

Seafood supply assessment in the 21st Supply Deposit of Brazilian Army

Avaliação do suprimento de pescado para o 21^o Depósito de Suprimentos do Exército Brasileiro

Evaluación del suministro de pescado para el 21^o Depósito de suministros del Ejército Brasileño

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ABSTRACT

Objectives: The aim of present study was to evaluate the sanitary characteristics associated to the Quality and Identity Standards of the frozen seafood provided for the 2nd MR by 21st SD; Identify strengths, weaknesses, opportunities and threats to optimize the supply process; Propose a strategic approach to mitigate supply non-compliances. **Methods:** Were performed seven Focus Groups, a SWOT analysis and the swot factors were weighted with the application of the Analytical Hierarchy Process AHP. **Results:** The frozen seafood supply process of the 2nd MR, centralized in the 21st SD, needs a technical, operational and documental restructuration, to ensure the maximum efficiency in the seafood purchase, storage and distribution; It is very important the participation of specialized Officers in the bind writing process. **Conclusion:** It is recommended the implementation of FSMS and qualify the staff. The adoption of strategies with focus in the Food Security is necessary to ensure a good and safety nutrition and reaching the results can promote the development of social changes through qualifying officers and soldiers.

Keywords: Food Supply, Food Storage, Perishable Foods, Fish Products, Food Preservation.

RESUMO

Objetivo: O objetivo do presente estudo foi avaliar as características sanitárias relacionadas aos Padrões de Qualidade e Identidade do pescado congelado fornecido para a 2^a RM pelo 21^o DP; Identificar pontos fortes e fracos, oportunidades e ameaças para aperfeiçoar o processo de fornecimento; Propor uma abordagem estratégica para mitigar as não conformidades de fornecimento. **Métodos:** Foram realizados sete Grupos Focais, uma análise SWOT e os fatores swot foram ponderados com a aplicação do Analytical Hierarchy Process AHP. **Resultados:** O processo de abastecimento de frutos do mar congelados da 2^a RM, centralizado no 21^o DP, necessita de uma reestruturação técnica, operacional e documental, para garantir a máxima eficiência na compra, armazenamento e distribuição de frutos do mar; É muito importante a participação de Oficiais especializados no processo de escrita de editais. **Conclusão:** Recomenda-se a implementação do SGSA e qualificar o pessoal. A adoção de estratégias com foco na Segurança Alimentar é necessária para garantir uma nutrição boa e segura e o alcance dos resultados pode promover o desenvolvimento de mudanças sociais por meio da qualificação dos oficiais e soldados.

Palavras-chave: Abastecimento de Alimentos, Armazenamento de Alimentos, Alimentos Perecíveis, Produtos Pesqueiros, Conservação de Alimentos.

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RESUMEN

Objetivo: El objetivo del presente estudio fue evaluar las características sanitarias relacionadas a los Estándares de Calidad e Identidad del pescado congelado suministrado para la 2ª RM por el 21º DP; Identificar puntos fuertes, puntos débiles, oportunidades y amenazas para optimizar el proceso de suministro; Proponer un enfoque estratégico para mitigar las no conformidades de suministro. **Métodos:** Se realizaron siete Grupos Focales, un análisis SWOT y los factores swot fueron ponderados con la aplicación del Analytical Hierarchy Process AHP. **Resultados:** El proceso de abastecimiento de mariscos congelados de la 2ª RM, centralizado en el 21º DP, necesita una reestructuración técnica, operativa y documental, para garantizar la máxima eficiencia en la compra, almacenamiento y distribución de frutos del mar; Es muy importante la participación de Oficiales especializados en el proceso de escritura de edictos. **Conclusión:** Se recomienda la implementación del SGSA y calificar al personal. La adopción de estrategias enfocadas en la Seguridad Alimentaria es necesaria para garantizar una buena nutrición y el alcance de los resultados puede promover el desarrollo de cambios sociales a través de la cualificación de los oficiales y soldados.

Palabras clave: Abastecimiento de Alimentos, Almacenamiento de Alimentos, Alimentos Perecederos, Productos Pesqueros, Conservación de Alimentos.

