekwulumili.	106	4.201	14	3.989
General Hospital Modern Embalmment Centre, Enugwu-Ukwu.	532	21.086	23	6.553
Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Mortuary, Amaku-Awka.	698	27.665	89	25.356
Hens Funeral Home, Aguleri	158	6.262	59	16.809
General Hospital Mortuary, Umueri	36	1.428	8	2.279
TOTAL	2523	100	351	100

KEY:
TBR – Represents frequency of Total Bodies Received
PB – Represents frequency of Putrefying Bodies.

Table 2: Different cases of putrefying bodies brought for embalming at the study areas

The table below show that the highest percentage of cases were the putrefying bodies due to accident injuries (29.34%) followed by putrefying bodies due to disease (24.50%). This incidence on accident cases was recorded more at Nnewi because of its dense population and high rate automobile accidents.

DC	HM	NM	EM	CM	FM	UM	FQ	%
BLD	2	38	3	13	7	1	64	18.23
PCP	5	-	-	4	-	1	10	2.85
PDC	4	34	5	32	10	1	86	24.50
PAA	1	20	4	7	1	-	33	9.40
PIB	2	8	6	10	8	1	35	9.97
PAI	-	43	5	21	30	4	103	29.34
PBB	-	15	-	2	-	-	17	4.84
PDB	-	-	-	-	3	-	3	0.85
Total	14	158	23	89	59	8	351	100

KEY:
HM – Hosanna Hospital Modern Embalmment Centre, Ekwulumili; NM – Nnewi Diocesan Hospital Modern Embalmment Centre, Akwudo-Nnewi; EM – General Hospital Modern Embalmment Centre, Enugwu-Ukwu; CM – Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Mortuary, Amaku-Awka; FM – Hens Funeral Home, Aguleri; UM – Represents data for General Hospital Mortuary, Umueri; DC – Different Cases; FQ – Frequency; BLD – Bodies transported over long distances; PCP – Putrefying bodies due to chemicals/poisons; PDC – Putrefying bodies due to certain disease conditions; PAA – Autopsy-accelerated putrefaction; PIB – Improperly embalmed bodies; PAI – Putrefying bodies from accident injuries; PBB – Putrefying burnt bodies; PDB – Putrefying drown bodies

Table 3: Age range of putrefying bodies being brought to the study areas.

Below is can be deduced that the vast majority of putrefying bodies belonged to the 14-50 years age group (77.21%). This is the active age group and this age group putrefies faster than all other age groups.

AGE RANGE	HM	NM	EM	CM	FM	UM	FREQUENCY	%
Below 14 years	2	26	-	2	1	-	31	8.83
14 - 50 years	10	119	18	70	46	8	271	77.21
Above 50 years	2	13	5	17	12	-	49	13.96
Total	14	158	23	89	59	8	351	100

KEY:
HM – Hosanna Hospital Modern Embalmment Centre, Ekwulumili.
NM – Nnewi Diocesan Hospital Modern Embalmment Centre, Akwudo-Nnewi.
EM – General Hospital Modern Embalmment Centre, Enugwu-Ukwu.
CM – Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Mortuary, Amaku-Awka.
FM – Hens Funeral Home, Aguleri.
UM – General Hospital Mortuary, Umueri.

Table 4: Variations of the embalming fluid compositions used for preserving putrefying bodies at the six study areas

The data below show that a greater number of the bodies were embalmed with: Formalin + Water + Arterial Dye + Glycerine + Methyl Alcohol composition. The six study areas adopted a certain composition of embalming fluid for all the different cases of putrefying bodies. The variation was recorded on the volume of embalming fluid used for different cases of putrefying bodies (see the discussion for details).

FLUID COMPOSITION	HM	NM	EM	CM	FM	UM	FREQ	%
Formalin + Water + Dye + Glycerine + Methanol	-	158	23	-	-	-	181	51.57
Formalin + Water + Dye + Glycerine + Ammonium Salt + Methanol	14	-	-	-	-	-	14	3.99
Formalin + Water + Ammonium Salt	-	-	-	89	-	-	89	25.36
Formalin + Water + Glycerine + Ammonium Salt	-	-	-	-	-	8	8	2.28
Formalin + Water	-	-	-	-	59	-	59	16.81
Total							351	100

KEY:
HM – Hosanna Hospital Modern Embalmment Centre, Ekwulumili; NM – Nnewi Diocesan Hospital Modern Embalmment Centre, Akwudo-Nnewi; EM – General Hospital Modern Embalmment Centre, Enugwu-Ukwu; CM – Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Mortuary, Amaku-Awka; FM – Hens Funeral Home, Aguleri; UM – General Hospital Mortuary, Umueri.

