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SHORT COMMUNICATION

DESIGN OF TRUCKS FOR LONG DISTANCE TRANSPORTATION OF CATTLE IN KENYA AND ITS EFFECTS ON CATTLE DEATHS

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ABSTRACT

In Kenya, the distance between the livestock production areas and terminal markets is vast, making livestock movement a necessity. The condition of vehicles transporting livestock is, therefore, an important factor for animal welfare and meat quality. These two parameters are particularly compromised over long durations of transportation. Consequently, economic losses along the livestock value chain may result. Therefore, the objective of the present study was to describe the design of trucks currently used to transport cattle in Kenya and quantify losses during trucking. A cross-sectional survey was carried out in six purposively sampled livestock markets; Moyale, Marsabit, Isiolo, Maralal, Narok and Kajiado. The markets are located along some of the major livestock routes in the pastoral areas. Direct interviews with truck drivers (N=75) and observations were made. Five key design features were assessed; floor design, ventilation system (air vents and roofs), specialized compartments and interior walls. Modified floor was frequent in 95.76% of the trucks. About 80.00% of the trucks had smooth interior walls while 77.12% and 94.26% of the trucks had side vents along the chassis and open roofs, respectively. None of the trucks was divided into compartments. The Kruskal Wallis Ranking score showed that presence of vents, floor design and smooth finish of the interior wall were the design features which significantly differed ($P<0.05$) with livestock market. A cattle mortality rate of 6.16% was reported. However, none of the design features significantly caused the deaths. The major cause was injuries from other animals due to poor animal handling. It was concluded that there are no dedicated trucks for long distance transportation of cattle. Instead, features that are either temporary or not recommended are used to transform locally available trucks into livestock hauliers. Improvement of animal welfare and reduction of economic losses along Kenya's livestock transport routes will be achieved through policies that address training needs of truck drivers and development of a standard design for trucks for livestock transport.

Key words: Animal welfare, truck design, cattle transport, meat quality, Kenya

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INTRODUCTION

More than 70% of livestock population in Kenya is raised in the pastoral areas [1]. In these areas, the herd is estimated to be worth Kshs 60 billion (approximately U.S. $800 million), with internal trade in the order of Kshs 6 billion (U.S. $80 million) per year [2]. Much of this trade involves live animals. A constant movement of animals in these areas is very strenuous. For example, animals are trekked 150-200 km before reaching primary markets from where they are further trekked for 14-30 days to secondary markets [2, 3]. Finally, they are loaded into trucks for transportation to Nairobi that is about 290 km away [1].

The demand for meat in Kenya is projected to increase by about 35% [2]. Animal transportation will most likely increase as well, because animals will have to be moved from farms to slaughterhouses through various channels such as ranches and livestock markets. The intensity at which transportation of these animals has increased is because of global marketing systems and structural adjustments that continue to attract the attention of animal welfare activists and scientists [4, 5] and most specifically meat scientists. The main reason for this is that animal transport is associated with a series of events that subject animal to stressful and unfavourable conditions thus compromising their welfare with a direct consequence on meat quality [6, 7].

In Kenya, the vast distance between the livestock production areas and terminal markets can result in poor animal welfare and meat quality. Various methods such as trucking, trekking and a combination of the two are popular locally. Due to security reasons, trucking is more preferred over trekking [3]. Trucking is particularly important in the pastoral areas because it affects the marketing efficiency of animals in the area [8]. The condition of trucks transporting animals is, therefore, important. Poor truck condition can exacerbate the extent of chronic stress in the animal, which in turn increases the frequency of injuries, death and Dark Firm and Dry (DFD) meat. Dark, firm and dry meat is of poor quality hence discounted heavily [9]. This type of meat is among the prevalent meat quality problems associated with poor animal handling [10]. This can in turn affect the income of the millions of livestock farmers in the pastoral areas who rely either directly or indirectly on livestock marketing.