INTRODUCTION

Twenty-seven Military Organizations (MO) compose the Second Military Region (2nd MR) of the Brazilian Army (BA), established in the State of São Paulo, with a contingent of approximately 9000 public servers, supplied by the 21st Supply Deposit of Brazilian Army (21st SD), logistics unit that operates as a supply deposit and distribution centre (BRASIL, 2010).

To attend the staff, the BA performs the purchase and distribution of food (BRASIL, 2014). Made with the Federal resources, is classified as public purchase (OLIVEIRA e SANTOS, 2015; FIUZA e MEDEIROS, 2013), therefore follows the precept of the rational resources use to obtain bests results (OLIVEIRA *et al.*, 2010). However, the public resources optimal use is not intrinsic to the acquisition operations, requiring constant improvements in the storage and distribution operations (BRASIL, 2005, 2015; BRASIL, 2017b).

Between 2015 and 2017 were served 18.10³ meals day⁻¹ in the 2nd MR. This operation with an average demand of 105,3t^{of} of seafood per year (BRASIL, 2005), however, the average of danied lots where 81,7t (77,5%), because was identified some kind of non-compliance (sanitary or related to the Quality and Identity Standards), resulting desapproval after being anylized by the 21st SD Food Inspection and Bromatology Laboratory (FIBL). The high desapproval percent of seafood (77,5%) is a indicative of non-effective *modus operandi* (BESKE *et al.*, 2014) but the supply system is complex and is necessary to know the details about the system and search solutions.

The seafood is an important source of protein, long chain fatty acids and vitamins (HUSS, 2000), however, the consumption of seafood can cause infections caused by bacterial, viral and parasitic source; intoxications caused by toxins produced by micro-organisms and algae and chronic exposure to environmental chemical compounds (MARQUES *et al.*, 2018). In the case of 2nd MR the problem are related principally to the Quality Standards and Sensorial Characteristics. The low acceptance of the product by the troops started the investigation.

The aim of present study was to evaluate the characteristics sanitary and related to the Quality and Identity Standards of the frozen seafood provided for the 2nd MR by 21st SD; Identify strengths, weaknesses, opportunities and threats to optimize the supply process; Propose a strategic approach to mitigate supply non-compliances. The Supply Chain Management is a widely explorate discipline (CHEN e DENG, 2013; PAGELL e WU, 2017), although, there is no literature about seafood supply chain in the Brazilian Army universe.

MATERIAL E METHODS

This study was approved by the Research Ethics Committee of the School of Veterinary Medicine and Animal Science, University of São Paulo, under the Protocol n.77150314, and it follows the ethical procedures established by resolution No. 466/2012 (BRASIL, 2012).

This is a cross-sectional study, performed in the 21st SD of BA, São Paulo State, between January 2015 and December 2017. It’s an empirical, exploratory and documental case study, performed in the organizational real context (GIL, 20012).

We analysed the Frozen Seafood Supply System, described the specific products, local characteristics and the particular *modus operandi* of the 21st SD. Posteriorly we explored documents searching information about purchase as a Public Bids, qualitative and quantitative supply data as principal non-compliance resulting disapproval lots. The Brazilian Army legal rules were analysed: “Manual de Alimentação das Forças Armadas” (BRASIL, 2010), “Regulamento de Segurança dos Alimentos das Forças Armadas” (BRASIL, 2010).

Seven Focus Group (GLASS *et al.*, 2015) was performed to know the main problems and asymmetry of the seafood supply operation. A focus group is a gathering of principal actors of the Military Organization, who participated in a planned discussion with the purpose that is intended to elicit Brazilian Army Officers perceptions about a seafood supply topics in an receptive environment, following a pre-established program and recording the principal information. The participants were Veterinary Army Office (n=4), Army Office (n=4), Army Sargent (n=1), Army General (n=1) and soldiers (n=2). From these interviews, the outstanding information, referring to the process, were listed statistically and tabulated in order to knows the absolute frequency (BUSSAB e MORETTIN, 2010) (**Equation 1**):

$$\sum f_i = n \tag{Eq. 1}$$

This information base allowed the identification the main factors related the seafood supply and were identified and grouped into a SWOT matrix. The SWOT analysis (HUMPHREY, 2005) is a systematic framework commonly performed to analyse internal factors of organizations (strengths, weaknesses) and external (opportunities, threats) and based in decision making (DLBOKIC *et al.*, 2017; ETONGO *et al.*, 2018).