Table 5: Outcome of embalming of putrefying bodies at the study areas

The table below shows that there was an 80.91% success rate record of embalmment reported from the six study areas. Three study areas recorded 100% success rates with respect to embalming procedures on putrefying bodies. The outcome of embalmment was reported using the standards observed from the checklist with respect to age, gender, body type, embalming fluid composition, embalming techniques, management procedures and storage procedures used to embalm putrefying bodies at the six study areas.

OUTCOME	HM	NM	CM	EM	FM	UM	FREQ	%
Success	14	158	60	23	25	4	284	80.91
No success	-	-	29	-	34	4	67	19.09
Total	14	158	89	23	59	8	351	100

KEY:
HM – Hosanna Hospital Modern Embalmment Centre, Ekwulumili.
NM – Nnewi Diocesan Hospital Modern Embalmment Centre, Akwudo-Nnewi.
EM – General Hospital Modern Embalmment Centre, Enugwu-Ukwu.
CM – Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Mortuary, Amaku-Awka.
FM – Hens Funeral Home, Aguleri.
UM – General Hospital Mortuary, Umueri.
FREQ – Frequency.

Table 6: Association between age range and outcome of embalming process at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital (COOUTH) Mortuary, Amaku-Awka.
The table below shows that 14-50 years age group recorded the highest embalming success (71.67%) and failure (93.10%) rate, followed by the group aged 50 years and above. Pearson chi-square testing however showed no significant association between age arrange of decomposing bodies and embalming success. ***(p>0.05).

	Success	Failure		
Age Range	Freq (%)	Freq (%)	Total	Significance
Below 14	2 (3.33)	0 (0.0)	2	$\chi^2 = 0.967$ P = 0.065
14 - 50 years	43 (71.67)	27 (93.10)	70	
Above 50 years	15 (25)	2 (6.9)	17	
Total	60 (100)	29	89	

Table 7: Association between age range and outcome of embalming process at Hens Funeral Home Aguleri

The age group 14-50 years showed the highest embalming success (52%) and failure (97.06%) rate, followed by the group aged 50 years and above. Pearson chi-square testing however showed a significant association between age range of decomposing bodies and outcome. *** (p<0.05). Hence, age range is a determinant factor for the outcome of embalmment for putrefying bodies.

	Success	Failure		
Age Range	Freq (%)	Freq (%)	Total	Significance
Below 14	1 (4.0)	0 (0.0)	1	$\chi^2 = 0.999$ P = 0.000
14 - 50 years	13 (52.0)	33 (97.06)	46	
Above 50 years	11 (44.00)	1 (2.94)	12	
Total	25 (100)	34 (100)	59	

DISCUSSION

The study reveals that the highest incidence of putrefying bodies was recorded from the active age group (14 – 50 years). It can also be observed from the study that there are scanty records of putrefying bodies compared to the total bodies received at the study areas. The incidence of different cases of putrefying bodies brought for embalming at the study areas was evaluated. About eight different cases of putrefying bodies were noted at the study areas and its records also reveal embalmment activities on putrefying bodies. The cases of putrefying bodies highlighted in this study require special attention and it corresponds to cases identified by Clarence and Frederick[8], Biswas[9], Brenner[1], Belsare[3] and Everplans[7]. This study reveals that the highest percentage of cases were the decomposing bodies due to accident injuries (29.34%) followed by decomposing bodies due to certain disease conditions. This suggests that greater attention should be paid on cases of accident injuries and disease conditions during the embalming process. In addition, most of the morticians at the study areas encountered difficulties when embalming accident cases.

Records from the six study areas show that the most frequent age group of putrefying bodies is the "14-50 years" age group. This is the active age group and it recorded the highest incidence (77.21%) on accident accelerated putrefying bodies and bodies putrefying as result of certain disease conditions at the time of death. This corresponds to records from Emue *et al.*[10] which recorded high incidence among the adult active group of Ogoni people. The composition of embalming fluid used for embalming putrefying bodies is a major determinant for the outcome of any embalming process. Records from the study areas show that all the mortuaries adopted a particular embalming fluid composition to embalm all the different cases of putrefying bodies received at their centres. About four study areas used an embalming fluid which contains formalin, glycerine and methanol and/or ammonium salt. This is in line with Jayovelu[11], Rao[2] and Belsare[3] who outlined the constituent of an ideal embalming fluid. This type of composition is meant to permeate faster into the body and also cause strong preservative effect on the putrefying body. Belsare[3] also noted that it is ideal to use a 40% concentrated formalin solution to preserve putrefying bodies. This corresponds to the

results obtained from four study areas.