Few countries in Africa have specialized vehicles for animal transport [11]. Therefore, livestock are transported in ordinary trucks, which are not designed for livestock transport [12]. These trucks result in sub-optimal transport conditions, which highly affect animal welfare and meat quality [13]. The increased emphasis on exploring strategies for mitigating against stress-mediated losses in the livestock sector [14] requires evidence based results to inform relevant stakeholders including the policy makers. Such information will bring structural and institutional changes in the animal transport sector that may then improve the welfare of the transported animals and income to the stakeholders. The objective of the present study therefore, is to describe the design of trucks currently used to transport cattle in Kenya, and establish losses caused by poor transportation.

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MATERIALS AND METHODS

Study area

The study was carried out in July 2015 in six livestock markets (Moyale, Marsabit, Isiolo, Maralal, Narok, and Kajiado) along major livestock marketing routes in pastoral areas of Kenya (Figure 1). These markets supply approximately 80-90% of the red meat produced and consumed in Kenya [1].

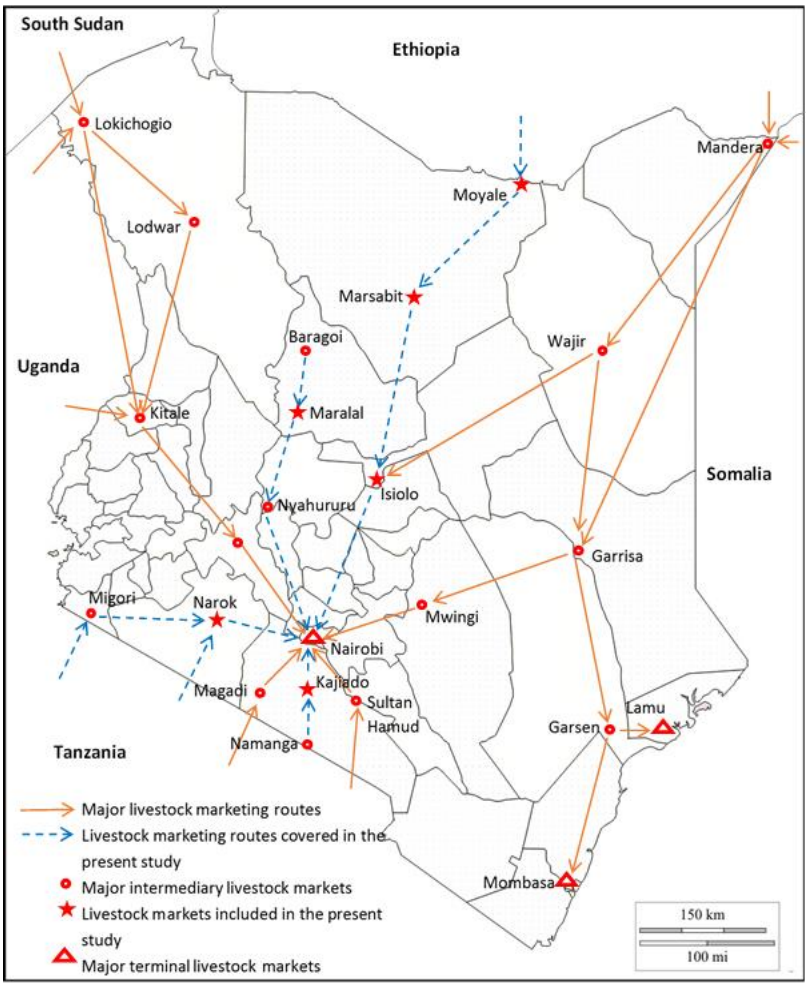

Figure 1: Major livestock marketing routes in Kenya

Study design and data collection

Data was collected in July 2015. A structured pretested questionnaire was administered to a cross-section sample (*N*=75) of purposively selected truckers (the unit of analysis) transporting live livestock along the selected routes. The sampling framework from which the truckers were selected comprised all the animal transporters in each of the market. The questionnaires contained three sections. The first section assessed the socio-demographic characteristics of the truckers. The second section contained six questions on truck design features as previously described as fundamental for long distance transportation of livestock [15], that is the truck was ventilated on the side, had a covered roof, had a smooth floor or materials to prevent cattle slippage, and if trucks

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were specifically designed to transport cattle. Each question in the second section consisted of bivariate variables (Yes/No). The third section consisted of five closed and open-ended questions on the number of cattle transported, the number of cattle that died and cause of death during last 5 days of transportation. Additionally, the truckers were asked to indicate how frequently cattle died during transportation and the measures taken to prevent the deaths. After administering the questionnaire, focus group discussions comprising 8-10 respondents were held at each of the markets. Key informant discussions were also held with county veterinary officers, county livestock production officers and county officials of livestock marketing council. Direct observations of available trucks were made.