Swot analysis are able to identify and describe internal and external factors of an organization (FRIEDRICHSEN *et al.*, 2017; HATEFI, 2018), however, the analysis does not assign value measures, weights or amounts relating (HOUBEN *et al.*, 1999). So and having as proposal assign values and order the factors³ with importance scale, it was used a hybrid method: a multiple criterion evaluation methodology *AHP*. The method considers the relative importance among the factors, comparing and determining an overall ranking. The factors are recognized elements (quantitative or qualitative; tangible or intangible), with fundamental importance to the supply system (SAATY, 2008). The factors should receive a relative importance degree (1 to 9). We use only odd numbers (**Table 1**).

Table 1. Pairwise comparison scale by Saaty (2008)

Numerical value(s)	Options
9	Extremely strong
7	Very strong
5	Strong
3	Marginally strong
1	Equal
2,4,6,8	Intermediate values to reflect inputs

Source: elaborated by the authors

³ Another term for factorize.

The pairwise comparison of the n factors was performed utilizing a square matrix $n \times n$, the criterions were arranged between rows and columns equivalently, implying in the value of a_{ij} represent the importance of the line i criterion related to the column j criterion (**Equation 2**).

$$a_{ij} = \frac{1}{a_{ji}}, \text{ for } i \neq j \text{ and } a_{ij} = 1, \text{ for } i = j \quad (\text{Eq. 2})$$

Thereby defined the A matrix = $[a_{ij}]$, ($1 \leq i \leq n$; $1 \leq j \leq n$) (**Equation 3**).

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \quad (\text{Eq. 3})$$

Where:

a_{ij} : comparison between a_i and a_j ;

a_i, j_j : comparison factors;

$a_{ij} = 1/a_{ji}$;

$a_{ii} = 1$.

After the definition of matrix $A = [a_{ij}]$ the matrix was filled with the values showed in the table 1, and the next step was the calculation of the factors weight using the *Eigenvector* and the *Eigenvalue* (SAATY, 2008). For all A matrix is possible calculate the w vector as showed (**Equation 4**):

$$Aw = \lambda_{max} w \quad (\text{Eq. 4})$$

Where:

A: comparison matrix;

w : weight vector;

λ_{max} : maximum matrix priority vector.

The values of the vector w can be obtained by summing the values of each matrix column, followed by the division of each element by the sum of your respective column (**Equation 5**):

$$w_i = \frac{(\prod_{j=1}^n a_{ij})^{1/n}}{\sum_{k=1}^n [(\prod_{j=1}^n a_{kj})^{1/n}]} \quad (\text{Eq. 5})$$

The Consistency Index (CI) was calculated and the Consistency Ratio (CR) (**Equation 6 e 7**):

$$CR = \frac{CI}{CR} \quad (\text{Eq. 6})$$

$$CI = \frac{(\lambda_{max} - n)}{n - 1} \quad (\text{Eq. 7})$$

Where :

CI: fixed value ;

n: factor numbers;

λ max: A value

The matrix is considered consistent if the ratio between the value of CI and the CR is less than 10%.