The outcome of embalming putrefying bodies at the mortuaries for the study was determined by the appearance and nature of the embalmed bodies after three weeks of the embalming process. Rao[2] noted the timeline for body putrefaction which outlines that it takes human remains to enter the decay stage of putrefaction at the third week. The major determinants for successful outcomes for embalming putrefying bodies are: the embalming fluid composition, gender, method of embalmment and management of the body. The result obtained from the study areas show that three mortuaries had a hundred percent (100%) success record. These mortuaries adopted an embalming fluid formular which constituted: a concentrated (40%) solution of formalin, methyl alcohol and / or ammonium salt. These constituents contain very strong preservative strength which is in line with Brenner[1] and Belsare[3]. The ratio for the mixture (uniform) of these chemicals to water is 1:2. The success rate of the three mortuaries with 100% record was also determined by the management approach used while embalming putrefying bodies. The approach is that the bodies were first placed at a pre-storage medium (where they were first observed for structural / post-mortem changes) before taken to the permanent storage medium. This study identified that this approach helped to abate autolysis on the putrefying bodies. Records from mortuaries with account of failure outcome, reveals poor embalming approach to putrefying bodies.

Further test conducted to determine the outcome of embalmment (using a Pearson Chi-square analytical tool) for all age groups at the six study areas reveals that the association between age range and outcome on putrefying bodies show no significance ($P>0.05$) at Chukwuemeka Odumegwu Ojukwu University Teaching Hospital mortuary, Amaku-Awka but showed a significance ($P<0.05$) at Hens funeral home, Aguleri. The result from Umueri General Hospital Mortuary reveals that only the active age group (14-50 years) were received and embalmed at the period of this study. However, age was not a determinant factor for the outcome of embalmment at this particular study area. Recall that Goff[4] and Rao[2] noted that younger people putrefy faster than older people. The predominant age group identified in this study is within the "14-50 years" group. Nevertheless, three study areas yielded a successful outcome without the influence of age factor.

CONCLUSION

This study reveals that the embalming fluid composition that yielded a more successful outcome constituted a mixture of 40 litres of 20% concentrated formalin, 10 litres of 50% concentrated methanol, 150 grams of ammonium salt, 5 litres of glycerine, 80 litres of water, 10 grams of thymol and 150 grams of arterial dye. This embalming fluid composition is suited for embalming putrefying bodies. The volume of embalming fluid required to preserve a putrefying body is dependent on stage of putrefaction and body mass. Large body volumes require increased embalming fluid volume. Bodies at the skeletal remain stage of putrefaction require increased volume of embalming fluid than bodies at fresh of bloated stage of putrefaction. This means that the stage of putrefaction may also be a determinant for the outcome of embalming putrefying bodies.

This study revealed that accident and autopsy cases require more attention compared to the other cases identified in this study. This is because most of the vital organs and vessels might have been damaged yielding to poor circulation of embalming fluid to the different body parts. In addition, drowned bodies require a mixture of formalin to water at the ratio of 1:0. In other words, raw formalin may be required to ensure a positive outcome when embalming cases of drowned bodies. Age range partly contributed to the outcome of embalmment on putrefying bodies in Anambra state. The age range that yielded a more successful outcome of embalmment is the active age group (14years to 50years). This study reveals that three mortuaries had a significant failure outcome. A major factor for the successive failures received at the three study areas (Chukwuemeka Odumegwu Ojukwu University Teaching Hospital Mortuary; Hens Funeral Home; and General Hospital Mortuary, Umueri) was the composition of embalming fluid. The embalming fluid used at these study areas lacked both methyl alcohol and ammonium salt (which are strong supportive preservatives). Hence, the success / failure rate for preserving putrefying bodies is greatly dependent on the embalming fluid composition and management procedures. This study will proceed to conclude that age partly contributes to the outcome (success / failure) of embalming putrefying bodies in Anambra state.

RECOMMENDATIONS

Based on the findings of this study, we proceed to recommend the following:

1. An ideal embalming fluid should constitute a mixture of 40 litres of 20% concentrated formalin, 10 litres of 50% concentrated methanol, 150 grams of ammonium salt, 5 litres of glycerine, 80 litres of water, 10 grams of thymol and 150 grams of arterial dye.
2. After the embalming process, the body should be closely observed (in a temporary storage medium) to detect any post mortem changes leading to putrefaction so as to apply specific measures such as: applying strong insecticides at putrefying areas and the use of injection technique to apply concentrated mixture of embalming fluid to affected / decomposing areas.

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