Data analysis

Data were statistically analysed using SPSS version 23.0 [16]. Non-parametric data collected in Section 2 of the questionnaire were tested for normality using the Shapiro-Wilk test as previously described [17]. Descriptive statistics (frequency percentage) of all variables were determined. In Section 2, the responses for each question from each respondent were categorized as either 1=correctly designed or 0=incorrectly designed. The number of questions with correct designs was divided with total number of design features analysed, which was five, and converted into percentages. Trucks from respondents having a percentage score of ≤ 70% were determined to have poor truck design , 71–89% the truck design was moderate and >90% then the truck design was good. Mann Whitney test (p=0.05) and Kruskal–Wallis one-way ANOVA test, which are used to analyse non-parametric data, were used to determine whether the number cattle that died statistically differed with truck design features and livestock markets, respectively.

RESULTS

Demographic characteristics

From six livestock markets located along major livestock routes, 75 truckers were included in the present study. Out of these, 21.33%, 20.00%, 18.67%, 17.33%, 13.33% and 9.33% were from Kajiado, Marsabit, Isiolo, Moyale, Mararal and Narok, respectively. The males were more (98.67%) than females (1.33%). Majority of the truckers (44.00%) were in the age group 31-40 years, while the smallest proportion of the truckers (2.67%) was under 20 years old. Truckers in the age group 41-50 years represented 29.33% of the truckers. Those in the age groups >50 and 21-30 years comprised 12% of the truckers each. More than half of the truckers (52.00%) lacked formal education. Truckers with primary and secondary level education included 26.67% and 21.33% of the respondents, respectively. On the other hand, majority of the truckers were employed whereby 69.33% of these were permanent employees, while 21.33% were temporary employees. The rest (9.33%) were self-employed. Majority of the truckers (34.67%) had more 5-10 years of experience. On the other hand, 25.33% and 24.00% of the truckers had 1-5 years of experience and >10 years of experience, respectively. Few of the truckers (16.00%) had <1 year of experience.

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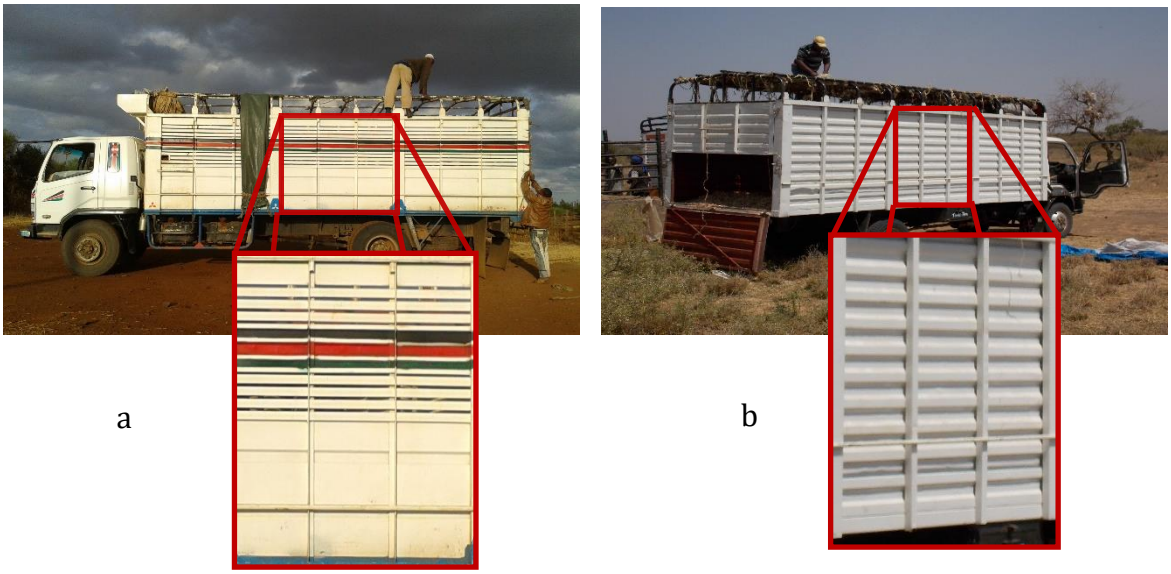
Truck design