RESULTS AND DISCUSSION

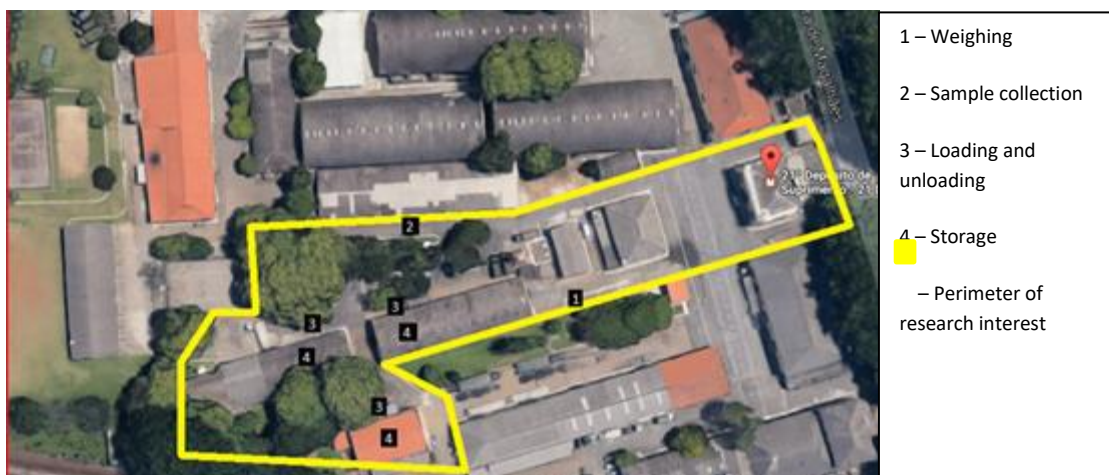
Private and public organisations have different personalities (theory of administrative law) and could not be compared. However, the examples that will be used to discuss the results don't claim to compare, replace or override the models used in the public and private administrative field. The BA is subjected to the Food Safety Standards and demand logistics operations as any private organization, so the discussions will target the improvement of the process under a common approach.

The 21st SD is a Quartermaster Unit, performs the distribution operation, attend 27 MO in the São Paulo State distributed in The Metropolitan Regions of: São Paulo, Campinas and Santos and also in Paraíba's River Valley.

The storage logistic adopted in the 2nd MR is centralized. According to Pacheco e Cirqueira (2006), there are a several reasons that some products are centred or not and this operation needs to be examined carefully. According to Maister (1976) products with high added value require a centralized storage in order to reduce duplication. The value added of seafood is not high. Is recommended to products with low value the decentralized storage (OESER e ROMANO, 2016).

The 21st SD is a MO and a Quartermaster Unit (**Figure 1**), structurally different from a food industry, warehouse or a simple MO. When compared to a civil organization, their food supply departments are similar to a distribution centre. There are no activities of manipulation and transformation of products, only reception, storage and shipment. In the figure 2 the area of supply operation is delimited. We consider and submitted the operations restricted to this area.

Figure 2 – Perimeter of the 21st SD, and places related to the seafood supply.



Source: elaborated by authors, 2017

The 21st SD, received and stored 316t of seafood between 2015 and 2017, fractioned in 41 lots (**Table 2**).

Table 2 – Seafood quantity (kg) purchased, denied and percentage of rejections of the different species stored in 21 SD.

Item	2015			2016			2017		
	Purchase	Denied	(%)	Purchase	Denied	(%)	Purchase	Denied	(%)
Cod fish	5.725	0	0,0	8.350	0	0,0	10.204	5.125	50,2
Weakfish (fillet)	0	0	0,0	13.000	13.000	100,0	16.200	12.790	79,0
Salmon (fillet)	155.786	153.920	98,8	55.824	52.399	93,9	50.990	8.000	15,7
TOTAL	161.511	153.920	95,3	77.174	65.399	84,7	77.394	25.915	33,5

Source: elaborated by authors, 2017

There are expressive percentages of rejection, especially for: weakfish and salmon fillet. Weakfish purchased decreased 47,9% during the period. The main non-compliances about these lots were: fillets with skin, liquid weight mislabelled and physical-chemical standards (**Table 3**). According to Ministerial Order nº 1428, November 26, 1993 (BRASIL, 1993) Quality and Identity Standards (QIS) are characteristics declared for each product, related to physical and chemical parameters, labelling, colour and texture.

Table 3 – Frozen Seafood non-compliances assessment between 2015 and 2017 in 41 lots purchased by 2nd MR.

Non-compliance	Occurrences	Percentage %
Net weight incompatible	11	26,8
Fish fillets with skin	12	29,3
Incompatible colouring with QIS*	1	2,4
Incompatible texture with QIS*	2	4,9
Potential of Hydrogen pH	2	4,9
Ammonia (NH ₃)	4	9,8
Species substitution	1	2,4
Incomplete invoice	2	4,9
Mislabelling	2	4,9
Surveillance status not proved	1	2,4
TOTAL	38	92,7

*QIS – Quality and Identity Standard (Brasil, 1993). Source: elaborated by the authors

Is important highlighting that net weight non-compliance is a food fraud in order to increase the price or the final volume (BARBOSA, 2016), and according to Decree 9.013 March 29, 2017 (BRASIL, 2017a), are characterized as risk activities or hygienic sanitary threat. The over glazing (FAO, 1995), mislabelling and species substitution are the most recurrent frauds in Brazil. (BARBOSA, 2016; LIMA e MESQUITA, 1996; NEIVA *et al.*, 2015).