About 96% of respondents reported to have modified the floor of their trucks. The floors were modified using either sawdust, sand or cowshed manure (Figure 2). Eighty percent (80%), 77.12% and 94.26% of respondents reported to have trucks with smooth interior walls, side vents (Figure 3) and open roofs, respectively. However, interior walls were made of metal sheets instead of wood and none of the respondents reported that their trucks were divided into individual cattle compartments (Figure 4). Presence of side vents (p=0.027), smooth interior walls (p=0.048) and floor modification (p=0.006), which significantly differed with livestock market (Table 1), were ranked highest in trucks in Isiolo, Moyale and Marsabit markets, respectively.

Figure 2: Truck floor modified with saw dust



a b

Figure 3: (a) Side vents present in trucks and (b) Side vents absent in trucks

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Figure 4: Cattle within a truck that has no individual compartments and its interior walls are made of metal

Number of cattle transported and those that died during transportation

All the respondents reported that they had transported an average of 1,461 cattle during the past one week, with cattle transported ranging from 10 to 25 per truck. A mortality rate of 6.16% (90 dead cattle out of 1,461 transported cattle) was reported by about 70% of respondents, where the deaths ranged from one to seven. The major causes of death were reported as injuries (34.00%), exhaustion and hunger (30.00%), truck accidents (16.00%) and diseases (14.00%). Injuries due to poor animal handling by animal loaders and off loaders were the least cause of cattle death (6.00%). Measures to prevent these losses were reported to have been put in place by 30.67% of respondents. The main measures included reduced number of cattle loaded per truck (42.86%), improved veterinary services (33.33%), improved security (14.29%) and training/awareness of the respondents (9.52%). Nonetheless, 58.67% of the respondents reported that no measures have been put in place, while 10.66% did not know if any measure had been put in place.

Relationship between design features and number of cattle that died during trucking

The number of cattle reported to have died during transportation were not significantly different among the surveyed markets ($p=0.091$) and were not significantly influenced by the truck designs ($p>0.05$) (Table 2). Based on the number of correct design features per truck, 53.33%, 37.33% and 9.33% of the trucks were categorized as good, moderate and poor design, respectively (Figure 5). Trucks with poor design corresponded with the highest number of cattle deaths followed by trucks with moderate design. The least number of deaths was reported in trucks with good design. Nevertheless, these differences were only tendencies and not statistically different ($p=0.089$).

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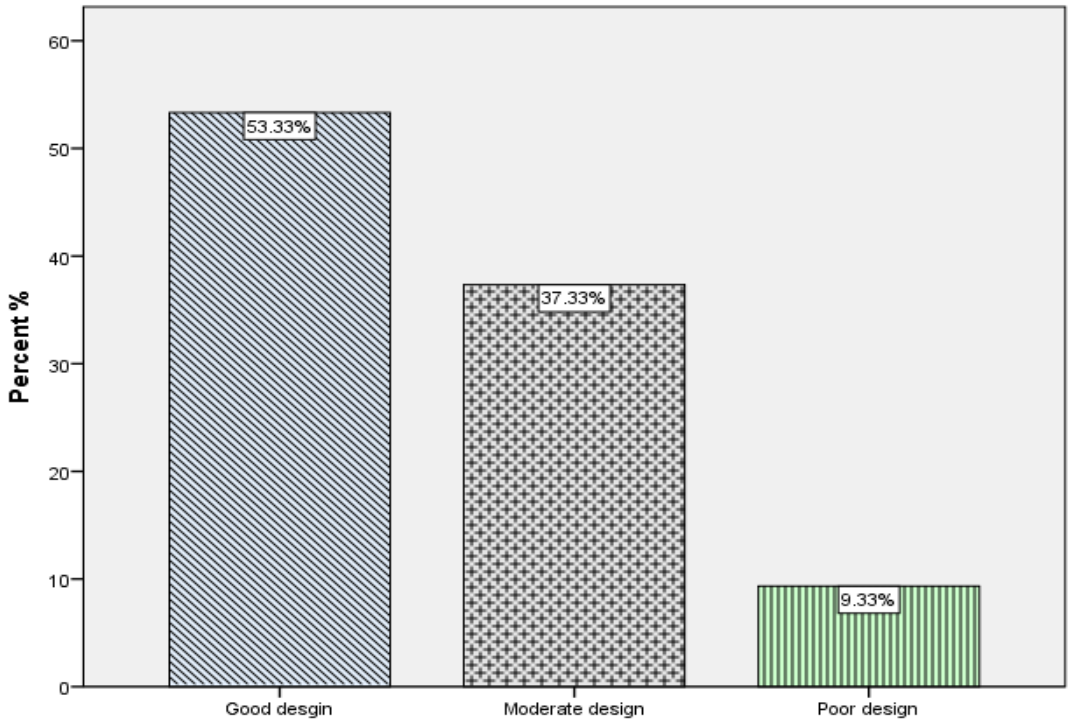