The expressive percentage of non-compliance showed the weakness of the frozen seafood supply. However, there are strong factors, threats and opportunities. To know which the specific factors are, a swot analysis was performed (**Table 4**).

Table 4 – Frozen Seafood Supply matrix *swot* of the 2nd MR.

Strengths (internal environment):
(FO1) Veterinary in staff;
(FO2) Experts in transport and storage;
(FO3) Discipline culture;
(FO4) Specialized laboratory;
(FO5) Acquisition of foodstuff in large volumes;
(FO6) Numerous and diverse professional skills;
Weaknesses (internal environment)
(FR1) There's no FSMS;
(FR2) There's no FSMS culture;
(FR3) There's no FS climate;
(FR4) Staff unqualified
(FR5) High energy (kcal) demand
(FR6) Bid text technically unspecified
(FR7) Poor conservation of the cold stores and the buildings integrity status
(FR8) Breaks in the cold chain
Opportunities (external environment):
(O1) Technical Cooperation with universities and research institutes;
(O2) Soldiers and Officers qualification in FS;
(O3) Talents identification and exportation
Threats (external environment):
(A1) Food waste;
(A2) Seafood low acceptance in daily <i>menu</i> .
(A3) Under-utilisation of technical and financial resources
(A4) Foodborne and outbreaks

Source: elaborated by authors.

The results obtained in the field “Strengths” shows clearly that the human resources is the key (FO1, FO2, and FO6). In this context Schmitt *et al.*, (2012), favour human capital and claim that is better invest in the human resources education instead of in new technologies and information. The access to new technologies and information cannot guarantee the efficient use, considering, in particular, that in developed countries technological advances are based on educational systems that enable the transfer of studies, research, products, information systems and knowledge in cultural, economic, scientific and social development.

The factor Discipline (FO3) is intrinsic of military culture (RÊGO, 2012). If well explored, this factor is good for the FSMS. However, care should be taken, a study conducted by Martins and Lopes (2012) to evaluate the prevalence of common mental disorders (CMD) and job stress, and the association between the two, among

military personnel in peacetime showed that one third of the male service personnel evaluated displayed CMD and that high effort and low reward at work and the rank of lieutenant in the military hierarchy were associated with these disorders.

The factors “Specialized Laboratory” (FO4) and “Acquisition of foodstuff in large volume” (FO5) demonstrate the power of the biggest organization. The major of private Brazilian organizations needs to contract laboratory analyse services and the volume traded are small. However, storage and distribution are logistic operations and the militarism is the birthplace of it (DEL RE, 1955). This factor should be used and explored, thereby, If the logistics were practiced in the past as a supply and transport operation, today is interspersed with managerial sciences, so the term Supply Chain Management (SCM) derives from the concept of logistics (SILVA e FLEURY, 2000). Therefore, only store and distribute currently aren't enough, demonstrating that the activity so held is overrated.

The factors (from FR1 to FR4, FR7 to FR8) are intrinsically related to the implementation of a FSMS. Control and overall monitoring can add a high value to the supply system. As an example we can mention the implementation of ISO 22000:2006 (ABNT, 2006; PANGHALET *et al.*, 2018; SOMAN e RAMAN, 2016), especially because all factors mentioned above can be corrected. The factor High energetic (kcal) demand (FR5) is intrinsic of the organization with numerous staff realizing manual labour. Is important the hygiene and control of food, in this case all staff is dependent of the meals served a long the day, foodborne can compromise the secure routine of MO's.

Bid text technically unspecified (FR6) is related to the non-participation of the Skill Officers (Veterinary) in the bind elaboration process. The valorisation of human resources again is perceived such a very important factor.

The “Poor conservation of the cold stores and the buildings integrity status” and “breaks in the cold chain” (FR7 and FR8) are critical. The maintenance of storage temperature is a Critical Control Point (CCP) (OPAS/INPPAZ/OMS, 2001; PANGHAL *et al.*, 2018).

The opportunities (O1, O2 and O3) are related to cooperation between BA and Universities and Research Institutes. The qualification of soldiers allows the back to the labour market, after the period of military service, with better conditions and major chances to insertion. There are a several challenges related a food safety. Qualification to the officers in master and doctoral programs and open house to researchers to work in the real ambient with daily's problems, approaching researchers and officers to change experiences are possible results to the cooperation between BA and Universities (CRUZ, 2018).

Threats are commonly similar to the all organization of the food chain. The economic and environmental factors (A1, A2 and A3) are trouble with real possibilities of mitigation through the implementation of FSMS. The factor A4 is commonly cited in the bibliography specialized as harmful and it is potential occurrence is powered when the organization operate without FSMS. Every factor are intrinsically related to non-compliances and absence of FSMS

In the AHP analysis, the pairwise comparison using the Saaty's comparison, were made. The results are shown in Table 5. We have determined a strategic combination to BA seafood supply. Each swot group was weighted and the group Weaknesses obtained the most significant priority (0.367). The factors of this group FR1 and FR2 were the most important factor in the swot analysis with 0,294 priorities inter group to both. The results show de urgency of the FSMS adoption.

The factors O2 and O3 of the group Opportunities were considered very important. Opportunities are fortuitous events that can promote positive outcomes for BA and for society. Qualification and promotion of people go beyond the frontiers of technical solutions and add social value to the strategy.

The strategy that fit for the solution of problems is the implementation of FSMS and the promotion of culture of food safety (GRIFFITH *et al.*, 2010). Through the protocols conducted by FSMS is possible to monitor products and processes (acquisition and storage), qualifying the staff and maintain educational programs, able to generate the perception of risk in the handlers (ROSSI *et al.*, 2017).

Table 5 – Overall priority of the SWOT factors by Analytic Hierarchy Process – AHP.

SWOT group	Group priority	Swot factors	Priority inter group	General priority	Consistency ratio (CR)
Strengths	0,123	(FO1) Veterinary in staff;	0,144	0,021	0,06
		(FO2) Experts in transport and storage;	0,065	0,012	
		(FO3) Discipline culture;	0,031	0,009	
		(FO4) Specialized laboratory;	0,400	0,031	
		(FO5) Acquisition of foodstuff in large volumes;	0,334	0,019	
		(FO6) Numerous and diverse professional skills;	0,026	0,010	
Weakness	0,367	(FR1) There's no FSMS;	0,294	0,136	0,01
		(FR2) There's no FSMS culture;	0,294	0,136	
		(FR3) There's no FS climate;	0,055	0,03	
		(FR4) Staff unqualified	0,068	0,034	
		(FR5) High energy (kcal) demand	0,062	0,031	
		(FR6) Bid text technically unspecified	0,079	0,099	
		(FR7) Poor conservation of the cold stores and the buildings integrity status	0,067	0,056	
		(FR8) Breaks in the cold chain	0,081	0,030	
Opportunities	0,365	(O1) Technical Cooperation with universities and research institutes;	0,116	0,039	0,01
		(O2) Soldiers and Officers qualification in FS;	0,405	0,131	
		(O3) Talents identification and exportation	0,479	0,079	
Threats	0,146	(A1) Food waste;	0,227	0,011	0,01
		(A2) Seafood low acceptance in daily menu.	0,305	0,019	
		(A3) Under-utilisation of technical and financial resources	0,468	0,067	

Source: elaborated by authors.

CONCLUSION

The frozen seafood supply process of the 2nd MR, centralized in the 21st SD, needs a technical, operational and documental restructuring, to ensure the maximum efficiency in the seafood purchase, storage and distribution, offering to the barracks a high biologic value product and using the economic resources by best way;

It is very importante the participation of specialized Officers in the bind writing process;

It is recommended that the 21st SD implements an FSMS and qualify the entire staff so that there is an understanding of this system;

The adoption of strategies with focus in the Food Security is necessary to ensure a good and safety nutrition and reaching the results can promotes the development of social changes through the qualifying of the officers and soldiers.

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2nd Lieutenant Diogo Augusto Freitas Cordeiro dos Santos.

Conflict of Interest

We declare that we have no conflict of interest

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