Figure 5: Percentage of trucks categorized based on number of correct design features of cattle transportation trucks

DISCUSSION

In the modern era, transportation of animals for slaughter has become a key feature of the livestock sector. The location of prime markets has led to increased distance between production areas and terminal markets. Furthermore, emergence of numerous channels such as intermediary markets, ranches and resting points has intensified the transport process. To ensure good animal welfare and quality meat, considerations have to be made about the current modes of transportation. Several key designs of trucks used to transport animals from the pastoral areas of Kenya were assessed in the present study. In addition, losses of cattle during transportation were quantified. So far, this appears to be the first time such a study has been conducted in these areas. The demographic results, showing a wide variety of ages, education level, years of experience, occupation as well as a majority of male participants in all of the surveyed livestock markets, suggest that the sample was indeed representative if not comprehensive.

The condition of trucks affected the welfare of slaughter animals [18]; hence the quality of meat available in local markets. Well-designed trucks can minimize some of the cost associated with unsuccessful adjustment of animals to transportation factors [19]. As such, the trucks should have floors with rough surfaces to prevent the animals from falling [20]. Although the respondents reported that the floors of their trucks were modified, the modifications were made using inappropriate materials. Absorption of excretions from transported animals by the sand, cowshed manure and sawdust result in slippery conditions when the materials reach their maximum absorption capacity [19,

20]. Slippery conditions may cause falling and trampling of cattle aggravating the injuries, and in extreme causing death [21]. In addition, these materials may impair the cleaning process of the trucks thus making the trucks a host of disease pathogens [22].
The nature of the trucks' interior walls was important in preventing bruises. Due to wear and tear, metal used in construction of the body is bound to become rough. In addition, bolts and nuts used to clad the metal sheets together can cause injuries in animals. Such injuries were likely to occur in the present study, where trucks had rough interior walls. To minimize the prevalence of bruises, hard wood is recommended for use on the side of the body of the trucks [15]. Despite of this, no truck was reported to have this modification. Another feature of the trucks is ventilation systems [23, 24]. Majority of the local trucks had side vents and an open roof, which by definition is a passive ventilation system. This system does not provide for constant macro-environment condition within the truck because it will depend on shape and speed of the truck as well as wind speed [25]. The system is especially inadequate when a truck is not moving because temperature and relative humidity inside the truck tend to rise causing cattle to shrink in body weight or become non-ambulatory [26-28]. Given that temperatures in Kenya's pastoral areas is high [29], this may be a common occurrence.

Compartments within a truck are a key design feature. They provide livestock with a barrier against shocks they are subjected to during transport. Some of these shocks include sudden brakes or travel on hilly, windy and rough roads [15]. Compartments provide sufficient space for each animal to adjust their posture naturally and brace themselves against the movement of the vehicle [21]. In addition, fighting tends to occur most often when a vehicle stops suddenly and animals are inadvertently 'pushed' into each other [30]. The trucks in the present study showed similarities with trucks in Namibia [31], where animals were transported in one compartment. This contrasts countries like Canada, where a recent study showed that compartments were present in all trucks [32].

Similarly, the significant differences in the interior wall and floor modification of the trucks can influence the rate at which injuries in transported animals occurs [15]. As a result, animals carried by trucks with low ranks in each of these two design features may have a higher prevalence of bruises than others may. Given that bruises on carcasses are normally trimmed off, substantial economic losses can occur.

Failure to watch over the welfare of cattle during handling increases their stress levels and may increase cattle deaths during transportation. Deaths during transportation to slaughter are a good indicator of the level of stress suffered by animals during transportation [33]. From the present results, it was evident that the animals were subjected to numerous stressors during transportation. Using cattle deaths as an indicator of animal welfare in the present study, it was observed that the level of stress in Kenyan cattle during handling is considerably high compared to other animals in some countries such as Czech Republic and Canada [34-38]. This is despite most respondents reporting that the deaths were infrequent.

The present results did not show any significant relation between the truck design and cattle mortality. This can be explained by the fact that the major cause of deaths was

injuries from other animals. Injuries may have been caused by among other factors, mixing of unfamiliar groups of animals [26]. This, together with the lack of compartments in the trucks, may cause fighting, tramping over fallen animals or prodding animals with horns causing injuries. Using data from Onono *et al*. [8], where the mean prices per cattle in Kenyan livestock markets is KS 18, 400 (US$ 184), death of 90 cattle meant a loss of about KS 1.6 million (US$ 16,560) occurred during the study period. One of the major measures to curb these deaths was reduced number of animals per truck. From the results, an average of 19 dead animals was reported.

In terms of overall design (Figure 1), only about half of the trucks were in good condition to transport livestock. The rest either needed to be considered for improvement or required urgent improvement. This may indicate that nearly half of the trucks used to transport cattle in the pastoral areas are a likely cause of poor animal welfare and meat quality.

CONCLUSION

In the present study, it was observed that there were no trucks dedicated to transport of livestock. Instead, features that are either temporary or not recommended were used to modify locally available trucks into livestock hauliers. Such features included sand or saw dust to provide a non-slip floor. In addition, the trucks relied on passive ventilation systems. The present design of the trucks is thus not sufficient to guarantee good animal welfare. This has an implication on sustainable meat production system in the country. This is clearly indicated by the substantial economic loss through cattle mortality as reported by the respondents. Although none of the studied design features significantly contributed to the mortality, injuries were the major cause of cattle death. This is an indication that poor animal handling practices are prevalent along the livestock value chain. To better understand the underlying causes, future studies that address other pre-slaughter stressors such as distance travelled by animals, number of unloading and offloading procedures along the routes, feed and water provision or temperature within the trucks can be carried out. In addition, improvement of animal welfare and reduction of economic losses along these routes will be achieved through policies that address training needs of truck drivers and development of a standard design for trucks for livestock transport in the country.

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Table 1: Mean ranks* of trucks design features

	N	Side vents present	Open roof	Smooth interior wall	Modified floor	Individual compartments present
Moyale	13	27.50[a]	28.75	48.92[b]	34.00[a]	34.50
Isiolo	14	45.00[b]	37.50	28.50[a]	34.00[ab]	34.50
Marsabit	15	39.17[ab]	37.50	33.17[ab]	41.00[b]	34.50
Maralal	10	27.50[ab]	37.50	35.50[ab]	34.00[ab]	34.50
Narok	7	33.33[ab]	37.50	40.17[ab]	34.00[ab]	34.50
Kajiado	16	36.83[ab]	35.17	30.83[a]	34.00[ab]	34.50
Sig. (p=)		0.027	0.074	0.006	0.048	NC

*Kruskal-Wallis H test
Values with similar letters within a column indicate statistically similar mean ranks
NC-Not computed

Table 2: Mean ranks* of the number of cattle deaths as influenced by truck design features

	Mean ranks of number of deaths		
Truck design feature	Yes	No	Sig.(p=)
Side vents present	23.62	23.17	0.929
Open roof	22.60	36.33	0.061
Smooth interior wall	21.78	30.56	0.054
Modified floor	23.27	26.83	0.725
Individual compartments present	0.00	23.5	NC

*Mann-Whitney test
NC-Not computed

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